

## Lepidoptera of North America

### 13. Flower Visitation by Colorado Butterflies (40,615 Records) with a Review of the Literature on Pollination of Colorado Plants and Butterfly Attraction (Lepidoptera: Hesperioidea and Papilionoidea)



Contributions of the C. P. Gillette Museum of Arthropod Diversity  
Colorado State University

**Cover illustration:** Flower-visiting butterflies. Top, *Hesperia viridis* female, nectaring at *Erysimum capitatum*. Bottom, *Parnassius phoebus smintheus* female, nectaring on *Eriogonum umbellatum*. Photos copyright Paul and Evi Nature Photography

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13. Flower Visitation by Colorado Butterflies (40,615 Records)  
with a Review of the Literature on Pollination of Colorado  
Plants and Butterfly Attraction  
(Lepidoptera: Hesperioidea and Papilionoidea)

by

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**Abstract.** I present 40,615 of my records of visits of adult butterflies (LEPIDOPTERA: Papilionoidea, Hesperioidea) to flowers and other food/water sources. Part I arranges the records by butterfly species to determine the flowers/foods most often visited by each butterfly species. Most butterflies visit a wide range of colors and types of flowers, with fewer visits to red at least in part because of a shortage of red flowers in the Colorado flora (subtropical/tropical butterflies evidently visit red more often, as demonstrated by hundreds of literature records for *Phoebis sennae*). But some butterflies show very different restricted preferences. Butterflies often visit numerous flowers that lack a “landing platform”, as their legs are capable of landing on any type of flower, so a landing platform is not necessary. Most popular flowers have a clustered inflorescence, though some do not. All Colorado butterflies prefer flowers that are in floral displays of clusters or closely joined together; none prefer solitary flowers. Short-proboscis butterflies are limited to smaller flowers. Lycaenidae mostly visit yellow and white flowers, probably in part because of a greater frequency of yellow and white colors among flowers that are small enough for their short proboscis. Long-proboscis butterflies can recycle abdominal fluid to dissolve dung for food, and they visit red flowers more often. Butterfly flight height partly determines which flowers can be visited. Apocynaceae (*Apocynum* and *Asclepias*) flowers sometimes kill butterflies by catching their proboscis. Females frequently sip mud, so it is a myth that butterflies visit mud only to get sodium; many visit mud to rehydrate. Part II arranges the records by flower species, and includes flower species that are common but not visited, to determine which flowers are attractive to butterflies and which are not. Although butterflies in general are not very particular in their flower choice (especially regarding flower color and ultraviolet pattern and size and shape), most of the pretty flowers in nature are seldom or never visited by butterflies, which seems to mean that floral scent is important in both attracting and repelling butterflies to flowers. The most popular plant family for butterflies is Asteraceae, in which most genera are popular. Other very popular flowers are *Asclepias*, *Apocynum*, *Verbena*, *Monarda*, *Buddleja*, *Eriogonum*, *Sedum lanceolatum*, *Erysimum*, *Jamesia*, some legumes including *Medicago sativa*, *Lythrum*, *Cnidioscolus*, *Ceanothus*, *Aesculus*, many Lamiaceae, *Penstemon*, and *Lobelia siphilitica*. Popular “butterfly flowers” merely must have white or visibly-bright colors, diurnal flowering, adequate but not strong floral scent, sufficient sugar concentration, and adequate access for the proboscis; nothing else seems necessary. Butterflies that visit sap and rotting fruit mostly belong to groups within Nymphalidae that display this behavior worldwide, while dung and carrion feeding occur in all the major taxa of butterflies. The chemical compounds attracting butterflies to flowers are reviewed and discussed, and specific chemicals attracting them to sap, rotting fruit, carrion, dung, etc. are successfully pinpointed from the literature. Known pollinators are listed for the Colorado plants that are popular and not popular with butterflies. Very few if any Colorado plants seem to be primarily pollinated by butterflies (most are pollinated by bees), and evidently no plants would become extinct if butterflies were not available to pollinate them. Thus Colorado butterflies are generally only occasional pollinators of flowers. Much more work needs to be done on the floral scents that attract butterflies.

**Key words:** flower visitation records of butterflies, flower preferences of butterflies, attractiveness of flower species to butterflies, foods of butterfly adults, butterfly pollination, pollination of Colorado plants, Lepidoptera, Colorado, Rocky Mountains, Great Plains.

## Introduction

This paper attempts to determine the food preferences of adult butterflies, including which flower species are popular with butterflies and which are not, based on 40,615 records of the foods visited by adult butterflies recorded in my notebooks, which list all the butterflies I observed or caught from 1959 to 2013, mostly in central Colorado (especially Jefferson County) but frequently in south-central Colorado and sometimes in nearly all other western states west of the Mississippi (especially California, Minnesota, and Arizona), and infrequently in Alberta and British Columbia Canada, and some states in the eastern U.S., and Mexico.

Methods. I have studied butterflies continuously from 1959 to 2013. In 1959 my mother made a little net for me using a coat hanger and a net bag made from opaque red cotton cloth. I couldn't see inside it, so the cloth was quickly replaced with cheesecloth, and soon a handle was fashioned from a golf club handle. One of my first butterflies was a large *Papilio cresphontes* collected on manure that I kept in a jar on dry grass. Then I made a little collection of butterflies stored in crude cardboard boxes using ceiling-tile as a pinning bottom. I would often accompany my father in nature while he mapped geologic strata and collected fossils for the U.S. Geologic Survey. During those 55 years I recorded in notebooks the species that I saw or collected. My expertise rapidly expanded, and I received a B.S. in zoology from the University of Colorado in 1968 and a Ph.D. in entomology from the University of California at Berkeley in 1972 with a thesis on mate-locating and dispersal of butterflies, and gained expertise in plant identification from several college courses but mostly through self-teaching using floras and flower-picture books.

I spent many thousands of days in the field studying butterflies, mostly in Colorado, accumulating roughly 100,000 records of mate-locating behavior of butterflies (Scott 1973e, 1974d, 1983, 2010), more than 4,000 records of larval hostplants (Scott 1986b, 1992, 2006), in addition to the current 40,614 records of the flowers/foods visited by butterflies. Recording merely flower visits of butterflies was never the primary purpose of any field trip. I recorded the flower visits I saw to be complete in recording interesting behaviors and other phenomena related to butterflies. Trips were made to study mate-locating behavior, and to locate hostplants. Some collecting of butterflies was generally undertaken at the same time, for scientific purposes (taxonomy or rearing etc.) and for exchange with other lepidopterists to build up a more-complete collection. Trips were made to maximize my exposure to as many butterfly species as possible while minimizing the expense.

Each record of adult food visitation in my notebooks contains the locality and date, the name of the butterfly, and the name of the flower species or type of food if not a flower. Each flower record is based on a butterfly visiting that flower apparently to feed (obviously, butterflies visit flowers for only one reason, to feed on their nectar). I often saw the proboscis actually placed into the flower, but most records involved the butterfly just visiting the flower in a way that looked like flower-feeding without my necessarily getting close enough to see the proboscis actually inserted into the flower. Visits that were very brief are listed as such if the butterfly did not seem to like that flower (for example "2 sec." in the records below means that the butterfly spent only two seconds on the flower). Records of feeding on other foods (sap, honeydew, dung, carrion, mud, etc.) were also recorded and usually involved seeing the proboscis. In the early decades, I recorded merely the butterfly species and flower species and date, and did not record more than one visit to that flower if there was more than one. (In those decades I recorded few visits to flowers anyway because I could not identify the flowers very well then.) Later, the number of visits to that flower species at that locality on that day was also recorded.

Identification of the flowers and their nomenclatural problems. There are more than two thousand species of higher plants in Colorado alone, and plants may have more morphological variation than butterflies, in shape and color, creating difficulty identifying them. I recorded very few visitations when I was young (in the 1950s and most of the 1960s), and gradually gained expertise in plant identification, and finally became an "expert" botanist, so now there are not very many dozen botanists in Colorado who are better at identifying plants. I gathered a collection of several thousand pressed plants for lab identification using

microscope and numerous purchased floras. In the early decades I relied on many botanists to help identify pressed plants, including Farrel Branson, Beecher Crampton, James A. Erdman, Charles Feddema, James Harding, L. R. Heckard, John R. Keith, June McGaskill, James L. Reveal, Hansford T. Shacklette, John Strother, and William A. Weber. (Recently I reidentified some plant specimens that were misidentified by those persons.) William Weber kindly identified plants for me without payment for many years, until I listed collection numbers such as “lot #35” etc. on grasses used as oviposition sites by *Hesperia* females and he wrongly assumed that those lot numbers meant that I was doing paid consulting work, so he charged me a fee, forcing me thereafter to better learn the plants and identify them myself. To identify a flower, you should try to match it in picture books such as Rickett et al. (1973), and then use the floras to either confirm that identification or identify it as one particular species among many that resemble that picture. Or more laboriously use the floras to identify flowers that lack pictures in available books. Those floras unfortunately use keys, which can cause huge mistakes in identification (just one mistake in a dozen couplets can lead to a grossly wrong identification), and many of the floras/plant books lack good descriptions that could be checked to correct those mistakes. (Tables of character states versus taxa are vastly superior to enable confident identification of plants and animals, because you can go quickly to the distinctive traits on the table, you can identify a specimen with a table even if your specimen lacks one or more character traits, the table doubles as a description of the taxon [and is better than traditional descriptions that often miss some traits], and tables are needed to enter taxonomic data into the handheld computer devices such as ipads that will be the primary identification devices of the future. Taxonomists should prepare tables, not keys.) This takes time especially when you find a flower that you have not identified before, so if you lack the time during a busy summer season you must collect and press a specimen of the flower species to save for later identification to get a confident identification. Having a sorted collection of pressed flowers helps identify those species identified previously, though you must always remember that botanists—like entomologists—split to the limit of resolution, so they name more and more taxa as microscopes and DNA machines improve, so there may be many flower species that look like yours, and the floras must be consulted for confident identification.

Plant nomenclature is in flux. Splitting is rampant in botanical names especially genera, and in Colorado the problem is severe, because there is no good scientific flora for Colorado. The only complete flora for Colorado (Harrington 1964) still has good useful descriptions of morphology of each species, but has just one perfunctory line about its distribution in Colorado and has nothing else about the plants, and is out of date at 50 years old. The only recent books (Weber and Wittmann 1996a, 1996b, 2012a, 2012b) are mere keys to the species in Colorado, with little or no additional information about the plants (tables of taxa versus character traits are absent), but sometimes the taxonomic decisions therein are better than those in other books such as the published volumes of the incomplete series Flora of North America. I have not studied the botanical literature to determine whether Weber’s highly-split names should be used, rather than the more traditional names in the Great Plains Flora (McGregor et al. 1986, a nice regular flora with actual descriptions and ranges etc.). Should the split names be used, even though most of them appear to be mindless splitting?, or should the traditional names that are widely known be used? Should floras made in faraway lands be used or should we trust the greater expertise of local botanists? Most plants have not been studied biologically or genetically, so the species/subspecies/form status of many are in dispute (for instance *Aster ericoides* has been frequently split into two to four species that clearly appear to be just variable weak varieties to me, and the altitudinal forms of *Heterotheca* are considered to be three species or just one by different botanists, the canescent leaf-underside *Cirsium incanum* was treated as a species but earlier and recently as a variety of glabrous *Cirsium arvense*, etc.). A particularly annoying occurrence in botanical nomenclature is that when botanical writers change the genus name of a plant (either due to splitting or due to a valid phylogenetic reason) they frequently change the species name as well at the same time. There are dozens of these changes (*Cryptantha jamesii* became *Oreocarya suffruticosa*, *Padus Malus* became *Malus pumila* or *Padus sylvestris* then *Pyrus malus*, *Rorippa nasturtium-aquaticum* became *Nasturtium officinale*, *Matricaria matricarioides* became *Lepidotheca suaveolens*, *Acer negundo* became *Negundo aceroides*, *Sida hederacea* became *Malvella leprosa*, *Potentilla fruticosa* became *Pentaphylloides floribunda* then *Dasiphora fruticosa floribunda*,

*Rhamnus frangula* became *Frangula alnus*, *Quamoclit pennata* became *Ipomoea quamoquit*, *Haplopappus spinulosus* became *Machaeranthera pinnatifida*, *Aster arenosus* became *Leucelele ericoides*, *Brachyactis ciliata* became *Aster brachyactis*, *Lycopersicon esculentum* became *Solanum lycopersicum*, etc. etc.) The names of numerous time-honored families such as Compositae and Leguminosae and Cruciferae etc. were changed, and now all end in -aceae. Botanists have shifted name changes into high gear. I mostly use the traditional generic names here because those have been used in the regular floras and the genus category is largely arbitrary, and list the split genus name as a subgenus, unless there seems to be some good phylogenetic reason to use the newer names found in Weber's books. Some of the highly-split names are additionally annoying because various newer floras such as Weber's and the California flora (Hickman ed., 1993) arrange the families and genera alphabetically (those botanists see how plant taxa are shuffling about as a result of DNA research and evidently give up and leave the names alphabetized the way they were in their computer), so that finding a genus in the book using only the older name is difficult, as the species placed in the former genus now are spread among multiple different split genera that are scattered in many different alphabetical places in the book, making them difficult to find so one must search through indexes or look at every genus listed in the book to try to reconstruct what happened to the names. Hopefully a real flora will be published soon for the southern Rocky Mountains area. I brought up to date old plant names listed in my notebooks to make them consistent throughout this paper. I had to correct names listed for some flowers in my older notebooks due to newer botanical knowledge of their correct names and improved identifications of the plants. I mainly used the names in Weber and Wittman's books as they are more up-to-date than the USDA Plants web site and Kartesz checklist etc., and they discuss changes made in the volumes of Flora of North America that have been published so far.

Due to the gradual increase of my botanical expertise, plus lack of time to carefully identify every plant, problems occur with the quality of some flower identifications in my notebooks, especially the older ones. The ~ and ? symbols in the records listed below are used for uncertain identifications: ~ means that the visited flower is the named species or another similar species; the ? symbol means the identification is not certain. Some flowers are listed only by genus, because the species could not be determined. Some flowers are just identified as "mustard", or "yellow sunflower"; there are a hundred species that at first were recorded merely as "yellow sunflower" (similar to *Helianthus* in the Asteraceae), because many of those require some time and expertise to identify to species. Nearly all of my "*Cirsium vulgare*" records up to 1988 were really *Carduus nutans*, so I changed those to "*Cirsium vulgare* (probably *Carduus nutans*)" here. Identifying the species of *Solidago* and *Erysimum* and *Senecio* and many others is often difficult, so these are frequently not identified to species. Many plants from Arizona were not properly identified fully because I lack the knowledge and floras to properly identify those (I used the library copy of the Kearney and Peebles flora sometimes) and I failed to collect specimens for later identification.

Computerizing the records took about a year (about 700 hours) to produce a computer file with 16,792 entries/paragraphs of records. Many of these records consisted of multiple visits to a flower species or other adult foods, so there are 40,614 total records (see Appendix A for the method used to determine this number) of adult visitation to food sources, usually flowers. Correcting typos, making the butterfly and plant nomenclature consistent, and compressing the alphabetized file (for instance compressing 37 records of a butterfly species on one flower species to one line containing 37x) took several more months. Flower colors were added, using the colors recorded in the notebooks plus (usually) the colors reported in floras, usually Harrington (1964) because of that book's excellent technical botanical descriptions of each plant including corolla/bract color. The basic chronological file of original records was maintained and updated, and half a dozen different files were then made from it in the process of alphabetizing and editing and compressing, and two of those files form the core of what is published here (the first being a compressed file of butterfly species and the flowers/foods they visit and the number of visits/records for each, the second being a compressed file of the flowers/foods visited by butterflies and the butterfly species that visit that flower/food and the number of visits/records for each).

The first file of butterfly species and flowers/foods visited was organized into one paragraph per butterfly species, with the flowers/foods listed for each butterfly. Then the butterflies were sorted by systematic relationship (determined from Scott 1986a, 2008) instead of alphabetically. This information forms Part I below, where conclusions are made about the adult food preference of each butterfly species. Relevant literature is cited at the end of this paper.

A compressed version of the original data file in Microsoft Word was then alphabetized by flower species visited, to determine the butterfly species that visit each flower species, and to determine the popularity of those flowers/foods for butterflies in general (the tedious method of making this computer file is detailed in Appendix B). This information forms Part II below, which discusses the popularity of the flowers to butterflies and also lists flowers in Colorado that are NOT visited by butterflies to contrast them with the popular flowers. Part II makes inferences from the data and from the literature regarding whether butterflies pollinate the various flower species, and also gives the pollinators of all those Colorado plants—popular and unpopular--based on published cited literature. Relevant plant papers and floras used in Part II are cited at the end of this paper.

The conclusions made in this paper about which flowers and flower types are preferred and which are shunned by the butterfly species, and which kinds of butterflies visit the common flower species and may pollinate them, should be of interest to both entomologists and botanists, especially because this paper is based on a large number of records, which should make the conclusions much more confident than the frequently-erroneous claims made in the usual “butterfly gardening” type of publication that reports this information for butterflies. The large number of records presented should be helpful to scientists involved in studies on the pollination of plants, and will supply reliable information to “butterfly gardening” enthusiasts and lepidopterists. And the raw records presented should be of use to later researchers who research the ultraviolet reflection patterns and the floral scents of the flowers in an attempt to better determine the causes of butterfly attraction to flowers.

## **Part I. The Flowers and Foods Visited by Each Butterfly Species**

User’s Guide to the Adult Feeding Records. Under each butterfly species, the flower species visited is listed. If no number is listed after the flower, only one visit or record was recorded in my notebooks. Numbers such as 1x mean one visit/record, 7x means 7 visits/records, etc. In my older notebooks, the flowers visited were listed for each locality/day but I did not record the number of visits per locality/day (whether one visit or twenty five visits or whatever), so the recorded number is a minimum estimate of what was seen in the field. After the flower visitation records, visits to rotten fruit, aphid honeydew, sap, dung, carrion, mud, etc. are listed. “Mud” here means any kind of moist or wet sand-dirt-soil. The symbol ~ beside a plant means it was either that species or something similar. The ? symbol means the identification was questionable.

Before presenting the detailed list of flowers etc. visited by each butterfly species, I now discuss the records along with relevant literature, in order to arrive at some conclusions about the butterflies’ preferences for various flower species.

Most butterflies visit a great variety of flowers. The common butterfly species generally have long lists of many dozen species of many kinds of flowers that they visit. The butterfly species with few flowers listed below are generally butterflies that are limited in range or season so had fewer opportunities to study, or they are species that occur far from my usual travels. C. Robertson (1929) published a 33-year study of 15,172 insect flower visitors in central Illinois, including Lepidoptera and bees and other insects, and Tooker et al. (2002) computerized his Lepidoptera records. Those records also show that the commonest butterflies produced long lists of visited flowers.

Different flowers grow in different habitats, so a butterfly species that occupies many habitats will visit numerous kinds of flowers.

Many of the lower-altitude butterfly species have several generations per year (versus just one in the higher mountains), and those species must usually visit different flowers during each generation, because



most flowers have short blooming periods, although some such as *Medicago sativa* bloom all summer and may be visited by several generations of butterflies. Thus multi-generation butterfly species are expected to be less specialized in their choice of flowers. Opler and Krizek (1984) note that flower visitation is lower in spring generations and higher in later generations. This is evidently due to higher temperatures later creating a greater need for fluids to avoid desiccation, and spring temperatures may be lower so the butterflies fly less.

Most butterflies visit most colors of flowers, but some butterflies prefer only some colors. Butterflies can see all the colors humans can, plus ultraviolet (see Part II, below), so the colors that butterflies see are somewhat different than what humans see. I make almost no observations concerning their ultraviolet preferences below because the ultraviolet-reflection pattern is not known for most Colorado flowers (Scott 1986a shows uv patterns of some flowers and many butterflies, and others are discussed below in Part II). So I will discuss here only the colors I can see:

A major conclusion is that many or most butterflies seem to show no preference for different colors, and they visit all colors from white to reddish (visits to red are comparatively few) to pink to orange to yellow to blue to violet and purple, everything except rare visits to green (some flowers such as *Euphorbia* etc. are greenish). But many show distinct preferences. The following are the strongest preferences observed: *Hesperia leonardus* shows a striking preference for *Liatris* flowers (the reason I--Scott [1986]--named it the Blazing Star Skipper), but will visit others and often visits *Carduus* etc. *Piruna* visits many flowers but greatly prefers pink *Geranium*. *Polites sonora* greatly prefers *Cirsium scariosum* var. *acaulescens* flowers that grow at ground level in wet meadows. *Notamblyscirtes simius* visits many flowers but oddly frequents yellow *Opuntia* and burrows down into the stamens to get nectar until only their wingtips are visible!

Other butterflies show distinct preferences that are less striking. Most butterflies seldom visit red flowers, so it is tempting to conclude that they don't like them. The deficit of visits to red flowers seems clear from the records, and is contrary to statements in some plant books that red is the typical color of butterfly flowers (such as Judd et al. 2008, who list "Bright; often red") (butterfly pollinated flowers are often pink though, see below), although Willmer's (2011) table 5.4 and p. 118 and fig 5.12 individually give different preferences but taken together they include all colors. One wonders if butterflies seldom visit red because most butterflies see red less well than other colors. However there are enough records of butterflies visiting red flowers and enough physiological studies (see Part II below) to be sure that most butterflies can see at least the light spectrum wavelengths that humans perceive as red. And Hesperidae with long proboscis frequently visit red *Hedysarum* while Papilionoidea with short proboscis do not, so few visits to red flowers may be mainly caused by the usually-longer corollas on red flowers, which are frequently adapted for hummingbird pollination. But the main reason for the red deficit may be a real shortage of red flowers in the flora of Colorado. There just aren't very many red flowers, perhaps because hummingbirds are not quite as common as elsewhere, so there are fewer opportunities for butterflies to visit red flowers that aren't there. Therefore, much of the red deficit may be due to simple lack of opportunity; Colorado butterflies may have visited more red flowers if more were available. A similar phenomenon may involve Lycaenidae, which apparently prefer yellow and white flowers; the reason could be their usual small size and the small size of their proboscis, because small flowers and short flowers and open flowers (the flowers a short proboscis can successfully suck nectar from) evidently have yellow and white flowers more often than longer flowers, and thus the short-proboscis lycaenids more often fit into the categories of "generalist pollinators" which have short mouthparts so must visit more accessible flowers with shorter tubes or smaller flowers or open flowers that can be easily imbibed, flowers such as Asteraceae which are mostly yellow, etc. Anyway the lycaenid "preference" for yellow and white may be an artifact of the usual colors of the flowers that are small enough for them to access (including the great abundance of yellow and white Asteraceae flowers); or maybe they have evolved some genetic preference for those. Opler and Krizek (1984) found that proboscis length of butterflies is proportional to the corolla length of their flowers, and proboscis length of butterflies (mode about 1 cm) is about twice the tube length of flowers visited (mode about 0.5 cm). Opler and Krizek (1984, Table 11) also noted that few butterflies except Hesperidae visited red/orange flowers in eastern United States.

Here is a summary of the distinct preferences for flowers--especially flower colors--displayed by the butterfly species that seem to be detectable in the detailed records listed below (ultraviolet colors were not considered here): Some *Erynnis* visit all colors, but seven species (*icelus*, *brizo*, *martialis*, *pacuvius*, *persius*, *afranius*, *telemachus*) prefer white and yellow flowers. *Anatrytone logan* prefers purple flowers. *Poanes hobomok* visits all colors and seems to visit pink and red flowers more than most butterflies. *Parnassius* prefer yellow and white flowers. *Papilio multicaudata* visits all colors except it seems to shun yellow. *Nathalis* prefers yellow. *Colias* species prefer yellow and blue/purple. *Euchloe* prefer yellow and white. *Pieris* and *Pontia* visit all colors except pure red. *Libythea carinenta* prefers white and yellow flowers. *Cyllopsis* never visits flowers. *Coenonympha tullia* prefers yellow. *Cercyonis pegala* visits all colors whereas *C. meadii* and *C. oetus* prefer white and yellow; *Cercyonis pegala* also often visits sap. *Erebia* prefer yellow and white flowers, and *E. callias* adds a huge attraction for mud. *Neominois* and *Oeneis* seldom visit flowers but when they do they prefer yellow and white flowers. *Anaea* never visits flowers, and visits sap. *Argynnis* (*Speyeria*) species often visit all colors, except *A. aphrodite* prefers rose-purple *Monarda*, and the *A. callippe*-group (including *callippe*, *atlantis*, *zerene*, *coronis*) more often visit yellow-white flowers and seldom visit red. *Boloria* most often visit yellow and white flowers. *Asterocampa* prefer sap, but also visit mostly whitish and yellow flowers. *Aglais milberti* and *Polygonia* prefer yellow and white, while *Nymphalis* prefer white and yellow; all those plus *Vanessa* seldom visit red, and *Polygonia* and *Nymphalis* and *Vanessa atalanta* often visit sap. *Euphydryas* prefer yellow and white. *Poladryas* prefers yellow flowers, and does not! visit mud. *Chlosyne* prefer yellow and white, except *C. whitneyi* also often visits blue flowers. *Phyciodes mylitta-pallida* prefer yellow and white, while other *Phyciodes* visit all colors but seldom red. Lycaenids in general prefer yellow and white flowers (as Scott and Scott 1978 noted), in part because their proboscis is small and evidently a larger proportion of small or short or open flowers tend to be white or yellow: *Apodemia* prefers white and yellow flowers. *Lycaena cupreus* prefers yellow flowers, while other *Lycaena* prefer yellow and white flowers, except *L. florus* and *L. dione* also often visit bluish ones; all *Lycaena* rarely visit red. *Hypaurotis* never visits flowers and often visits sap and raindrops. *Satyrium sylvinus* visits all colors of flowers except perhaps pure red, but most hairstreaks prefer yellow/white flowers. The mostly-tropical *Strymon melinus* visits all colors including red, and likewise the mostly-tropical Polyommataini="Polyommatainae" (*Leptotes*, *Brephidium*, *Hemiargus*) visit all colors, while most temperate zone Polyommataini prefer yellow/white colors. *Celastrina* prefer white flowers. *Eriogonum*-feeding *Euphilotes* prefer white and yellow flowers. *Glaucopsyche lygdamus* visits most colors except perhaps red. *Plebejus* prefer yellow and white flowers, except *P. melissa* and *P. saepiolus* also often visit bluish ones; all seldom visit red. Butterflies that often visit sap also tend to often visit rotten fruit. (My summaries of the preferences for colors were merely based on casual inspection of the records, and true preferences for colors would obviously require detailed experiments presenting all colors plus ultraviolet simultaneously to test butterfly preference, so these "preferences" are biased by whatever color flowers were available to the butterfly at the time.)

Bergerot et al. (2010) found that butterflies with longer proboscis length were more specialized in flower visitation than butterflies with shorter length (although there was great variation for both groups in their graph), but the present records suggest that if anything the reverse is true in the Rocky Mountains fauna. Small-proboscis Lycaenidae seem to have about the same number or fewer number of flowers visited as long-proboscis Hesperidae. Evidently a butterfly with long proboscis can visit long and short flowers, whereas a butterfly with short proboscis is limited to short ones.

A better understanding of the flowers visited by butterflies would include data on the lengths of the butterfly proboscis, the minimum lengths of a tiny straw placed into the flower to just reach the nectar, the color of the flowers in ultraviolet as well as light visible to humans, the size of the flower and the degree of clustering of the flower (the size of the inflorescence floral display), the height of the flower, the flower scents, sugar concentration in the flower nectar, plus the habitat, altitude, amount of forest and shade, etc. A full analysis like that would be a huge undertaking.

Tiple et al. (2009) attempted to measure some of those things in India, where they observed 27,570 nectar visits of about 50 butterfly species on many nectar plants over several years. They measured the

flower length, the proboscis length (which varied from 4 mm in *Pseudozizeeria* to 38 mm in a *Papilio*), body length and weight and wingspan, and calculated a “wing load” index (weight divided by wing area) and a “proboscis index”. The measurements of proboscis length and other body measurements were highly correlated so the study of those traits provided little insight. They found of course that small-proboscis butterflies (such as most Lycaenidae) visited shorter flowers, and long-proboscis ones visited short and long flowers. Most of their conclusions involved peculiarities of visitation by various taxa, like the ones I reported above, although they mostly discussed differences between the butterfly families. They also found that Lycaenidae prefer shorter flowers, Papilionidae longer ones, because of their great difference in proboscis length. The butterfly taxa that prefer sap are similar worldwide. They concluded that Papilionidae preferred sparse flowers, Pieridae moderately-sparse flowers, while Hesperidae and Nymphalidae preferred dense massing (clumping) of flower inflorescences. This is definitely not the case in Colorado, where all the families visit mostly massed flowers: the Colorado flowers are either packed tightly together in massed inflorescences such as Asteraceae, or there are numerous flowers crowded on the inflorescence, or the plant has numerous flowers. Evidently the Papilionidae in India often visited large single flowers on trees, whereas nearly all the trees in Colorado are wind-pollinated except some cultivated trees. They reported that Pieridae and Lycaenidae preferred flowers of herbs while Hesperidae and Nymphalidae preferred flowers of shrubs. In Colorado, the majority of flowers are herbs.

Actually, all the flower-feeding butterflies in Colorado mostly visit flowers that are clustered, either with many small flowers on an inflorescence, or joined into Asteraceae flowers, etc. Most Colorado flowers that butterflies often visit are in clusters of many flowers. Chilean butterflies also preferred larger floral displays (Arroyo et al. 2007). There is not a single butterfly species in Colorado that mostly visits solitary flowers. Evidently Colorado butterflies prefer a big display of flowers clustered near or together.

Stefanescu and Traveset (2009) compiled another large data set, of 29,305 recorded visits to 214 flower species by 100 butterfly species over 12 years in northeastern Spain. They found that butterflies with long flight periods and those of open areas visited more generalized flowers, which of course happens because they encounter more kinds of flowers in different seasons and habitats. Their woodland habitats tended to have butterflies that are more specialized in flower visits than open-habitat butterflies that visit more varieties of flowers. But an examination of this possible trend in Colorado produces only ambiguity: In Colorado, forest butterflies have a limited repertoire of flowers because *Picea engelmannii* and *Pinus contorta* forests grow thick (due to wrongful fire suppression), and *Picea* branches cover the ground and choke out most life (like the dog-hair-thick forests covering much of Switzerland, and the taiga worldwide), resulting in an impoverished flora and fauna, and the thick forests are mostly at higher altitude so the fauna flies later and it is often too cold in the forest shade for butterflies to fly and feed. After those forests burn, butterflies become common. The deepest-forest butterfly in Colorado is *Oeneis jutta*, but it only occurs in more-open forest with enough sunlight reaching the forest floor to permit growth of *Carex geyeri* sedges, and it rarely visits flowers, and both of my records are to very different flowers. The most woodland-habitat *Amblyscirtes* (*A. vialis*) feeds on many types of flowers and on few Asteraceae, but the semi-woodland *Colias scudderii* and the open-moist-woodland *Pieris marginalis mcdunnoughii* and *Boloria titania* and *Lycaena florus* feed mostly on Asteraceae (but so does the open-weedy-habitat *Lycaena helloides*), while the slightly-more forest-habitat *Argynnis* (*Speyeria*) *hesperis* and the more meadow-habitat *Argynnis* (*Speyeria*) *atlantis* both feed on many Asteraceae. The forest lycaenid *Callophrys spinetorum* rarely feeds on Asteraceae, but most (non-forest) *Callophrys* and *Strymon* seem to feed on Asteraceae less than usual, for unexplained reasons as the remaining Lycaenidae often feed on Asteraceae. Colorado butterflies occur at different altitudes and times and habitats and contact different flowers, and making generalizations about flower visitation is very difficult, as the butterflies already visit such a wide variety of flowers to begin with.

Corbet (2000) also attempted to determine which butterflies preferred which kinds of flowers, and calculated “wing loading” (wing area divided by body weight). She suggested that butterflies with high wing loading visited clustered or nectar-rich flowers, while butterflies with low wing loading visited solitary and less nectar-rich flowers. And she claimed that *Vanessa* and relatives with long proboscis and higher wing loading often visited deeper flowers such as *Buddleja*, while lycaenids with smaller wing

loading visited short flowered Asteraceae etc. These trends are not evident in Colorado. Of course Lycaenidae have smaller proboscis so they can't visit long flowers, but other than that, ALL Colorado butterfly families mostly visit clustered flowers, and nearly all—including *Vanessa* and relatives--often visit Asteraceae flowers. My records are many, and they represent all seasons of the year, all habitats at all altitudes from desert and plains and riparian habitats and fens to mountain forests and meadows and alpine tundra and rockslide, over a huge area. The butterflies in this area feed on so many different flowers, of so many kinds and shapes and colors, that it is very difficult to find simplistic trends. And I have not measured nectar concentration so I can offer no conclusions about it, other than the studies reported in Part II below that seem to indicate that butterflies often visit flowers with high sugar concentration as well as those with low concentration and the glucose/hexose ratio also matters little. I conclude that there are not many valid conclusions.

(By the way, wing loading in butterflies depends mainly on the mate-locating method of the species rather than floral visitation, as males that "perch to await females" have bigger stronger bodies with more jet-plane-shaped wings, while males that "patrol to seek females" have smaller weaker bodies and more rounded wings for long-range cruising, and females tend to have larger more rounded wings for slow and steady oviposition [Scott 1974d; see Scott 2010 for discussion of raiting, flaiting, and fleeking etc.]. Additionally, butterflies with strong thoraxes compared to the area of wings (such as Hesperidae) generally fly more precisely than other butterflies, so their energy expenditure in flight ends up no higher than the smaller-bodied butterflies because they get to their destination faster. And butterflies with a jagged erratic flight such as Theclini (which have a bigger thorax) or a hopping flight such as Satyrinae evidently use that flight as an aerial predator-avoidance strategy, so analyzing such species' life strategies merely using wing-loading energetics is bound to be misleading.)

Special flight patterns for seeking nourishment. Scott (1973b) found that various butterflies have a special flight pattern that they use to seek flowers and mud, when those are scarce on hillsides and ridgetops. They fly downward to a gulch, then fly down-valley until flowers or mud are found. In semi-dry conditions, this flight pattern seems to maximize their chance of finding flowers and mud in the moister conditions that occur lower down in gulches where ground water tends to come to the surface of the ground and accumulate. Lycaenids including *Callophrys johnsoni*, *Callophrys augustinus*, *Atlides halesus*, *Erora laeta quaderna*, and *Satyrium saepium* (also MacNeill 1967), and the nymphalids *Oeneis uhleri* and *Euphydryas bernadetta* were all observed in this down- valley flight. After feeding, the adults then depart for hillsides, or to hilltops where most of these species go to mate. California *Euphydryas editha* at one colony commute downhill to feed on flowers then return to the colony (Gilbert & Singer 1973).

In the tropics, *Heliconius* butterflies often "trap line" between flowers (Gilbert, 1972), and repeat the same flight pattern each day. *Hesperia leonardus* adults do seem to trap line by flying rapidly between *Liatis* flowers, but I do not know whether they have any memory of the location of those flowers or just fly rapidly and sooner or later encounter them.

Flowers killing butterflies. Rarely, flowers kill visiting butterflies. The killers are nearly always *Apocynum* and *Asclepias* in the family Apocynaceae. 13 *Euphydryas anicia capella* and one *Phyciodes pulchella camillus* were caught and most were found dead, after their proboscis became stuck in the stamen column slits of *Apocynum androsaemifolium*. One *Pieris rapae*, one *Polites mystic*, and one *Polites themistocles* were caught by their proboscis getting stuck between the corona and petals of the strange flowers of *Asclepias speciosa*. One *Vanessa cardui* died after its proboscis was found wrapped around the peduncle of *Anemone canadensis*.

Other foods may also kill butterflies. Strangely, three *Chlosyne gorgone* were found dead next to dog dung, probably because something the dog ate (or a de-worming chemical given to the dog by a veterinarian?) passed through the dog's intestines unchanged and was toxic to the butterflies.

Part II below discusses other aspects of butterfly attraction to flowers, including the popularity of the various flower species to butterflies, the colors of flowers and ultraviolet patterns, butterfly vision, floral scents, the attractive components of flower nectar, and pollination of the flower species by butterflies.

The visitation records and preferences of butterflies for their adult foods follow.

## The Adult Butterflies and their Foods

### HESPERIIDAE, EUDAMINAE

*Epargyreus clarus* (Cramer) visits flowers of all colors: *Apocynum androsaemifolium* pinkish-white 5x; *Apocynum cannabinum* whitish 47x; *Asclepias syriaca* pink 2x; *Carduus nutans* rose-purple; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple; *Cirsium arvense* purple 12x; *Dipsacus fullonum* var. *sylvestris* white to lilac 5x; *Epilobium* (*Chamerion*) *danielsi*=~*angustifolium* red-purple; *Geranium caespitosum* pink 2x; *Gilia pinnatifida* white; *Glycyrrhiza lepidota* yellowish-white 16x (one got proboscis caught ½ sec); *Hesperis matronalis* var. *alba* white; *Iris missouriensis* pale blue; *Jamesia americana* white; *Lupinus argenteus* blue 3x; *Lythrum salicaria* purple 6x; *Medicago sativa* violet 97x; *Monarda fistulosa* rose-purple 22x; *Penstemon secundiflorus* purple; *Phaseolus vulgaris* bush bean whitish; *Philadelphus lemoinei* white; *Rudbeckia laciniata ampla* yellow; *Symphoricarpos* ~*rotundifolius* pink; *Symphoricarpos occidentalis* pink; *Tamarix chinensis*=*ramosissima* rosy-white; *Thalictrum dasycarpum* whitish; *Tilia americana* yellowish-cream 2x; *Tradescantia occidentalis* blue unpopular flower only 1 sec.; *Trifolium pratense* red-purple 27x; white flowering plant; *Zinnia elegans* (pink 1x, yellow with orange center 30 min. 1x); dung of bird landed on in shade; mud 9x (one was in recycling position with proboscis below abdomen). An internet photo (Citizendium Encyclopedia, under “pollinator”) shows *E. clarus* supposedly pollinating a *Cephalanthus occidentalis* white flower because the anthers extend and contact the butterfly body, but the stigmas are way below because of the long legs. Venables and Barrows (1985) saw visits on 23 mostly-garden flowers, and found pollen on adults, but concluded they are mostly nectar thieves.

*Chioides zilpa* (Butler): Pinguinca tree.

*Aguna asander* (Hewitson): *Asclepias pollinia* on leg (William McGuire specimen).

*Zestusa dorus* (W. Edwards): mud 26x.

*Codatractus arizonensis* (Skinner) visits white or pink flowers at least: *Acacia angustissima* white-flowered thornless; *Baccharis* 3x whitish; *Cnidocolus angustidens* white; *Polygonum* ?*pensylvanicum* pink some; mud.

*Codatractus valeriana* Ploetz=*mysie* (Dyar) probably visits flowers of all colors, and often visits mud:

*Cnidocolus angustidens* white with ragged leaves and points from leaves; Lamiaceae small blue;

*Polygonum* ?*pensylvanicum* pink; *Valeriana* ~white/rose; mud.

*Urbanus dorantes* (Stoll): blue legume.

*Autochton cellus* (Boisduval and LeConte): *Baccharis* whitish 2x.

*Achalarus casica* (Herrich-Schaeffer): mud 4x.

*Thorybes drusius* (W. Edwards): mud.

*Thorybes pylades* (Scudder) visits flowers of all colors, and often visits mud: *Aesculus californica* whitish 1x; *Apocynum androsaemifolium* pinkish-white 2x; *Astragalus shortianus* purple; *Barbarea orthoceras* yellow; *Cirsium* ?rose-purple 3x; *Eriogonum umbellatum* yellow 2x; *Hedysarum boreale*? red legumes; *Jamesia americana* white; *Lathyrus leucanthus* white; *Lathyrus polymorphus incanus* purple and pink 2x; ~*Lathyrus eucosmus* pink pea; *Lathyrus* or *Vicia* ?blue-purple-pink; pea flower; Lamiaceae white; *Oxytropis lambertii* reddish-purple; ~*Pedicularis*? blue elephant flower; *Penstemon virens* blue; *Symphoricarpos albus* pink; *Symphoricarpos occidentalis* pink; *Vicia americana* purple; white flowering shrub; mud 15x.

*Thorybes mexicana* (Herrich-Schaeffer) evidently visits flowers of all colors even red, and often visits mud:

*Delphinium* ~*ramosum* blue; *Erigeron*? *ursinus* blue; *Gentianella acuta* “*amarella*” blue 2x; *Hedysarum boreale*? red legumes; *Oxytropis sericea* white; *Sedum lanceolatum* yellow; *Symphoricarpos albus* pink;

*Taraxacum officinale* yellow 2x; *Trifolium repens* whitish 2x; mud 5x.

*Cogia hippalus* (W. Edwards): *Cnidocolus angustidens* white with ragged leaves and points from leaves 2x;

*Polygonum* ?*pensylvanicum* pink several; mud wet sand.

*Cogia caicus* (Herrich-Schaeffer): mud 2x.

## HESPERIIDAE, PYRGINAE

- Apyrrothrix araxes arizonae* (Godman and Salvin) is the only butterfly known to land on water puddles by spreading the wings flat on the water and floating motionless on the water surface while they imbibe (to depart they flap the wings and zoom away) (Scott 1989). They may often visit all colors: *Baccharis* whitish ~47x; Lamiaceae white; *Oxytropis lambertii* reddish-purple 5x; *Polygonum ?pensylvanicum* pink 4x; ~*Senecio spartioides* yellow; sunflower yellow very-large-leaf; white Lamiaceae 2x; *Zinnia ~elegans* many ?pink; mud; water puddle 2x (wings spread on water while imbibing).
- Staphylus ceos* (W. Edwards): *Baccharis* whitish; pea flower blue-red; *Polygonum ?pensylvanicum* pink 2x; *Valeriana* ~white/rose.
- Pholisora catullus* (Fabricius) evidently visits all colors of flowers, and mud: *Arctium minus* rose-purple; *Astragalus gracilis* var. *parviflorus* purple 2x; *Geranium caespitosum* pink; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow 2x; *Lactuca serriola* yellow; *Lupinus argenteus* blue; *Medicago sativa* violet 3x; *Sphaeralcea coccinea* orange 3x; *Trifolium fragiferum* pink; mud 3x.
- Pholisora mejicanus* (Reakirt) visits blue-purple flowers and probably all colors, and mud: *Cirsium arvense* purple; *Cleome (Peritoma) serrulata* pinkish (briefly on); *Lappula redowskii* light-blue; *Verbena bracteata* blue 7x; mud.
- Hesperopsis alpheus* (W. Edwards): *Erigeron pumilus* white 10x; *Medicago sativa* violet (Maurice Howard) and other flowers (Scott and Scott 1978); *Psoralea?* thin blue legume.
- Hesperopsis libya lena* (W. Edwards): *Centaurea repens* blue 4x; *Medicago sativa* some (Michael S. Fisher). Most *Erynnis* seem to prefer white/yellow flowers, except for *E. funeralis*, *horatius*, and *tristis*.
- Erynnis icelus* (Scudder and Burgess) seems to prefer white flowers: *Antennaria parvifolia* whitish; *Cerastium strictum* “arvense” white 2x; *Erigeron pumilus* white; *Prunus virginiana* white 3x; *Senecio fendleri* yellow; mud 9x.
- Erynnis brizo burgessi* (Skinner) seems to prefer white and yellow flowers: *Arctostaphylos uva-ursi* whitish; *Astragalus drummondii* white; *Astragalus parryi* white 11x; *Cerastium strictum* “arvense” white; *Erysimum ~asperum* yellow; *Erysimum capitatum* orange-yellow; *Lesquerella montana* yellow 5x; purple legumes; *Senecio canus* yellow 2x; *Senecio fendleri* yellowXcanus yellow; white flowers; mud 12x.
- Erynnis martialis* (Scudder) prefers white and yellow flowers, sometimes blue/purple: *Apocynum androsaemifolium* pinkish-white 9x; *Astragalus agrestis* purple; *Astragalus flexuosus* purple 6x; *Ceanothus fendleri* white 13x; *Cerastium strictum* “arvense” white 3x; *Eriogonum umbellatum* yellow; *Erysimum capitatum* (orange 1x, yellow 2x); *Heterotheca villosa* yellow 2x; *Jamesia americana* white; *Lathyrus leucanthus* white 3x; *Lesquerella montana* yellow 4x; *Mertensia lanceolata* blue 8x; *Penstemon virens* blue; *Potentilla fissa* yellow 2x; *Sedum lanceolatum* yellow 7x; *Senecio canus* yellow 5x; *Senecio fendleri* yellow; *Taraxacum officinale* yellow; mud 10x.
- Erynnis pacuvius* (Lintner) most often visits white and yellow, but also visits purple, bluish, pink, even red flowers: *Antennaria parvifolia* whitish; *Apocynum androsaemifolium* pinkish-white 4x; *Arctostaphylos uva-ursi* whitish; *Astragalus crassicaarpus* white; *Astragalus agrestis* purple; *Astragalus flexuosus* purple 3x; *Ceanothus fendleri* white 9x; *Cerastium strictum* “arvense” white; *Erysimum ~capitatum* yellow; *Geranium caespitosum* pink; *Hedysarum boreale?* red legumes; *Heterotheca villosa* yellow; *Jamesia americana* white; *Lesquerella montana* yellow 4x; *Mertensia lanceolata* blue; *Sedum lanceolatum* yellow; *Senecio canus* yellow 11x; *Senecio fendleri* yellow 6x; *Symphoricarpos albus* pink; *Taraxacum officinale* yellow; *Thlaspi arvense* white; white flowering plant; mud 19x.
- Erynnis funeralis* (Scudder and Burgess) visits bluish and yellow and pink flowers etc.: blue legume; *Erigeron ursinus* blue-purplish; *Heterotheca pumila* yellow; ~*Lathyrus eucosmus* pink pea; *Medicago sativa* violet; tiny yellow-flowered plant like long-leaf *Artemisia dracunculus*; *Zinnia grandiflora* 5-10 cm roadside yellow-with-orange-center sunflowers; mud 6x.
- Erynnis baptisiae* (W. Forbes): *Trifolium pratense* red-purple.
- Erynnis afranius* (Lintner) prefers yellow/white flowers, but also visits all other colors: *Allium textile* white; *Apocynum cannabinum* whitish; *Campanula ~rotundifolia* blue; *Cirsium arvense* purple 7x (+ var).

*incanum* 2x); *Clematis ligusticifolia* white; *Convolvulus arvensis* whitish; *Grindelia squarrosa* yellow; *Heterotheca villosa* yellow 4x; *Hymenoxys (Tetraneuris) acaulis* yellow 3x; *Lathyrus polymorphus incanus* purple and pink; *Lesquerella montana* yellow 2x; *Lupinus argenteus* blue; *Marrubium vulgare* cream; *Medicago sativa* violet 41x; *Melilotus alba* white 2x; *Monarda fistulosa* rose-purple; *Oxytropis lambertii* reddish-purple 4x; *Penstemon glaber* deep blue or bluish-purple; *Psoralea tenuiflora* blue-purple 2x; *Senecio fendleri* yellow 2x (plus one ½ sec.); *Solidago altissima "canadensis"* yellow; *Symphoricarpos albus* pink 2x; *Taraxacum officinale* yellow; *Thermopsis divaricarpa* yellow; *Thlaspi arvense* white; *Verbena stricta* purplish-blue 2x; white flowering plant; mud 23x.

*Erynnis persius* (Scudder) prefers white and yellow, but also visits all other colors: *Allium textile* white to light-rose 3x; *Antennaria parvifolia* whitish; *Apocynum androsaemifolium* pinkish-white 7x; *Arctostaphylos uva-ursi* whitish; *Astragalus agrestis* purple 3x; *Astragalus flexuosus* purple 14x; *Astragalus laxmannii "adsurgens"* usually whitish 3x; *Barbarea orthoceras* yellow 4x; *Berberis (Mahonia) repens* yellow; *Berteroa incana* white; *Cerastium strictum "arvense"* white 5x; *Claytonia rosea* pinkish-white; *Comandra umbellata* white; *Cryptantha virgata* white; *Erigeron pumilus* bluish-white 8x; *Eriogonum umbellatum* yellow 3x; *Erysimum capitatum* orange; *Harbouria trachypleura* yellow; *Heterotheca villosa* yellow 3x; *Jamesia americana* white 4x; *Lathyrus leucanthus* white pea; *Lesquerella montana* yellow 16x; *Lupinus argenteus* blue; *Mertensia lanceolata* blue; *Oxytropis lambertii* reddish-purple 3x; *Penstemon angustifolius* blue; *Penstemon virens* blue; *Phacelia heterophylla* ~pinkish 3x; *Physaria vitulifera* yellow; *Potentilla fissa* yellow 2x; *Pseudostellaria "Stellaria" jamesiana* white; *Pulsatilla patens multifida* purpley-white; *Ranunculus ?glaberrimus* yellow; *Ribes cereum* pinkish-white; *Sedum lanceolatum* yellow 13x; *Senecio canus* yellow 16x; *Senecio fendleri* yellow 22x; *Senecio integerrimus* yellow 5x; *Thermopsis divaricarpa* yellow 12x and female tried to feed on flower twice; *Thlaspi arvense* white 4x; *Thlaspi (Noccaea) fendleri "montanum"* white; *Townsendia grandiflora* bluish-white 6x; *Viola nuttallii* yellow (1x and one 2 sec.); mud 64x incl. visit by female.

*Erynnis telemachus* Burns prefers white and yellow flowers, sometimes blue and orange: *Allium* violet; *Antennaria parvifolia* whitish; *Apocynum androsaemifolium* pinkish-white; *Astragalus parryi* white 3x; *Barbarea orthoceras* yellow 10x; *Berberis (Mahonia) repens* yellow 3x; *Cerastium strictum "arvense"* white 3x; *Claytonia rosea* pinkish-white; *Delphinium ~geyeri* blue; *Erysimum capitatum* orange 2x; *Lesquerella montana* yellow 5x; *Linum lewisii* blue; *Mertensia lanceolata* blue 3x; *Pseudostellaria "Stellaria" jamesiana* white; *Ribes cereum* pinkish-white 2x; *Senecio canus* yellow 4x; *Senecio fendleri* yellow 2x; *Taraxacum officinale* yellow 4x; *Thermopsis divaricarpa* yellow 5x (2 were seen inserting proboscis between sepals and corolla); *Viola canadensis scopulorum* white 2x; white flowering plant; yellow flower; juices from expanding *Quercus gambelii* leaf buds 4x; wet rotting wood many; dung; mud 22x.

*Erynnis propertius propertius* (Scudder and Burgess): *Calyptridium umbellatum* white; mud 2x.

*Erynnis propertius meridianus* E. Bell: white-flowered shrub similar to *Amelanchier*.

*Erynnis horatius* (Scudder and Burgess) visits all colors, even red: *Allium cernuum* pinkish-white; *Apocynum androsaemifolium* pinkish-white; *Arctium minus* rose-purple; *Carduus nutans* rose-purple; *Erysimum ~asperum* yellow; *Geranium caespitosum* red; *Hedysarum boreale?* red legumes; *Liatris punctata* purplish; *Melilotus alba* white 4x; *Melilotus officinalis* yellow; *Symphoricarpos albus* pink; *Trifolium ?white or pink*; mud 3x.

*Erynnis tristis* (Boisduval) evidently often visits purple-violet and pink as well as white and yellow flowers.

Ssp. *tristis*: *Eriogonum grande* orange (photo); *Medicago sativa* violet many; Lamiaceae. Ssp. *tatius*: Asteraceae yellow; *Oxytropis lambertii* reddish-purple; *Polygonum ?pensylvanicum* pink; *Raphanus sativus* bluish-white; *Verbena* purple (for ?*tristis*); mud 10x.

*Systasea zampa* (W. Edwards) = *evansi* (E. Bell): blue legume 2x; mud.

*Pyrgus centaureae loki* Evans visits yellow flowers, sometimes bluish or pink or whitish flowers and mud: *Arnica cordifolia* yellow 7x; *Arnica mollis* yellow 2x; *Barbarea orthoceras* yellow 2x; *Erigeron simplex* usually blue 2x; *Erigeron ursinus* blue 18x; *Fragaria virginiana glauca* white 2x; *Hymenoxys grandiflora* yellow; *Kalmia polifolia* pink 3x; *Mertensia?* blue; *Polygonum bistortoides* whitish 2x; *Sedum rhodanthum* pink 2x; *Senecio crassulus* yellow 5x; *Senecio dimorphophyllus* yellow 6x; ~*Senecio*

*fremontii* var. *blitoides* yellow sunflower with leaf blade round and wavy-margined; *Senecio integerrimus* yellow 2x; *Senecio werneriaefolius* yellow; *Taraxacum officinale* yellow 9x; *Trollius laxus* yellow; *Viola labradorica* violet-purple; catkin (male) of *Salix arctica* pinkish; mud 2x.

*Pyrgus ruralis* (Boisduval): mud.

*Pyrgus xanthus* W. Edwards probably visits all colors of flowers also, and mud: *Antennaria parvifolia* whitish 2x; *Antennaria rosea* rosy-whitish; ?*Erigeron ursinus* blue “Aster”; *Potentilla subviscosa* yellow often; *Taraxacum officinale* yellow often; manure (Scott 1975b); mud 5x.

*Pyrgus scriptura* (Boisduval) probably visits all colors of flowers, and manure and mud: *Heterotheca villosa* yellow 4x; *Heliotropium curassavicum* “white-blue low scorpioid Borage”; *Oxytropis lambertii* purple-violet; *Verbena bracteata* bluish-purple; manure; mud 4x.

*Pyrgus communis* (Grote) visits all colors of flowers (seldom red), often visits mud, and rarely visits compost and dung. It ignores many large flowers in favor of smaller ones: *Achillea millefolium* “*lanulosa*” white (+ one on cultivated var. ½ sec.); *Agastache rupestris* red 2x; *Allium textile* white to light-rose 2x; *Antirrhinum majus* [many colors] 2 sec.; *Aptenia cordifolia* purple-pink; *Aster ascendens* usually bluish; *Aster ericoides* white 11x + var. *falcatus* 2x; *Aster lanceolatus hesperius* bluish-white; *Aster porteri* white 4x; Asteraceae yellow; Asteraceae shrub yellow; *Astragalus flexuosus* purple 2x; blue legume; *Centaurea cyanus* blue; *Centaurea diffusa* white 8x; *Centaurea maculosa* lavender 15x; *Chrysanthemum Xsuperbum* white; *Chrysanthemum morifolium* purple 1 sec.; *Chrysothamnus nauseosus* yellow 23x; *Cichorium endivia* blue; *Cirsium arvense* purple 3x; *Convolvulus arvensis* whitish 3x; *Coreopsis verticillata* var. “Moonbeam” yellow; *Coronilla varia* pink; *Cosmos bipinnatus* white with yellow center; *Cryptantha jamesii* white; *Cucumis sativus* yellow; *Echinacea purpurea* purple; *Erigeron divergens* blue; *Erigeron pumilus* white 5x; *Erigeron ursinus* blue-purplish/blue; *Eriogonum brevicaulis* yellow; *Eriogonum effusum* white; *Eriogonum umbellatum* yellow; *Erysimum asperum* yellow 4x; *Gaillardia pulchella* reddish with yellow apex; *Gazania longiscapa* hybrid whitish with ultraviolet middle; *Gomphrena globosa* purple; *Grindelia squarrosa* yellow 9x; *Gutierrezia sarothrae* yellow 4x; *Helianthus petiolaris* yellow ½ sec.; *Heterotheca canescens* yellow 5x; *Heterotheca villosa* yellow 12x; *Hymenopappus filifolius* yellow 1x; *Hymenoxys (Tetranuris) acaulis* yellow; *Lappula redowskii* light-blue 9x; *Liatris punctata* purplish 10x; *Linum lewisii* blue; *Lobelia ~siphilitica* (1/2 m tall like *Verbena*) violet-blue 4x; *Lobularia maritima* “blue Alyssum”; yellow-flowered low bush; *Machaeranthera canescens* deep blue/purple 3x; *Machaeranthera pattersoni* purple/violet 7x; *Machaeranthera annua=phyllocephala* yellow 3x; *Machaeranthera pinnatifida=Haplopappus spinulosus* yellow 3x; *Machaeranthera tanacetifolia* blue-purple; *Malva neglecta* pinkish-white 3x; *Medicago sativa* violet 80x; *Melilotus officinalis* yellow 2x; *Nepeta cataria* white; *Nepeta Xfaassenii* violet 8x; *Oxytropis lambertii* purple 3x; *Penstemon strictus* blue; *Perovskia atriplicifolia* blue 3x; *Phyla=Lippia cuneifolia* white 2x; *Psoralea tenuiflora* blue-purple; *Rorippa sinuata* yellow 2x; *Rubus* “Darrow Blackberry” white; *Rudbeckia hirta* yellow 4x; *Rudbeckia laciniata ampla* yellow; *Sedum lanceolatum* yellow 2x; *Senecio fendleri* yellow 2x; *Senecio canus* yellow; *Senecio spartioides* yellow 3x; *Senecio tridenticulatus* yellow; *Sidalcea malvaeflora* purple; *Sisymbrium altissimum* yellow; *Sphaeralcea coccinea* orange 3x; *Tagetes ~erecta* orangish large petaly marigold; *Tagetes patula* 8x (2 orange-yellow, rest orangish/orange); *Tagetes tenuifolia* yellow 2x; *Taraxacum officinale* yellow 11x (+ one only ¼ sec.); *Thelesperma filifolium* yellow; *Trifolium fragiferum* pink 5x; *Trifolium repens* whitish 46x; *Verbena* (near-venosa) “Purpletop” purple; *Verbena bracteata* bluish-purple; *Verbena bracteata* pink; *Verbena hastata* purplish-blue; *Verbesina encelioides* golden-orange; *Veronica ~americana* prostrate bluish ½ sec.; *Viguiera (Heliomeris) multiflora* yellow 2x; *Viola nuttallii* yellow; *Viola tricolor* var. *tricolor* purple 2x; *Zinnia elegans* 7x (incl. yellow 3x, orange 2x); dung of human; compost (male fed repeatedly on fresh compost spread in garden); mud 32x.

*Pyrgus (communis?) albescens* Ploetz: *Raphanus sativus* bluish-white.

*Pyrgus philetas* W. Edwards: *Polygonum ?pensylvanicum* pink some; yellow sunflower with dissected leaves; yellow violet-like flower; mud 30x.

*Carcharodus flocciferus* Zeller (Europe): *Ranunculus* yellow buttercup.

*Helioptes domicella* (Erichson): mud.



*Heliopetes ericetorum* (Boisduval): ~*Eriogonum compositum* whitish “dense *Eriogonum* vaguely like *effusum*” 3x; white flowering plant many; mud 5x.

#### HESPERIIDAE, HETEROPTERINAE

*Carterocephalus “palaemon” skada* (W. Edwards) Cal.: *Calyptridium umbellatum* white.

*Piruna pirus* (W. Edwards) makes more than half its visits to *Geranium caespitosum* pink, which it may occasionally pollinate, many to *Apocynum*, and the rest of its visits are to many flowers of all colors, and mud: *Achillea millefolium “lanulosa”* white; *Apocynum androsaemifolium* pinkish-white 77x; *Apocynum cannabinum* whitish 50x; *Arctium minus* rose-purple; *Arnica mollis* yellow; *Asclepias speciosa* pink 2x; *Aster laevis* var. *geyeri* blue; *Astragalus flexuosus* purple 5x; *Ceanothus fendleri* white 3x; *Cirsium arvense* purple 39x + var. *incanum* 2x; *Cryptantha ~thyrsiflora* white; *Geranium caespitosum* pink 404x incl. Janet Chu. *Geranium* is the favorite: when feeding on *Geranium* both sexes land on petals with head toward anthers/stigmas and put proboscis next to stamen column then put proboscis down into holes (by stamens) and the top of bend of proboscis often touches anther and the labial palp tip sometimes touches anther, and an antenna often touches (near base) anther/stigma (they may pollinate *Geranium* if pollen is found on their head, as they suck nectar as adults land on petals and fit under the stamens and probably contact them sometimes, but would they contact the 4 stigmas which rise in a column surrounded by the arching stamens?; pollination is evidently infrequent because they seldom touch the stigmas); *Grindelia squarrosa* yellow; ?*Hackelia floribunda* 1m tall plant with tiny blue flowers; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow 2x; *Jamesia americana* white; *Lathyrus eucosmus* rose-purple; *Medicago sativa* violet 161x; *Melilotus alba* white; *Monarda fistulosa* rose-purple 3x; *Nasturtium officinale* white; *Rudbeckia laciniata ampla* yellow 2x; *Solidago ~altissima “~canadensis”* yellow 4x; *Trifolium pratense* red-purple; fluids ejected from abdomen as Paul A. Opler states they suck up fluids [evidently to feed on ~bird dung]; mud 16x.

*Piruna polingii* (W. Barnes): *Geranium* purplish 6x.

*Piruna aea mexicana* H. Freeman: mud 14x.

#### HESPERIIDAE, HESPERIINAE

*Megathymus yuccae* (Boisduval and LeConte): mud.

*Agathymus* species feed only on mud.

*Agathymus neumoegeni neumoegeni* (W. Edwards): mud 17x.

*Agathymus aryxna aryxna* (Dyar) : mud 7x; *A. aryxna baueri* mud 18x; *A. aryxna freemani* mud 3x incl. visit by female.

*Agathymus evansi* (H. Freeman): mud ~10x.

*Agathymus remingtoni estelleae* Stallings and Turner: mud.

*Ancyloxypha numitor* (Fabricius) visits flowers of all colors. *Alisma subcordatum* whitish; *Anemone canadensis* white 2x; *Asclepias incarnata* pink; *Asclepias syriaca* pink; *Cirsium arvense* purple 5x; *Cirsium vulgare* rose-purple; *Erigeron philadelphicus* white 2x; *Helianthus divaricatus* [not *tuberosus*?] yellow; *Helianthus tuberosus* yellow 6x; *Heliopsis helianthoides* yellow; *Lobelia siphilitica* violet-blue; *Lotus corniculatus* yellow 5x for a long time; *Lythrum alatum* purple; *Medicago lupulina* yellow 3x; *Medicago sativa* violet 133x; *Oxalis stricta* yellow; *Phlox pilosa* pink 3x (and male 2 sec and 2 sec); *Potentilla norvegica* yellow 12x; *Taraxacum officinale* yellow 8x (and seed head very briefly); *Trifolium pratense* red-purple 6x (and one 5 sec.); *Trifolium repens* whitish; *Verbena hastata* purplish-blue 13x; *Vicia americana* purple 7x; *Viola tricolor* var. *tricolor* purple; mud 3x.

*Ancyloxypha arene* (W. Edwards): *Valeriana* ~white/rose.

*Oarisma powesheik* (Parker): *Echinacea angustifolia* purple 9x; “*Cirsium vulgare*” surely *Carduus nutans* rose-purple.

*Oarisma garita* (Reakirt) visits all colors of flowers, all the way from red to blue: *Achillea millefolium “lanulosa”* white; *Allium textile* white (another did not land after inspecting two white flowers); *Apocynum androsaemifolium* pinkish-white 10x; *Arnica mollis* yellow; *Asclepias speciosa* pink; *Aster ascendens* usually bluish; *Aster glaucodes* white to violet; *Astragalus agrestis* purple violet 2x;

*Astragalus bisulcatus* purple 12x; *Astragalus flexuosus* purple 27x; *Calochortus gunnisonii* white; *Campanula rotundifolia* blue; *Carduus nutans* rose-purple 2x; *Ceanothus fendleri* white 5x; *Cerastium strictum* "arvense" white 5x; *Cirsium arvense* purple 7x (and var. *incanum* 2x); *Cirsium ochrocentrum* rose-purple; *Cleome (Peritoma) serrulata* pink; *Convolvulus arvensis* whitish 2x; *Coreopsis tinctoria* yellow (sunflower with *Achillea* leaves); *Crepis acuminata* yellow; *Crepis occidentalis* yellow; *Erigeron ~glabellus* blue hairy; *Erigeron divergens* white 2x; *Erigeron pumilus* bluish-white 11x; *Erigeron speciosus* blue 3x; *Erigeron ursinus* blue-purplish 5x; *Eriogonum subalpinum* [pinkish]-cream 14x; *Eriogonum umbellatum* yellow 2x; *Gaillardia aristata* yellow with red-purple base 4x incl. Janet Chu; *Geranium caespitosum* pink 13x (one seen placing proboscis on base of column); *Hedysarum boreale?* red legumes; *Heterotheca villosa* yellow 7x; *Lappula redowskii* bluish-white; *Linum lewisii* blue 2x; *Lupinus argenteus* blue 1x and one only ½ sec.; *Medicago sativa* violet 7x; *Melilotus officinalis* yellow; *Oxytropis lambertii* reddish-purple 5x (one sucking each flower of inflor.); *Penstemon ~confertus procerus* small-flowered blue; *Penstemon virens* blue 2x and another only ½ sec; *Potentilla concinna* yellow 2x; *Potentilla fissa* yellow (this flower is nearly shunned by most butterflies); *Potentilla pulcherrima* yellow; *Potentilla hippianaXpulcherrima* yellow; *Potentilla ?hippiana* yellow; *Rosa ~woodsii* ~pink; *Rudbeckia hirta* yellow 3x; *Sedum lanceolatum* yellow 18x; *Senecio canus* yellow; *Senecio fendleri* yellow 4x; *Senecio triangularis* yellow; *Senecio?* yellow; *Sisymbrium altissimum* yellow; *Symphoricarpos albus* pink; *Tetradymia canescens* yellow; *Townsendia ~hookeri* white; *Trifolium hybridum* pinkish-white 2x; *Vicia americana* purple 2x; mud.

*Oarisma edwardsii* (W. Barnes) visits all colors of flowers from red to blue: *Apocynum androsaemifolium* pinkish-white; *Asclepias speciosa* pink 2x; *Aster laevis* blue big; *Astragalus* ?bluish [whitish?]; *Linum [lewisii]* blue (Scott and Scott 1978); *Ceanothus fendleri* white 2x; *Geranium caespitosum* pink 3x; *Hedysarum boreale?* red legumes; *Lesquerella ?montana* yellow; *Melilotus alba* white; *Melilotus officinalis* yellow; *Oxytropis lambertii* reddish-purple 2x; *Penstemon ?virens* blue; *Symphoricarpos albus* pink.

*Copaeodes aurantiaca* (Hewitson) visits flowers of all colors: *Baccharis* whitish; blue legume; *Cnidocolus angustidens* white; *Lantana ~camara* yellow-red; *Polygonum ?pensylvanicum* pink several; *Raphanus sativus* bluish-white 3x; sunflower yellow; *Valeriana* white-pinkish; *Zinnia* ?pink or yellow; mud 3x.

*Adopaeoides prittwitzii* (Ploetz): *Lotus greenei* low 3 cm plant with flowers yellow but basal part orange-brown; *Nasturtium officinale* white many; *Ranunculus* yellow flower without usual yellow petals.

*Thymelicus lineola* (Ochsenheimer) probably visits flowers of all colors but often visits purple: *Cirsium arvense* purple 150x; *Medicago sativa* violet; *Trifolium hybridum* pinkish-white 2x; *Trifolium pratense* red-purple 2x. Pivnick and McNeil (1985) noted that *T. lineola* prefers *Trifolium pratense* red-purple, *Medicago sativa* violet, and *Vicia cracca* bluish-purple.

*Amblyscirtes* feed on flowers rather seldom it appears, of all colors evidently, based on the few records I have of them, more often on blue-purplish than yellow-white ones.

*Amblyscirtes exoteria* (Herrich-Schaeffer): Lamiaceae white.

*Amblyscirtes aenus* W. Edwards: *Apocynum androsaemifolium* pinkish-white; *Cirsium ochrocentrum* rose-purple 2x; *Erysimum asperum* yellow; *Geranium caespitosum* pink; *Medicago sativa* violet; *Penstemon* blue; red-purple legume 3x; bird dung recycling by sucking drops coming from anus; mud 4x.

*Amblyscirtes nereus* (W. Edwards): mud.

*Amblyscirtes osleri* (Skinner): *Apocynum androsaemifolium* pinkish-white; *Cirsium arvense* purple; *Cirsium* probably; *Hedysarum boreale?* red legumes; *Lathyrus eucosmus* white; *Lathyrus polymorphus incanus* purple and pink; *Monarda fistulosa* rose-purple; *Oxytropis lambertii* purple 9x; *Penstemon secundiflorus* purple 4x; *Symphoricarpos albus* pink; mud 7x.

*Amblyscirtes eos* (W. Edwards): *Asclepias speciosa* pink; *Astragalus* sp. ?bluish; *Heterotheca canescens* yellow; *Liatriis punctata* purplish 6x; ?*Lobelia siphilitica* [perhaps *Salvia azurea?*] blue 2x; mud (wet sand).

*Amblyscirtes elissa* Godman: *Baccharis* whitish.

*Amblyscirtes nysa* W. Edwards: *Cleome lutea* yellow; *Lantana ~camara* yellow-red; ~*Lathyrus eucosmus* pink pea; *Senna hirsuta* var. *leptocarpa* yellow; mud 2x.

*Amblyscirtes vialis* (W. Edwards) prefers purplish flowers, but also visits yellow and whitish ones etc.: *Apocynum androsaemifolium* pinkish-white 3x; *Astragalus flexuosus* purple 13x; *Geranium caespitosum* pink; *Heterotheca villosa* yellow; *Jamesia americana* white; *Lathyrus eucosmus* rose/purple; *Medicago sativa* violet; *Mertensia lanceolata* blue 2x; *Oxytropis lambertii* reddish-purple; *Penstemon secundiflorus* purple 5x; *Rubus idaeus melanolasius* white 2x; *Scutellaria brittonii* deep-violet-blue; *Taraxacum officinale* yellow 4x; *Thermopsis divaricarpa* yellow 5x; *Trifolium pratense* red-purple 2x; *Verbena stricta* purplish-blue 4x; *Oxytropis lambertii* reddish-purple; mud 13x.

*Amblyscirtes phylace* (W. Edwards) often visits *Oxytropis lambertii*: *Astragalus agrestis* purple; *Barbarea orthoceras* yellow; *Campanula rotundifolia* blue; *Ceanothus fendleri* white; *Geranium caespitosum* pink 2x; *Linum lewisii* blue; *Oxytropis lambertii* reddish-purple ~20x; *Phaseolus heterophyllus* flower with two orange hoods and yellow center with vine stem and tri-part leaves; mud 3x.

*Lerodea eufala* (W. Edwards) apparently visits all colors of flowers: *Aster* ?*chilensis* bluish; blue legume; Asteraceae yellow; *Eriogonum latifolium* whitish 3x; *Heterotheca canescens* yellow 12x; *Lantana ~camara* yellow-red; *Liatris punctata* purplish 2x; ?*Lobelia siphilitica* [perhaps *Salvia azurea*?] blue Lamiaceae; *Medicago sativa* violet 3x; *Polygonum pennsylvanicum* pink ~5x; purple flower many; small white-flowered vine; sunflower big yellow; *Verbena* purplish-blue.

*Lerodea arabus* (W. Edwards): blue legume.

*Lerema accius* (J. Smith): *Zinnia ~elegans* and small *Zinnia* ?pink 4x.

*Hylephila phyleus* (Drury) seems to visit flowers of all colors: Asteraceae yellow 2x; *Baccharis salicifolia* whitish 2x; blue legume; *Eriogonum latifolium* whitish 2x; *Gomphrena globosa* bright purplish-crimson; *Lantana ~camara* yellow-red; *Medicago sativa* violet; sunflower big yellow; *Trifolium repens* whitish 3x; *Verbena* purplish-blue; *Verbena hastata* purple 5x; *Zinnia ~elegans* ?pink 9x.

*Hesperia* species visit a wide variety of flowers including red-purplish and blue-purplish ones. They often visit *Cirsium* and mud. *Hesperia leonardus* usually visits only *Liatris punctata*.

*Hesperia uncas* W. Edwards visits all colors of flowers, esp. yellow and white: *Agoseris glauca* yellow 2x; *Arabis divaricarpa* blue 2x; *Asclepias speciosa* pink 2x; *Aster ericoides* white 2x incl. var. *ericoides*; Asteraceae yellow; *Astragalus drummondii* white 3x; *Astragalus kentrophyta* yellowish-white; blue asters; *Carduus nutans* rose-purple 17x; *Chrysothamnus nauseosus* yellow 8x; *Cirsium arvense* purple 5x; *Cirsium canescens* whitish 2x; *Cirsium ochrocentrum* (rose-purple 1x, lavender-white 1x); *Cirsium scariosum* var. *acaulescens* whitish; *Cirsium undulatum* rose-purple; *Cirsium vulgare* rose-purple; *Cryptantha jamesii* white 4x; *Erigeron pumilus* white 3x; *Erysimum asperum* yellow 4x; *Grindelia squarrosa* yellow 4x; *Helianthus*? yellow 2x; *Heterotheca villosa* yellow 6x; *Hymenopappus filifolius* yellow 4x; *Liatris punctata* purplish 5x; *Lupinus argenteus* blue; *Medicago sativa* violet 2x; *Monarda fistulosa* rose-purple; *Opuntia macrorhiza* yellow; *Opuntia polyacantha* yellow 8x; *Oxytropis lambertii* blue-purple; *Oxytropis deflexa* var. *sericea* whitish; *Oxytropis lambertii* reddish-purple; *Oxytropis sericea* whitish 2x; *Penstemon albidus* white with violet guide lines; *Penstemon secundiflorus* purple; *Potentilla pensylvanica* yellow; *Senecio fendleri* yellow; *Senecio tridenticulatus* yellow; *Senecio*-type yellow; *Tamarix chinensis*=*ramosissima* rosy-white; *Taraxacum officinale* yellow 2x; *Thelesperma filifolium* yellow; *Verbesina encelioides* golden-orange; mud 3x incl. female.

*Hesperia uncas tomichi* M. Fisher: *Asclepias halli* whitish 5x; *Calochortus nuttallii* violet-white; *Eriogonum lonchophyllum* white 22x; *Lepidium eastwoodiae* white ½ sec.; *Lygodesmia juncea* pink 1 sec.

*Hesperia juba* (Scudder) visits white, yellow, occasionally orange and purplish-violet etc. flowers, especially *Chrysothamnus nauseosus* in late summer, and frequents mud: *Allium textile* white to light-rose; *Aster porteri* white; *Barbarea orthoceras* yellow 2x; *Chrysothamnus nauseosus* yellow 161x; *Erigeron pumilus* bluish-white 5x; ~*Eriogonum compositum* whitish “dense *Eriogonum* vaguely like *effusum*”; *Eriogonum umbellatum* yellow; *Erysimum capitatum* usually orange; *Harbouria trachypleura* yellow; *Heterotheca villosa* yellow 3x; *Liatris punctata* purplish 2x; *Medicago sativa* violet; *Physocarpus monogynus* white; *Senecio canus* yellow 2x; mud 19x.

*Hesperia comma* (Linnaeus) (the following includes ssp. *ochracea*, *idaho*, *idahoXsusanae*, *idahoXassiniboia*, *oroplata*) visits purplish-bluish and yellow and white flowers, even pink and rose-

purple, and frequents mud: *Achillea millefolium* “*lanulosa*” white 2x; *Arctium minus* rose-purple 12x; *Aster ascendens* blue 5x; Aster blue; *Aster ericoides* white 2x; *Aster glaucodes* white to violet; *Aster laevis* var. *geyeri* blue 44x; *Aster lanceolatus hesperius* bluish-white 6x; *Aster porteri* white 48x; *Aster campestris* lavender; *Berteroa incana* white; *Campanula rotundifolia* blue for a few sec.; *Carduus nutans* rose-purple 51x; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple; *Centaurea diffusa* white 4x; *Centaurea maculosa* lavender 55x; *Centaurea repens* blue; *Chrysothamnus nauseosus* yellow 295x; *Cichorium intybus* blue 2x; *Cirsium arvense* purple 3x and var. *incanum* 2x; *Cirsium vulgare* rose-purple 3x; *Cirsium* ?purple 3x; *Dipsacus fullonum* var. *sylvestris* white to lilac; *Erigeron* ~blue 2x; *Erigeron speciosus* blue 7x; *Erigeron ursinus* blue-purplish blue 2x; *Eriogonum brevicaulis* yellow 3x; ~*Eriogonum compositum* whitish “dense *Eriogonum* vaguely like *effusum*”; *Eriogonum effusum* white 8x; *Eriogonum flavum* yellow 3x; *Eriogonum lobbii* var. *robustius* cream abundant; *Eriogonum umbellatum* yellow 4x; flowers white; flowers yellow; *Geranium caespitosum* pink; *Grindelia squarrosa* yellow 80x; *Gutierrezia sarothrae* yellow 3x; *Helianthus petiolaris* yellow 3x; *Helianthus pumilus* yellow; *Heterotheca canescens* yellow 2x; *Heterotheca villosa* yellow 203x; Lamiaceae; *Liatris punctata* purplish 274x; *Machaeranthera bigelovii* purple/violet 2x; *Machaeranthera canescens* deep blue/purple 3x; *Machaeranthera pattersoni* purple/violet 55x; *Medicago sativa* violet 6x; *Penstemon virgatus asagravi* lavender-purple; *Rudbeckia laciniata ampla* yellow; *Senecio spartioides* yellow 5x; *Solidago altissima* “*canadensis*” yellow; *Solidago missouriensis* yellow 6x; *Solidago* yellow; *Viguiera (Helimeris) multiflora* yellow 9x; mud 78x.

*Hesperia comma colorado* (Scudder) visits yellow, white, and blue-purplish flowers (few red flowers grow at its high altitude): *Arnica mollis* yellow; Aster ~*ascendens* blue 2x; *Erigeron melanocephalus* white or pinkish; *Erigeron pinnatisectus* blue/purple yellow-centered violet; *Erigeron ursinus* blue-purplish 3x; *Haplopappus (Oreochrysum) parryi* yellow; ~*Haplopappus (Pyrocoma) lanceolata* tall yellow astery Asteraceae; *Haplopappus (Tonestus) pygmaeus* yellow; *Heterotheca pumila* yellow 18x; *Heterotheca villosa* yellow 15x; *Hymenoxys grandiflora* yellow; *Potentilla* prob. *pulcherrima* yellow; *Sedum lanceolatum* yellow 2x; *Solidago simplex* var. *nana=decumbens* yellow.

*Hesperia comma harpalus* (W. Edwards): *Calyptridium umbellatum* white many.

*Hesperia woodgatei* (R. Williams): aster blue; white bushy flower.

*Hesperia ottoe* W. Edwards prefers purplish flowers, and sometimes visits all other colors: *Asclepias pumila* whitish; *Asclepias speciosa* pink 2x; *Carduus nutans* rose-purple 167x; *Cirsium arvense* purple 2x; *Cirsium ochrocentrum* rose-purple; *Cirsium undulatum* rose-purple 3x; *Cleome (Peritoma) serrulata* pinkish Janet Chu; *Echinacea angustifolia* purple 6x; *Heterotheca canescens* yellow; *Lobelia siphilitica* violet-blue Lamiaceae 3x; *Monarda fistulosa* rose-purple 22x; *Solidago* ~*altissima* “~*canadensis*” yellow; *Trifolium pratense* red-purple; mud 5x.

*Hesperia leonardus pawnee* Dodge visits yellow, white, and occasionally orange and blue-purplish flowers and often visits mud, but usually feeds just on *Liatris punctata* purplish in Colo., Neb., and Minn.: *Aster ericoides* white 2x; *Aster porteri* white 2x; Aster blue several (Paul A. Opler); *Carduus nutans* rose-purple 6x (incl. Paul A. Opler); *Chrysothamnus nauseosus* yellow 59x; *Cirsium* (Paul A. Opler); *Eriogonum effusum* white perching?; *Eriogonum umbellatum* yellow; *Grindelia squarrosa* yellow 4x; *Gutierrezia sarothrae* yellow 5x; *Helianthus annuus* yellow 2x (incl. Paul A. Opler); *Helianthus petiolaris* yellow 2x; *Heterotheca villosa* yellow 4x (incl. Paul A. Opler); *Liatris punctata* purplish 256x (mainly uses this flower, Scott and Scott 1978); *Lycium barbarum halimifolium* violet 3 sec; *Senecio spartioides* yellow 3x; *Solidago missouriensis* yellow; *Tagetes* ~*erecta* orange; *Verbesina encelioides* golden-orange ~30x; mud 23x. *H. leonardus pawnee* and the next *H leonardus montana* surely pollinate *Liatris punctata* because they swiftly “trap line” between the flowers, and the stamens and stigmas extend outward enough to provide pollination opportunities.

*Hesperia leonardus montana* (Skinner) visits purplish, pinkish, bluish, and white flowers, but nearly always visits just *Liatris punctata*: *Aster lanceolatus hesperius* bluish-white 2x; *Aster porteri* white 3x; *Carduus nutans* rose-purple 86x; *Cirsium* pink; *Cirsium* white; *Dalea purpurea* pink-purple; *Erigeron speciosus* blue? “pink Asters”; *Geranium caespitosum* pink; *Heterotheca villosa* yellow 11x; *Liatris punctata* purplish 595x; *Machaeranthera pattersoni* purple/violet blue 13x.

*Hesperia leonardus leonardus* T. Harris is the only *H. leonardus* ssp. that is often found on flowers other than *Liatris*, commonly on high flowers (Scott and Stanford 1981): It is still abundant on *Liatris punctata* purplish in Mich., N.J. and Iowa (Steve Spomer and Tim Warwick). It sometimes feeds on other flowers: *Aster*, *Cirsium*, *Clematis*, *Eupatorium purpureum* pink-purplish [and including “bonehead” meaning Boneset], *Liatris* other species purplish, *Solidago* yellow, *Vernonia angustifolia* purple.

*Hesperia pahaska* Leussler visits purplish and all other colors of flowers (Scott 1973a studied this species): *Asclepias asperula occidentalis* purple 1x; *Asclepias hallii* purple 5x; Asteraceae yellow; *Astragalus drummondii* white 20x; *Astragalus miser* var. *oblongifolius* [not *bisulcatus*] pale-violet 3x; *Baccharis* whitish; *Carduus nutans* rose-purple 3x; *Cirsium* prob. rose-purple; *Cirsium arvense* purple 17x; *Cirsium canescens* whitish; *Cirsium ochrocentrum* rose-purple 4x; *Cirsium undulatum* (rose-purple 1x, lavender 2x); *Cirsium vulgare* rose-purple 16x; *Cleome (Peritoma) serrulata* pink 3x; *Cryptantha jamesii* white 13x; *Descurainia sophia* yellow 1x; *Erigeron canus* blue-white 2x; *Erigeron pumilus* white 4x; *Eriogonum flavum* yellow-cream; *Eriogonum umbellatum* yellow; *Erysimum asperum* yellow 10x; *Hedysarum boreale*? red legumes; *Heterotheca villosa* yellow 1x; *Hymenopappus filifolius* yellow 2x; *Jamesia americana* white; *Leucelene ericoides*=*Aster arenosus* white 1x; *Linaria genistifolia dalmatica* yellow and redder at apex; *Machaeranthera bigelovii* purple/violet 2x; *Melilotus officinalis* yellow 2x; *Mirabilis multiflora* purplish 1x; *Monarda fistulosa* rose-purple 4x; *Opuntia polyacantha* yellow 46x; *Oxytropis lambertii* purple 20x; *Penstemon secundiflorus* purple 80x; *Penstemon virgatus asagrayi* lavender-purple 7x; *Polygonum ?pensylvanicum* pink 2x; *Sedum lanceolatum* yellow 3x; *Senecio fendleri* yellow; *Symphoricarpos albus* pink; *Thermopsis montana* yellow; *Trifolium* white to pink; *Zinnia ~elegans* ?pink small 9x; mud 3x.

*Hesperia viridis* (W. Edwards) visits all colors of flowers except perhaps pure red: *Achillea millefolium* “*lanulosa*” white; *Asclepias speciosa* pink 2x (one has pollinia on leg); *Astragalus ?bisulcatus* large tall pinkish-purple; *Carduus nutans* rose-purple 7x; *Ceanothus fendleri* white 2x; *Cirsium* ?purple 3x; *Cirsium arvense* purple 22x; *Cirsium ochrocentrum* rose-purple several; *Cirsium undulatum* rose-purple; *Clematis ligusticifolia* white some; *Cleome (Peritoma) serrulata* pinkish; *Conium maculatum* white; *Cryptantha jamesii* white; *Erigeron pumilus* usually white; *Eriogonum leptophyllum* whitish; *Eriogonum umbellatum* yellow; *Gaillardia aristata* yellow with red-purple base; *Helianthus pumilus* yellow 4x; *Heterotheca villosa* yellow 9x; *Liatris punctata* purplish; *Marrubium vulgare* cream; *Medicago sativa* violet 5x; *Melilotus alba* white some; *Monarda fistulosa* rose-purple 11x; *Opuntia macrorrhiza* yellow; *Opuntia phaeacantha* yellow 2x; *Opuntia polyacantha* yellow; *Oxytropis lambertii* reddish-purple; *Penstemon secundiflorus* purple 2x; *Pericome caudata* yellow; *Senecio*-type several yellow; *Solidago altissima* “*canadensis*” yellow; mud 5x.

*Hesperia attalus* (W. Edwards): *Liatris punctata* purplish.

*Hesperia dacotae* (Skinner) visits at least purplish flowers: *Carduus nutans* rose-purple 41x; *Cirsium undulatum* rose-purple; *Echinacea angustifolia* purple 12x.

*Hesperia lindseyi* (W. Holland): *Aesculus californica* whitish 12x; *Asclepias speciosa* pink 3x; *Brodiaea* ~bluish; *Eriodictyon californicum* white to lavender several; lily yellow; Lamiaceae several; mud.

*Hesperia miriamae* MacNeill: “aster” [probably *Erigeron*] blue.

*Hesperia nevada* (Scudder) visits all colors of flowers (except perhaps red) including blue-purple: *Arnica rydbergii* yellow; *Asclepias hallii* white; *Astragalus agrestis* purple 33x; *Astragalus drummondii* white; *Astragalus hallii* purple; *Astragalus laxmannii* “*adsurgens*” usually whitish 2x; blue flower; *Cryptantha virgata* white; *Erigeron pumilus* bluish-white 5x; *Eriogonum lonchophyllum* white; *Eriogonum subalpinum* [pinkish]-cream 3x; *Erysimum capitatum* usually orange 52x; *Geranium caespitosum* pink; *Harbouria trachypleura* yellow; *Oxytropis lambertii* purple 20x; *Oxytropis sericea* white 2x; *Penstemon strictus* blue; *Penstemon virens* blue; *Penstemon cyathophorus* pink-blue; *Sedum lanceolatum* yellow 8x; *Senecio canus* yellow (another left after ¼ sec.); mud 13x.

*Polites (Yvretta) carus* (W. Edwards): *Polygonum ?pensylvanicum* pink; mud many.

*Polites (Yvretta) rhesus* (W. Edwards) visits white, yellow, and blue-purplish-violet flowers, and prefers *Astragalus drummondii*, *Erysimum asperum*, and *Oxytropis lambertii* where those are present: *Allium textile* white to light-rose 2x; *Astragalus drummondii* white 3x (preferred, Scott and Scott 1978);

*Astragalus kentrophyta* or *sericoleucus* ~yellow-white; *Astragalus missouriensis* rose-purple; *Astragalus ?shortianus* rose-purple dozens; *Erigeron pumilus* usually white; *Erysimum asperum* yellow 39x; *Hymenoxys (Tetraneuris) acaulis* yellow 3x; *Musineon divaricatum* yellow; *Opuntia polyacantha* yellow; *Oxytropis lambertii* purple-violet 29x; *Oxytropis sericea* white 5x; *Penstemon angustifolius* blue; *Phlox hoodii canescens* white with yellow centers 2x; *Scutellaria brittonii* deep-violet-blue long; *Senecio fendleri* yellow; *Senecio plattensis* yellow 2x; *Senecio tridenticulatus* yellow; *Taraxacum officinale* yellow; *Vicia americana* purple.

*Polites sabuleti sabuleti* (Boisduval) visits all colors of flowers except perhaps pure red: *Aster ascendens* usually bluish; *Aster ?chilensis* bluish; *Aster ericoides* white 26x; *Aster lanceolatus hesperius* bluish-white 8x; *Astragalus alpinus* purple; *Carduus nutans* rose-purple; *Cirsium arvense* purple; *Cirsium vulgare* rose-purple; *Cleome (Peritoma) serrulata* pinkish; *Erigeron pumilus* usually white; *Grindelia squarrosa* yellow; *Haplopappus (Pyrocoma) lanceolata* yellow; *Helenium autumnale* yellow; *Heterotheca canescens* yellow; *Machaeranthera canescens* deep blue/purple 2x; *Medicago sativa* violet 4x; *Polygonum pennsylvanicum* pink; *Solidago altissima "canadensis"* yellow 2x; *Solidago (Euthamia) gymnospermoides* yellow; *Solidago missouriensis* yellow 4x; *Solidago (Euthamia) occidentalis* yellow 19x; sunflower big yellow; *Taraxacum officinale* yellow; *Trifolium fragiferum* pink; *Verbesina encelioides* golden-orange; mud 2x.

*Polites draco* (W. Edwards) visits yellow and white and less-often bluish-purple flowers, and often visits mud: *Achillea millefolium "lanulosa"* white; *Aletes ~acaulis (?anisatus)* yellow; *Antennaria parvifolia* ½ sec.; *Arnica mollis* yellow; *Arnica rydbergii* yellow; *Aster foliaceus* var. *apricus* purple 2x; *Astragalus agrestis* purple 11x; *Astragalus drummondii* white several; *Astragalus flexuosus* purple 3x; *Ceanothus fendleri* white; *Erigeron elatior* pink-purple; *Erigeron pumilus* bluish-white 9x; *Erigeron ursinus* blue-purplish 5x; *Eriogonum subalpinum* [pinkish]-cream 4x; *Erysimum capitatum* (yellow 1x, orange 3x); *Harbouria trachypleura* yellow; *Heterotheca pumila* yellow 2x; *Hymenoxys grandiflora* yellow; *Iris missouriensis* pale-blue crawled down and turned and put proboscis between petal bases; *Oxytropis lambertii* reddish-purple 4x; *Penstemon virens* blue 2x; *Sedum lanceolatum* yellow; *Senecio canus* yellow; *Senecio crassulus* yellow 2x; *Taraxacum officinale* yellow 5x; mud 8x.

*Polites peckius surllano* Scott visits all colors including red and pink, but usually visits purplish-blue-violet flowers: *Achillea millefolium "lanulosa"* white; *Aster ericoides* white; *Aster ~fendleri* white; *Astragalus gracilis* var. *parviflorus* purple; *Buddleja davidii* purple/violet 27x; *Carduus nutans* rose-purple 2x; *Centranthus ruber* red 4x; *Ceratostigma plumbaginoides* violet; ~*Chrysanthemum parthenium* small (2.5 cm flower) white-with-orange-center Asteraceae 2x; *Cirsium arvense* purple 11x; *Cirsium discolor* pinkish-violet 2x; *Cirsium vulgare* rose-purple; *Echinacea purpurea* purple 7x; *Erigeron philadelphicus* white; *Gomphrena globosa* purple or bright purplish/crimson 13x (prefers *Gomphrena* over *Salvia*); *Hesperis matronalis* pink; *Lavandula angustifolia* light-purple 3x; *Liatris punctata* purplish 59x; *Lobelia ~siphilitica* violet-blue; *Lupinus argenteus* blue; *Lychnis coronaria* red 12x; *Malva sylvestris* pink; *Medicago sativa* violet 163x; *Nepeta Xfaassenii* violet 2x; *Rudbeckia hirta* yellow (not popular, rarely visits) 2x; *Salvia farinacea* (purple-blue 40x, violet-blue 26x, white 1x) (not as popular as *Verbena* and *Zinnia*); *Salvia nemorosa* "East Friesland" blue 8x; *Scabiosa columbaria* blue-lilac 9x; *Solidago missouriensis* yellow rested didn't feed; *Sonchus uliginosus* yellow; *Symphoricarpos ~occidentalis* pink; *Tagetes erecta* yellow-orange 4x; *Tagetes patula* orange 2x; *Taraxacum officinale* yellow 2x; *Teucrium chamaedrys*=Germander red-purple 6x; *Thermopsis divaricarpa* yellow; *Trifolium pratense* red-purple; *Trifolium repens* whitish; *Verbena bipinnatifida* (pink to purple 2x, purple 2x); *Verbena hastata* purple 3x; *Verbena rigida* purple; *Verbena stricta* purplish-blue; *Vicia cracca* dark-blue hanging-flower; *Zinnia angustifolia* red (not popular); *Zinnia elegans* 25x (crimson 1x, orange 4x, pink 7x, yellow with orange center 1x, red and orange 2x, white 1x). In addition, watching urban park flowers I learned that the following flowers are not popular and are mostly not visited: *Achillea millefolium* cultivated var. rosy to white (unpopular flower, 2x rested on it but did not feed, and none visited it other times); *Agastache rupestris* red none; *Campanula carpatica* blue none; *Campanula ~rapunculoides* none; *Caryopteris clandonensis* none several days; *Diascia ~rigescens* pink none; *Erigeron speciosus* blue none; Evening primrose pink none; *Fallugia* white flowers none; *Gaillardia pulchella* reddish with yellow apex none;

*Gilia* scarlet none; *Perovskia atriplicifolia* blue none; *Petunia hybrida* white, red, rosy, and purple all none; *Physostegia virginiana* pinkish-white none; *Platycodon grandiflorum* blue none; *Salvia* “like *Gilia*” red none; *Solidago* ~*altissima* “~*canadensis*” yellow none.

*Polites peckius peckius* (W. Kirby): *Rudbeckia hirta* yellow AZ; *Erigeron* ~*ursinus* blue (Gunnison Co. CO).

*Polites themistocles* (Latreille) visits all colors of flowers, blue-purple-violet and yellow and whitish and pink and even orange and red, and sometimes visits mud: *Apocynum androsaemifolium* pinkish-white 3x; *Asclepias speciosa* pink 2x (one caught between corona and petals by proboscis, another had pollinia on leg); *Asclepias verticillata* whitish; *Aster laevis* var. *geyeri* blue; *Aster lanceolatus hesperius* bluish-white 10x; *Astragalus agrestis* purple 5x; *Astragalus flexuosus* purple; *Astragalus laxmannii* “*adsurgens*” usually whitish 3x; *Bidens cernua* yellowish; *Buddleja davidii* (pink-purple 1x, purple 1x); *Carduus nutans* rose-purple 20x; *Centaurea cyanus* ~blue 3x; *Centaurea dealbata* purple; *Centranthus ruber* red 6x; *Chrysanthemum Xsuperbum* white 3x; *Cirsium arvense* purple 6x; *Convolvulus arvensis* whitish 7x (+ another only 1 sec.); ?*Coreopsis* orange; *Delphinium ajacis* violet briefly; *Echinacea angustifolia* purple 2x; *Echinacea purpurea* purple 3x; *Erigeron pumilus* usually white; *Gomphrena globosa* (purple 26x, bright purplish-crimson 9x); *Hedysarum boreale*? red legumes many; *Jamesia americana* white; *Liatris punctata* purplish 9x; *Lobelia* ~*siphilitica* violet-blue 2x; *Lupinus argenteus* blue 3x; *Lychnis coronaria* red (not popular); *Medicago sativa* violet 92x; *Monarda fistulosa* rose-purple 2x; *Oxytropis lambertii* reddish-purple 2x; *Phacelia heterophylla* ~pinkish; *Rudbeckia hirta* yellow 5x (not very popular); *Salvia farinacea* (purple 25x, purple-blue 15x, violet 4x, white 4x) (preferred over *Gomphrena*, but not as popular as *Verbena* and *Zinnia*); *Salvia* ~*officinalis* blue 5x; *Sedum lanceolatum* yellow; *Symphoricarpos albus* pink many; *Tagetes patula* yellow-orange 11x; *Taraxacum officinale* yellow 13x; *Trifolium pratense* red-purple 3x; *Verbena bipinnatifida* (purple 14x, pink 1x, rosy 4x, rosy-white 1x, white 9x); *Veronica* ~*americana* blue or nearly white only 1/3 sec; *Vicia americana* blue; *Zinnia elegans* 121x (1 of these on crimson flowers, 3 on violet-red, 1 on rosy, 6 on rose-white, 57 on pink, 15 on orange, 15 on yellow, 1 on yellow-around-pink, 14 on white); mud 2x. In addition, the following urban park flower-garden flowers were found to be unpopular: *Achillea millefolium* rosy to white none; *Agastache rupestris* red none; *Campanula carpatica* blue none; *Diascia* ~*rigescens* pink none; Evening primrose? pink none; *Gilia* scarlet none; *Perovskia atriplicifolia* blue none; *Petunia* hybrid purple and rosy flowers none; *Petunia* red and white flowers none; *Physostegia virginiana* rosy-cream none; *Platycodon grandiflorum* blue none; *Salvia* “like *Gilia*” red none; *Zinnia angustifolia* red none.

*Polites origenes rhena* (W. Edwards) visits all colors of flowers (even pink and red), especially purplish-blue-violet (especially *Monarda*), and often visits mud: *Achillea millefolium* “*lanulosa*” white; *Apocynum androsaemifolium* pinkish-white 3x; *Asclepias speciosa* pink (leg had two pollinia); *Asclepias syriaca* pink 3x (one leg had pollinia); *Carduus nutans* rose-purple 21x; *Cirsium ochrocentrum* rose-purple violet 5x; *Cirsium undulatum* rose-purple; *Cirsium* prob. rose-purple; *Clematis ligusticifolia* white; *Echinacea angustifolia* purple; *Geranium caespitosum* pink 2x; *Hedysarum boreale*? abundant on red legumes; *Helianthus pumilus* yellow 6x; *Heterotheca villosa* yellow 3x; *Medicago sativa* violet 11x; *Monarda fistulosa* rose-purple 118x; *Oxytropis lambertii* reddish-purple; *Penstemon secundiflorus* purple 2x; *Ratibida columnifera* purple; *Solidago* ~*altissima* “~*canadensis*” yellow few; *Symphoricarpos albus* pink many; *Verbena stricta* purplish-blue 12x; sap of *Salix amygdaloides*; mud 5x.

*Polites mystic* (W. Edwards) visits all colors of flowers (including red), especially purplish-blue-violet (especially *Monarda*), and mud: *Apocynum androsaemifolium* pinkish-white 5x; *Apocynum cannabinum* whitish 52x; *Asclepias speciosa* pink 16x (two of these had pollinia on leg; a female was caught between corona and petals by her proboscis); *Asclepias tuberosa* orange; *Convolvulus (Calystegia) sepium angulata* white in flower tube; *Carduus nutans* rose-purple 9x; *Cirsium arvense* purple 8x + var. *incanum* 2x; *Cirsium ochrocentrum* rose-purple 3x; *Cirsium undulatum* rose-purple; *Cirsium scariosum*=*coloradense* (for *P. mystic*?) whitish; *Clematis ligusticifolia* white; *Cryptantha virgata* white 2x; *Eriogonum umbellatum* yellow; *Gaillardia aristata* yellow with red-purple base; *Gaillardia pulchella* reddish with yellow apex long pink center and pink petals 6x; *Geranium caespitosum* pink 3x (but another ignored it); *Hackelia floribunda* blue; *Heterotheca villosa* yellow; *Lupinus argenteus* blue; *Medicago sativa* violet 12x; *Mentha arvensis* pink; *Monarda fistulosa* rose-purple 40x; *Oxytropis*

*lambertii* reddish-purple 3x; *Penstemon secundiflorus* purple 3x; *Penstemon virens* blue; *Taraxacum officinale* yellow; *Trifolium pratense* red-purple 13x; mud 4x.

*Polites sonora* (Scudder). Ssp. *utahensis* (Skinner) greatly prefers the whitish *Cirsium scariosum* var. *acaulescens* which sprawls its flowers at GROUND level with NO stem! Otherwise it visits blue and purple and yellow and whitish flowers, plus manure and mud: ~*Aster ascendens* blue 2x; *Astragalus drummondii* white; *Berteroa incana* white; *Cirsium* prob. rose-purple; *Cirsium arvense* purple ~8x; *Cirsium* ~*scariosum* 2' whitish-blue; *Cirsium scariosum* (=coloradense=drummondii) var. *acaulescens* whitish 71x (the favorite flower); *Erigeron* ~*ursinus* blue 4x; *Erigeron ursinus* blue-purplish 5x; *Melilotus officinalis* yellow; *Rudbeckia hirta* yellow; *Taraxacum officinale* yellow; cow manure; mud 2x. Ssp. *sonora* visited: *Calyptridium umbellatum* white some; purple Lamiaceae.

*Polites vibex* (Geyer): *Monarda fistulosa* rose-purple 2x.

*Wallengrenia egeremet* (Scudder): *Cirsium arvense* purple; *Helianthus petiolaris* yellow; Lamiaceae flower blue (1/2 m tall like *Verbena*) 2x; ?*Lobelia siphilitica*.

*Pompeius verna* (W. Edwards): *Asclepias incarnata* pink.

*Atalopedes campestris* (Boisduval) visits all colors of flowers except perhaps pure red. *Asclepias incarnata* pink; *Asclepias speciosa* pink 2x; *Asclepias syriaca* pink; *Asclepias* sp. pink; *Aster* ?*chilensis* bluish; *Aster* blue; *Aster ericoides* white var. *ericoides* white 3x; *Aster novi-belgii* purple; *Bidens cernua* yellowish 2x; *Caryopteris clandonensis* "Longwood Blue" blue; *Chrysanthemum Xsuperbum* white; white sunflower (*Chrysanthemum?* *Gerbera?*); *Chrysothamnus nauseosus* yellow ~9x; *Cirsium arvense* purple 3x; *Cirsium discolor* pinkish-violet 3x; *Cirsium vulgare* rose-purple; *Coreopsis* annual ~yellow; *Cosmos bipinnatus* orange; *Echinacea purpurea* purple 2x; *Gaillardia aristata* yellow with red-purple base 2x; *Heterotheca canescens* yellow ~17x; *Liatris punctata* purplish 4x; *Lobelia siphilitica* dark blue; ?*Lobelia siphilitica* [perhaps *Salvia azurea?*] blue Lamiaceae; *Medicago sativa* violet 25x; *Nepeta cataria* white; *Penstemon* blue cultivated; *Polygonum pensylvanicum* pink; *Solidago* yellow; big sunflower yellow; sunflower yellow; *Tagetes* ~*erecta* yellow-orange 25x; *Tagetes patula* (orangish 4x, yellow 3x); *Teucrium chamaedrys* red-purple 7x; *Trifolium pratense* red-purple 2x; *Trifolium repens* whitish 3x; *Verbena hastata* purple 15x; *Verbena Xhybrida* "Imagination" purple 18x; ?*Verbena* tall 1m blue flower; *Zinnia elegans* 19x (and also pink 10x, yellow 3x, yellow around pink, small hybrid white 5x); mud 2x. Venables and Barrows (1985) saw visits on 27 mostly-garden flowers, and found pollen on adults but concluded they are mostly nectar thieves.

*Atrytone arogos* (Boisduval and LeConte) visits flowers of all colors, mostly purplish (and blue to pink) ones, but often yellow: *Apocynum androsaemifolium* pinkish-white 3x; *Asclepias pumila* (white 4x, whitish-green); *Asclepias speciosa* pink ~22x; *Asclepias syriaca* pink 2x; *Carduus nutans* rose-purple 11x; "Cirsium vulgare" probably *Carduus nutans* rose-purple 62x; *Cirsium arvense* purple ~129x; *Cirsium ochrocentrum* rose-purple; *Cirsium undulatum* rose-purple; *Cirsium vulgare* rose-purple 3x; *Dalea purpurea* cylindrical pink/rose-purple legume 2x; *Echinacea angustifolia* purple 7x; *Eriogonum flavum* yellow; ~*Eupatorium purpureum* pink-purplish 1 m "Liatris" with wide leaves; *Gaillardia aristata* yellow with red-purple base; *Geranium caespitosum* pink; *Grindelia squarrosa* yellow 2x; *Helianthus pumilus* yellow 11x; ?*Heliopsis helianthoides* yellow serrate sunflower; *Heterotheca villosa* yellow 9x; *Liatris punctata* purplish 15x; *Lobelia siphilitica* violet-blue Lamiaceae 2x; *Medicago sativa* violet ~38x; *Monarda fistulosa* rose-purple 32x; "Penstemon" ~*albidus* white; *Ratibida columnifera* yellow 2x; *Rudbeckia hirta* yellow; *Solidago altissima* "canadensis" yellow 56x; *Solidago* ~*missouriensis* yellow; *Solidago* yellow 2x; sunflower yellow 2x Janet Chu; mud 7x.

*Poanes taxiles* (W. Edwards) visits all colors including red, especially purplish (especially *Monarda*), and mud: *Apocynum androsaemifolium* pinkish-white 6x; *Apocynum cannabinum* whitish 2x; *Asclepias incarnata* pink 2x; *Asclepias speciosa* pink 2x; *Astragalus bisulcatus* purple; *Campanula rapunculoides* blue; *Carduus nutans* rose-purple 8x; *Ceanothus fendleri* white 2x; *Centranthus ruber* red; *Ceratostigma plumbaginoides* violet 2x; *Cirsium arvense* purple 18x + var. *incanum* 1x; *Cirsium canescens* whitish narrow leaves white; *Cirsium ochrocentrum* rose-purple 3x; *Cirsium undulatum* rose-purple; *Cirsium vulgare* rose-purple 2x; *Convolvulus* (*Calystegia*) *sepium angulata* white 4 cm flowers 9x (5x crawled inside 5 cm corolla tube, and female crawled completely into flower and extended proboscis to feed);



*Convolvulus arvensis* 2x; *Delphinium ajacis* (violet 23x, pink 1x); *Delphinium cardiopetalum* violet 2x; *Dianthus barbatus* orange; *Echinacea purpurea* purple; *Epilobium* (*Chamerion*) *danielsii*=*angustifolium* red-purple 2x; *Geranium caespitosum* pink 8x; *Grindelia squarrosa* yellow; *Hedysarum boreale*? red legumes; *Hesperis matronalis* pink; *Heterotheca villosa* yellow 2x; *Jamesia americana* white 3x; *Lathyrus latifolius* pink; *Lavandula angustifolia* purple/lavender 3x (plus two only ½ sec.); *Lithospermum multiflorum* yellow; *Lychnis coronaria* red 4x; *Lythrum salicaria* purple 2x; *Medicago sativa* violet 79x; *Melilotus alba* white; *Monarda fistulosa* rose-purple 247x incl. Anne U. White and Janet Chu; *Monarda fistulosa* cultivated var. red; *Nepeta Xfaassenii* blue 2x; *Oxytropis lambertii* purple 2x; *Penstemon ~calycosus* pink 2x; *Penstemon secundiflorus* purple 3x; *Penstemon virens* blue; *Penstemon virgatus asagravi* lavender-purple; *Phlox* white 2 sec.; *Potentilla fruticosa* yellow 2 sec.; *Prunella vulgaris* blue; *Rosa* cream; *Scabiosa columbaria* blue 2x; *Scutellaria brittonii* deep violet-blue; *Sedum lanceolatum* yellow; *Silene armeria* pink 1x; *Spiraea japonica* “Gold Flame” pink-red; *Symphoricarpos albus* pink; *Trifolium pratense* red-purple 8x; *Verbena stricta* purplish-blue 3x; *Verbena Xhybrida* “Imagination” purple 2x; bird dung (abdomen dips down to put a drop onto dung, proboscis back under body nearly to midpoint of abdomen sucks it up); mud 12x incl. female.

*Poanes hobomok* (T. Harris) visited red and pink flowers in my few records: *Asclepias syriaca* pink and pollinia on leg; *Hedysarum boreale*? abundant on red legumes; *Lathyrus eucosmus* red-purple pea; *Symphoricarpos albus* pink many; *Rubus idaeus melanolasius* fed on green raspberry (old flower-young berry). To confirm this color preference I added flowers recorded by Allen (1997), Gochfeld and Burger (1997), Iftner et al. (1992), Marrone (2002), Nielsen (1999), Opler and Krizek (1984), Royer (2003), Tooker et al. (2002), and internet photos: *Allium schoenoprasum* lavender; *Apocynum androsaemifolium* whitish to pink; *Apocynum* whitish to pink; *Arabis*? lavender; *Asclepias* including *A. syriaca* pink; *Asclepias purpurascens* purple; *Asclepias* pink; *Aster* lavender/yellow disc; *Aster* white with yellow disc; *Centaurea ~montana* blue; *Chrysanthemum leucanthemum* white; *Chrysanthemum Xsuperbum* white; *Echium vulgare* blue or sometimes pink or white; *Fragaria virginiana* pink; *Geranium maculatum* rosy-purple (some white); *Glechoma hederacea* purplish-blue; *Hesperis matronalis* pink 2x; *Hieracium aurantiacum* orange-red; *Iris versicolor* blue-violet (some white); *Lamium amplexicaule* pink; *Ledum groenlandicum* white; *Ligustrum* white; *Lonicera* yellow? (some white, red, or purple); ?*Lythrum salicaria* purplish; *Nepeta Xfaassenii* violet; *Phlox pilosa* roseate to pink or violet; *Rubus* white (rarely reddish); *Rubus* blackberry white (rarely reddish) common; *Sonchus oleraceus* yellow; *Syringa vulgaris* lilac-purple; *Taraxacum officinale* yellow; *Tradescantia virginica* purple; *Trifolium pratense* pink; *Verbena* pinkish; *Vicia ~cracca* lavender; mud; bird dung frequently. So *Poanes hobomok* sometimes visits all colors, often white and blue/purplish, but may prefer red and pink; at least it seems to visit reddish flowers more than most butterflies.

*Poanes viator* (W. Edwards): *Asclepias incarnata* pink 51x; *Asclepias syriaca* pink/incarnata pink and pollinia on leg; *Asclepias syriaca* pink and 1 pollinia on leg.

*Poanes melane* (W. Edwards): *Aesculus californica* whitish 2x; *Cirsium canescens* whitish.

*Stinga morrisoni* (W. Edwards) probably visits all colors of flowers, except perhaps pure red, and often visits mud: *Arctostaphylos uva-ursi* whitish; *Astragalus miser* var. *oblongifolius* pale-violet; *Erysimum ~capitatum* yellow; *Lesquerella montana* yellow 2x; *Opuntia polyacantha* yellow 3x; *Oxytropis lambertii* reddish-purple 14x; *Penstemon secundiflorus* purple 11x; *Senecio canus* yellow; *Senecio fendleri* yellow; *Senecio integerrimus* yellow; *Taraxacum officinale* yellow; mud 14x.

*Ochlodes agricola* (Boisduval): *Aesculus californica* whitish 6x; *Brodiaea* bluish; *Eriodictyon californicum* white to lavender; Lamiaceae.

*Ochlodes sylvanoides* (Boisduval) visits all colors of flowers except pure red. Most flowers are Asteraceae because of the late-summer flight period. *Achillea millefolium* “lanulosa” white 2x; *Arctium minus* rose-purple 23x; *Asclepias speciosa* pink; *Aster ascendens* blue 4x; *Aster* blue; *Aster ericoides* white 2x; *Aster foliaceus* purple 15x; *Aster glaucodes* white to violet; *Aster laevis* var. *geyeri* blue 68x incl. Janet Chu; *Aster lanceolatus hesperius* bluish-white 53x; *Aster novae-angliae* purple 9x; *Aster porteri* white 64x; Asteraceae shrub yellow 4x; *Astragalus laxmannii* “adsurgens” whitish; *Berteroa incana* white 3x; *Carduus nutans* rose-purple 70x; *Centaurea* ?bluish; *Centaurea diffusa* (lavender 7x, white 19x);

*Centaurea maculosa* purple; *Centaurea repens* blue; *Cerastium strictum* “*arvense*” ?*Stellaria media* white; *Chrysanthemum leucanthemum* white 2x; *Chrysanthemum Xsuperbum* white; *Chrysothamnus nauseosus* yellow 36x; *Cichorium intybus* blue; *Cirsium* prob. rose-purple; *Cirsium arvense* purple 21x + var. *incanum* 18x; *Cirsium centaureae* yellowish-white 2x; *Cirsium vulgare* rose-purple 6x; *Dipsacus fullonum* var. *sylvestris* violet-pink 8x incl. Anne U. White; *Epilobium* (*Chamerion*) *danielsi*=*angustifolium* red-purple 3x; *Erigeron speciosus* blue 13x; *Eriogonum flavum* yellow; *Eriogonum latifolium* 2x; *Geranium caespitosum* pink 8x; *Grindelia squarrosa* yellow 29x; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow 54x; *Liatris punctata* purplish 22x; *Linaria genistifolia dalmatica* yellow but red at apex probed several times but did not succeed and flew; *Lythrum salicaria* purple 8x; *Machaeranthera canescens* deep blue/purple; *Machaeranthera pattersoni* purple/violet 12x (+2x for “*M. pattersoni/canescens*”); *Medicago sativa* violet 89x; *Mentha arvensis* pink; *Monarda fistulosa* rose-purple 6x [this flower blooms mostly earlier]; *Nepeta cataria* white; *Polygonum pensylvanicum* pink several; *Rudbeckia laciniata ampla* yellow 5x; *Solidago* ~*altissima* “~*canadensis*” yellow 20x; *Solidago missouriensis* yellow 4x; *Sonchus uliginosus* yellow; sunflower yellow; *Tagetes patula* orange-yellow; *Trifolium pratense* red-purple 7x; *Verbena hastata* purplish-blue 7x; *Viguiera* (*Heliomeris*) *multiflora* yellow 11x (+6x only 1-2 sec. each); yellow flower several; *Zinnia elegans* pink common; mud 72x.

*Ochloides yuma yuma* (W. Edwards) visits all colors except perhaps pure red: *Arctium minus* rose-purple; *Asclepias* sp. purple; *Aster* ?*chilensis* bluish several; blue asters; *Chrysothamnus nauseosus* yellow 5x; *Cirsium* sp. purple; *Grindelia* yellow; *Helianthus* yellow; Lamiaceae blue (all Scott, Shields, and Ellis 1976); *Asclepias subverticillata* cream; *Cirsium arvense* purple; *Cirsium vulgare* rose-purple; *Eriogonum latifolium* 2x; *Melilotus officinalis* yellow; *Polygonum pensylvanicum* pink 3x; *Solidago* yellow.

*Ochloides yuma anasazi* S. Cary and Stanford: *Cirsium vulgare* rose-purple 54x; *Pericome caudata* yellow 12x.

*Paratrytone snowi* (W. Edwards) visits all colors of flowers, more often purplish ones (this species was studied by Scott 1973a): *Achillea millefolium* “*lanulosa*” white; *Allium geyeri* pink 1x; *Apocynum androsaemifolium* pinkish-white; *Artemisia frigida* pale greenish 4x; *Astragalus hallii* purple 60x; *Astragalus miser*? white; *Astragalus* purple; *Astragalus* red-purple 2x; *Cirsium canescens* whitish 2x; *Cirsium ochrocentrum* rose-purple violet 2x; *Cirsium undulatum* rose-purple lavender 3x; *Cryptantha jamesii* white 1x; *Eriogonum jamesii* cream 4x; *Geranium caespitosum* pink 4x; *Hymenoxys richardsonii* [not *Hymenopappus filifolius*] yellow 4x; *Ipomopsis aggregata collina* [not *Gilia texana*] red 1x; *Linum lewisii* blue 2x; *Lupinus argenteus* blue 8x; *Monarda fistulosa* rose-purple 40x; Lamiaceae ?*Monarda* ~rose-purple; *Oenothera hookeri* yellow 2x; *Oxytropis deflexa* var. *sericea* white; *Oxytropis lambertii* purple 82x; *Penstemon* blue; *Penstemon caespitosus* blue 2x; *Penstemon griffinii* blue 7x; *Penstemon* large purple 2x; *Penstemon virgatus asagrayi* [not *secundiflorus*] lavender-purple 96x; *Phacelia heterophylla* ~pinkish; *Potentilla* yellow 1x; *Trifolium pratense* red-purple; *Urtica dioica gracilis* gray-green 1x; mud 3x. *Ipomopsis sancti-spiritus* is claimed to be pollinated by this in New Mex. (Cary et al. 2011).

*Anatrytone logan* (W. Edwards) prefers purple flowers, sometimes yellow etc. *A. logan logan*: *Asclepias syriaca* pink 2 pollinia on legs of 2 adults; *Cirsium undulatum* rose-purple 3x; *Echinacea angustifolia* purple; *Medicago sativa* violet; *Verbena stricta* purplish-blue; *Vicia cracca* bluish-purple. *A. logan lagus*: *Carduus nutans* rose-purple 3x; *Cirsium arvense* purple 2x; *Cirsium ochrocentrum* rose-purple; *Cirsium vulgare* rose-purple; *Heterotheca villosa* yellow; *Medicago sativa* violet; *Monarda fistulosa* rose-purple 23x; sunflower yellow (raiting=perching?); mud 4x.

*Euphyes conspicua* (W. Edwards) often visits *Asclepias*: *Asclepias incarnata* pink 3x; *Eupatorium perfoliatum* white 2x.

*Euphyes dion* (W. Edwards) also often visits *Asclepias*: *Asclepias incarnata* pink 6x; *Asclepias syriaca* pink 4x; *Sonchus arvensis* [*oleraceus*?] yellow.

*Euphyes bimacula* (Grote and Robinson) often visits *Asclepias*: *Asclepias incarnata* pink; *Asclepias speciosa* pink 13x (3 had pollinia on leg); *Asclepias syriaca* pink 9x (one had pollinia on leg); *Cirsium arvense* purple 3x; *Melilotus officinalis* yellow.

*Euphyes vestris* (Boisduval) visits all colors of flowers even reddish, especially *Monarda*, often visits mud, and recycles dung: *Agastache urticifolia* pinkish; *Anemone canadensis* white; *Apocynum androsaemifolium* pinkish-white 30x; *Asclepias incarnata* pink; *Asclepias speciosa* pink 10x; *Asclepias syriaca* pink 13x; *Astragalus drummondii* white; *Astragalus flexuosus* purple 2x; *Astragalus laxmannii* “*adsurgens*” cream; *Calylophus serrulata* (Onagraceae) yellow bush 20 cm tall ~10 flowers; *Carduus nutans* rose-purple 8x; *Ceanothus fendleri* white 9x; *Cirsium arvense* purple 4x; white bird droppings 3x (2 of them observed sucking it on leaf after diluting it with drop from abdomen) 3x; *Erigeron divergens* rose-purple to white; *Erigeron speciosus* blue; *Eriogonum umbellatum* yellow 2x; *Euphorbia esula* yellow-green; *Galium* ~*triflorum* whitish; *Gaura* reddish; *Geranium caespitosum* pink 15x; *Grindelia squarrosa* yellow; *Hedysarum boreale*? red legumes; *Heterotheca villosa* yellow 8x; *Jamesia americana* white; *Lathyrus* ~*polymorphus incanus* blue/purple; *Lathyrus eucosmus* red-purple pea; *Lupinus argenteus* white (unpopular flower, probed flower ½ sec. then left); *Marrubium vulgare* cream; *Medicago sativa* violet 11x; *Melilotus alba* white; *Monarda fistulosa* rose-purple 106x incl. Anne U. White; *Penstemon virens* blue; *Phacelia heterophylla* 3x (usually purplish but one white); *Rudbeckia laciniata ampla* yellow; *Solidago altissima* “*canadensis*” yellow 4x; *Symphoricarpos albus* pink; *Symphoricarpos occidentalis* pink; *Trifolium pratense* red-purple 2x; *Verbena stricta* purplish-blue 13x; *Veronica* ~*catenata* pale-blue or white; mud 8x.

*Notamblyscirtes simius* (W. Edwards) visits flowers of all colors (Scott 1973d studied this species): *Astragalus* ?*bisulcatus* large tall pinkish-purple [not *A. miser* as reported by Scott 1973d]; *Astragalus drummondii* white 5x; *Astragalus miser* var. *oblongifolius* pale-violet [not *A. bisulcatus*] 7x; *Astragalus missouriensis* blue; *Cirsium arvense* purple 1x; *Cirsium* ?purple probably; *Cryptantha jamesii* white 15x; *Erigeron pumilus* white 13x; *Erysimum asperum* yellow 1x; *Hymenopappus filifolius* yellow 1x; *Lygodesmia juncea* pink 1x; *Machaeranthera pinnatifida*=*Haplopappus spinulosus* yellow; *Opuntia macrorhiza* yellow ~26x; *Opuntia polyacantha* yellow (adults crawl into and almost disappear among the stamens) 77x (*Opuntia polyacantha* purple had no visits); *Oxytropis deflexa* var. *sericea* whitish; *Oxytropis lambertii* red-blue 3x; *Penstemon secundiflorus* purple 95x; *Taraxacum officinale* yellow 1x.

*Atrytonopsis hianna hianna* (Scudder) evidently visits flowers of all colors: *Allium textile* white to light-rose 4x; *Erysimum asperum* yellow 7x; *Penstemon* blue; *Penstemon secundiflorus* purple; *Rubus deliciosus* white; *Scutellaria brittonii* deep-violet-blue; *Thermopsis divaricarpa* yellow; mud 2x.

*Atrytonopsis hianna deva* (W. Edwards): *Cirsium* ~*arizonica* big reddish; *Cirsium* ?purple 3x.

*Atrytonopsis vierecki* (Skinner): asters white; *Cirsium* ~*undulatum* blue several; *Cirsium* ?purple 2x; *Verbena* bluish.

*Atrytonopsis lunus* (W. Edwards): ~*Lathyrus eucosmus* pink pea.

*Atrytonopsis pittacus* (W. Edwards): asters white 11x; *Verbena* purplish ~13x; mud 3x.

*Atrytonopsis cestus* (W. Edwards): ?*Bouvardia glaberrima* riparian shrub with red tubular flower; *Cirsium* ~*arizonica* big reddish; mud some.

*Atrytonopsis python* (W. Edwards): *Cirsium* ~*undulatum* blue; *Cirsium* prob. rose-purple; white flowering plant.

*Atrytonopsis ovinia edwardsi* W. Barnes and McDunnough: ?*Bouvardia glaberrima* riparian shrub with red tubular flower; *Cirsium* ~*arizonica* big reddish; blue legume; mud 7x.

#### PAPILIONIDAE, PARNASSIINAE

*Parnassius clodius* Ménériés visits white and yellow flowers at least: *Achillea millefolium* “*lanulosa*” white; *Calyptidium umbellatum* white 12x; clover; Lamiaceae 3x; *Senecio* yellow.

*Parnassius phoebus smintheus* E. Doubleday prefers yellow and white flowers, sometimes orange, and seldom visits blue-purple ones. It sometimes visits mud (Scott 1973c studied this species). It evidently pollinates some yellow Asteraceae such as *Senecio*. *Achillea millefolium* “*lanulosa*” white 1x; *Agoseris aurantiaca* orange; *Agoseris glauca* yellow 3x (one male caught by foreleg in slit of flower the petal or stamen wound around his leg); *Antennaria parvifolia* whitish; *Apocynum androsaemifolium* pinkish-white; *Arenaria* (*Eremogone*) *fendleri* white 2x; *Arnica mollis* yellow 5x; Asteraceae yellow; *Astragalus laxmannii* “*adsurgens*” usually whitish 2x; *Ceanothus fendleri* white; *Chrysothamnus nauseosus* yellow

1x; *Cirsium canescens* whitish 2x; *Erigeron ~simplex* blue 2x; *Erigeron pumilus* bluish-white 24x; *Erigeron* sp. white 7x; *Erigeron ?ursinus* blue; *Eriogonum flavum* yellow-cream; *Eriogonum subalpinum* cream; *Eriogonum umbellatum* yellow 4x; *Erysimum capitatum* orangish-yellow 3x; *Gaillardia aristata* yellow with red-purple base 4x; *Geum (Acomastylis) rossii turbinatum* yellow; *Gutierrezia sarothrae* yellow (not *Chrysothamnus viscidiflorus*); *Harbouria trachypleura* yellow 11x; *Helianthus?* yellow sunflower; *Heterotheca villosa* yellow 4x; *Hymenoxys grandiflora* yellow 2x; *Jamesia americana* white; *Lesquerella montana* yellow 2x; *Monarda fistulosa* rose-purple; *Physocarpus monogynus* white; *Polygonum bistortoides* (photo Dodson and Dunmire 2007); *Potentilla ?hippiana?* yellow 1x; *Potentilla fissa* yellow; *Potentilla gracilis* yellow 2x; *Rudbeckia laciniata ampla* yellow; *Scutellaria brittonii* deep-violet-blue; *Sedum lanceolatum* yellow 117x; *Senecio canus* yellow 30x; *Senecio fendleri* yellow 43x (a male has much pollen from it, a female covered with its pollen, so they must pollinate it); *Senecio* sp. yellow [most probably *S. fendleri* or *S. canus*] 97x (one pollinating it covered with yellow pollen); *Senecio fremontii* var. *blitoides* yellow; *Senecio integerrimus* yellow; *Senecio werneriaefolius* yellow 2x spatulate leaf; *Taraxacum officinale* yellow 7x; *Haplopappus (Tonestus) pygmaeus* yellow; *Tragopogon dubius major* lemon-yellow; sap of *Salix amygdaloides* visited by females; mud 5x.

*Parnassius phoebus hermodur* H. Edwards mostly visits yellow flowers: *Arnica mollis* yellow; *Arnica rydbergii* yellow 5x; *Heterotheca pumila* yellow 6x; *Sedum lanceolatum* yellow 7x; *Senecio atratus* ½ sec.; *Senecio canus* yellow 3x; *Senecio dimorphophyllus* yellow; *Hymenoxys (Tetraneuris) brevifolia* yellow.

#### PAPILIONIDAE, PAPILIONINAE, TROIDINI

*Battus philenor hirsuta* (Skinner): *Aesculus californica* whitish; *Brodiaea pulchella* bluish 2x.

*Battus philenor philenor* (Linnaeus): *Baccharis* whitish; *Cleome lutea* yellow 2x; *Liatris punctata* purplish 4x; ~*Lobelia siphilitica* “blue flowers like *Penstemon*”; *Oxytropis lambertii* reddish-purple; *Zinnia ~elegans* ~pink several.

#### PAPILIONIDAE, PAPILIONINAE, PAPILIONINI

*Papilio machaon* ssp. *bairdii* W. Edwards and ssp. *brucei* W. Edwards (*brucei* is also a form within ssp. *bairdii*) visits most colors of flowers (esp. purplish), and often visits mud: *Asclepias speciosa* pink (f. *bairdii* 25x, f. *brucei* 4x); *Carduus nutans* rose-purple (f. *bairdii* and f. *brucei*) 2x+; *Castilleja integra* crimson [briefly?]; *Cirsium ?purple* 2x; *Cirsium arvense* purple; *Cirsium vulgare* rose-purple (f. *bairdii* 21x, f. *brucei* 20x); (ssp. *brucei*) *Cirsium ~centaureae* yellowish-white small head; (ssp. *brucei*) *Cirsium vulgare* rose-purple 4x; *Cleome (Peritoma) serrulata* 4x (+ pinkish 4x [incl. for form *hollandi* and f. *brucei*], whitish 1x); (ssp. *brucei*) *Liatris punctata* purplish; *Medicago sativa* violet 90x; (ssp. *brucei*) *Verbena stricta* purplish-blue; mud ~3x and (ssp. *brucei*) ~2x.

*Papilio zelicaon* Lucas (and its black form *nitra*) visits all colors of flowers, even red: *Apocynum androsaemifolium* pinkish-white 2x + 1x for form *nitra*; *Astragalus laxmannii* “*adsurgens*” white; *Brassica nigra* yellow 2x; Brassicaceae yellow; ?*Brodiaea* blue; *Centranthus ruber* red-blue 2x; *Cirsium canescens* whitish; *Cirsium ochrocentrum* rose-purple; *Cirsium arvense* blue; *Cleome (Peritoma) serrulata* pinkish (Scott and Scott 1978); f. *nitra* *Coryphantha vivipara* purple-pink; *Cryptantha* white small; *Delphinium geyeri* whitish; *Eriogonum latifolium* whitish; *Eriogonum umbellatum* yellow; *Erodium ~cicutarium* violet; *Erysimum asperum* yellow; *Erysimum capitatum* orange 7x + 2x f. *nitra*; *Erysimum ~capitatum* yellow 4x + 8x f. *nitra*; *Harbouria trachypleura* yellow 1x + 1x f. *nitra*; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow; *Iris germanica* blue; *Jamesia americana* white 4x; *Medicago sativa* violet; *Monarda* rose-purple (Scott and Scott 1978); *Oxytropis lambertii* purplish 4x (+ pinkish 1x f. *nitra*); *Penstemon angustifolius* blue; *Penstemon secundiflorus* purple 3x; *Penstemon virens* blue 25x; *Plantago lanceolata* white; *Potentilla fissa* yellow; *Prunus americana* white; *Ribes cereum* pinkish-white 8x + 1x f. *nitra*; *Raphanus sativus* bluish-white; *Rudbeckia hirta* yellow; *Senecio canus* yellow 7x; *Senecio fendleri* yellow; *Senecio integerrimus* yellow; *Senecio* yellow; *Syringa vulgaris* pink-purple; *Hymenoxys (Tetraneuris) brevifolia* yellow; *Thermopsis divaricarpa* yellow 3x; *Townsendia grandiflora*

bluish-white 2x; *Tragopogon dubius major* lemon-yellow; *Wyethia helenoides* yellow; f. nitra female catkins *Salix monticola*; mud 3x.

*Papilio polyxenes* Fabricius visits all colors of flowers, even red and yellow ones, and very often purplish ones: *Agoseris glauca* yellow; *Asclepias incarnata* pink 4x; *Asclepias speciosa* pink; *Aster ascendens* usually bluish; *Aster novae-angliae* purple; *Astragalus agrestis* purple; *Astragalus laxmannii* “*adsurgens*” white with pink center 4x; *Baccharis* whitish; *Buddleja davidii* pink-purple; *Carduus nutans* rose-purple 14x; *Castilleja integra* crimson 2x; *Chrysothamnus nauseosus* yellow 4x; *Cirsium arvense* purple 9x and var. *incanum* 1x; *Cirsium ?canescens* white; *Cirsium discolor* pinkish-violet 45x; *Cirsium undulatum* lavender 2x; *Cirsium vulgare* rose-purple 3x; *Cirsium* prob. rose-purple; *Cleome lutea* yellow; *Conium maculatum* white 4x; *Delphinium ajacis* violet 2x; *Dianthus barbatus* red 3x; *Dipsacus fullonum* var. *sylvestris* violet-pink 13x; *Echinacea purpurea* purple 8x; *Eriogonum flavum* yellow; *Erysimum ~asperum* yellow 2x; *Erysimum capitatum* orange 8x; *Euphorbia “Agaloma” marginata* white and green 2 sec; *Helianthus pumilus* yellow (1x + 2 sec.); *Helianthus tuberosus* yellow; *Hemerocallis fulva* orangish; *Heterotheca villosa* yellow; *Liatris punctata* purplish 11x (one for f. pseudoamericanus); *Lobelia siphilitica* blue; *Lythrum salicaria* purple; *Medicago sativa* violet 6x; *Monarda fistulosa* rose-purple 4x; *Nepeta cataria* white; *Oxytropis lambertii* reddish-purple 5x; *Penstemon secundiflorus* purple; *Penstemon virens* blue 2x; *Penstemon virgatus asagravi* lavender-purple; *Prunus virginiana* white; *Ribes cereum* pinkish-white 2x; *Scabiosa columbaria* blue-lilac; *Sedum lanceolatum* yellow; *Senecio canus* yellow 2x; *Senecio fendleri* yellow; *Solidago altissima “canadensis”* yellow; *Stachys palustris* pink Lamiaceae a little; *Syringa vulgaris* pink-purple 4x (one only 1 sec.); *Trifolium pratense* red-purple 26x; *Trifolium repens* whitish; *Verbena hastata* purplish-blue; *Vicia americana* purple; *Zinnia elegans* usually pink 5x; *P. polyxenes rudkini*: *Heterotheca villosa* yellow.

*Papilio indra indra* Reakirt visits all colors of flowers, and often visits mud: *Apocynum androsaemifolium* pinkish-white; *Carduus nutans* rose-purple; *Cryptantha virgata* white; *Delphinium ?ramosum* ~blue; *Erysimum asperum* yellow 2x; *Erysimum capitatum* (orange 14x, yellow-orange 2x, yellow 4x); *Grindelia squarrosa* yellow; *Hackelia floribunda* blue; *Helianthus pumilus* yellow; *Jamesia americana* white 22x; *Lesquerella montana* yellow; *Ribes cereum* pinkish-white; *Scutellaria brittonii* deep-violet-blue; *Senecio fendleri* yellow; mud 5x.

*Papilio crespontes* Cramer: *Clematis Xjackmani* blue 4 sec.; manure.

*Papilio astyalus* Godart: mud.

*Papilio glaucus glaucus* Linnaeus seems to prefer pinkish flowers, occasionally white: *Asclepias incarnata* pink 2x; *Rhododendron (Azalea)* yellow (male and black female, Garden Smart TV show); *Cirsium discolor* pinkish-violet; *Lonicera tatarica* pink 2x; *Phlox paniculata* pink (This Old House TV show); *Ribes cereum* pinkish-white; *Syringa reticulata* white.

*Papilio glaucus rutulus* Lucas visits all colors of flowers, even orange-red, and often visits mud: *Asclepias speciosa* pink; *Agastache urticifolia* pinkish; *Apocynum androsaemifolium* pinkish-white 17x; *Asclepias incarnata* pink 2x; *Asclepias speciosa* pink 19x; *Campanula rapunculoides* blue; *Carduus nutans* rose-purple 9x; *Ceanothus velutinus* white; *Chaenomeles japonica* orange-red; *Cirsium arvense* purple 2x + var. *incanum* 1x; *Cirsium canescens* whitish; *Cirsium ochrocentrum* rose-purple; *Cirsium vulgare* rose-purple; *Coreopsis grandiflora* yellow (avidly); *Delphinium ajacis* violet 4x; *Echinacea purpurea* purple 2x; *Eriodictyon* white to lavender; *Eriogonum lonchophyllum* white; *Helianthus pumilus* yellow; *Hesperis matronalis* pink 2x; *Jamesia americana* white; *Liatris punctata* purple; *Lilium pardalinum* orange (New Sunset Western Garden Book); ~*Nepeta cataria* white; *Oxytropis lambertii* reddish-purple; *Paeonia lactiflora* pinkish a couple sec.; *Philadelphus lemoinei* white 2x; *Potentilla fruticosa* yellow; *Prunus americana* white Janet Chu; *Purshia tridentata* pale-yellow; *Rudbeckia hirta* yellow 2x; *Rudbeckia laciniata ampla* yellow; *Tilia americana* yellowish-cream 2x; *Tilia europaea* ochre 3x; *Verbena hastata* purplish-blue; mud 11x.

*Papilio eurymedon* Lucas visits white, yellow, purple-blue-violet, orange, and pink flowers (and an internet photo shows it on red *Aquilegia* in Nevada), and mud: *Apocynum androsaemifolium* pinkish-white 16x; *Carduus nutans* rose-purple 4x; *Ceanothus fendleri* white; *Cercis occidentalis* (internet photo); *Cirsium canescens* whitish; *Delphinium nuttallianum* deep blue-purple 5x; *Eriodictyon* white to lavender;

*Erysimum capitatum* 4x (2 orange, 1 yellow); *Hesperis matronalis* pink; *Jamesia americana* white 8x; *Lilium philadelphicum* orange; *Lupinus* violet; *Oxytropis lambertii* reddish-purple 3x; *Penstemon secundiflorus* purple 4x; *Penstemon virens* blue 6x; *Physocarpus monogynus* white; *Prunus virginiana* white; *Rubus deliciosus* white; *Solidago ~altissima* “~canadensis” yellow; mud 12x.

*Papilio multicaudata* W. Kirby visits all colors of flowers (from purple or bluish to pinkish and red and white), except it seldom visits yellow ones. It definitely pollinates the lily *Hemerocallis ~fulva*. Because of its apparent ability to pollinate, I researched the literature (Shapiro 2007, Emmel and Emmel 1973, and mostly from numerous photos on the internet) and added those records with asterisk\*. *Aesculus californicus*\* white; *Agastache rupestris*\* red 2x; *Alcea rosea*\* white; *Allium schoenoprasum*\* lavender 2x; *Antirrhinum majus* yellow 1 sec.; *Asclepias fascicularis*\* white; *Asclepias incarnata* pink (3x, 1x\*); *Asclepias speciosa* pink (6x, 4x\*); *Astilbe* “Venus” pink 2x; *Bouvardia glaberrima* (Rubiaceae) long red tubular flower bush (all over S Ariz.); *Buddleja davidii* (violet 2x, also\* blue 1x, pink 1x, purple 2x, purple with yellowish center 1x); *Campanula persicifolia*\* pale-blue; *Campanula rotundifolia* blue 2 sec.; *Carduus nutans* rose-purple (25x, 1x\*); *Centaurea dealbata* Bluet pinkish 5 sec.; *Centaurea near ruthenica* white 3x (one only 3 sec.); *Centranthus ruber* red 2x; *Cirsium arizonicum*\* red 2x; *Cirsium arvense* purple; *Cirsium canescens* whitish; *Cirsium neomexicanum* ~pink; *Cirsium ochrocentrum* rose-purple; *Cirsium undulatum* rose-purple 2x; *Cirsium ~undulatum*\* rose-purple 5x; *Cirsium vulgare* rose-purple 4x; *Cirsium* spp.\* ~purple; *Clematis Xjackmani* blue 2x (but both only 2 sec.); *Crocasmia Xcrocsmiiflora* red (photo), *Delosperma ~cooperi* yellow; *Delphinium ajacis* violet 85x (male lands on lower flowers of inflorescence then helicopters up to the other ~4-5 flowers one by one by aiming body vertical and using fw to rise up), 1x\*; *Dianthus barbatus* (orange 1x, plus\* red 1x and violet-red 1x); *Echinacea purpurea* purple 31x (but three were 1-2 sec./brief), 2x\*; *Erysimum capitatum* orange 4x; *Eupatorium ~urticifolium*\* white; *Euphorbia esula* yellow-green; *Geranium ~sanguineum* red (1x, + only 2, 2, 3 sec.); *Helianthus annuus* yellow briefly; *Hemerocallis ~fulva* orange (with some red) 7x (+once only 3 sec.) (a very popular flower they seem to pollinate, as 1<sup>st</sup> male had orange-yellow pollen behind ventral forewing costa ~2 cm from middle of body, that looks like *Hemerocallis* pollen; 2<sup>nd</sup> had orange pollen on ventral forewing yellow area just behind costa 1.5 cm from body; 3<sup>rd</sup> had pollen on ventral forewing just behind costa 1.5 cm from body; 4<sup>th</sup> male on var. “Magnificence” was deep into flower [half visible]); *Heracleum sphondylium montanum=lanatum* white ¼ sec; *Hesperis matronalis* pink 21x (but 4 were only 1 sec. and two were 2 sec.); *Ipomoea ~purpurea*\* violet with blue tube; *Ipomopsis rubra* “Fuchsia Gilia” red (photo Jean Morgan in Denver Post); *Iris germanica* blue 1x (another 1 sec.); *Iris missouriensis* pale-blue (SD Gary Marrone); *Jamesia americana* white; *Liatris punctata* purplish very briefly; *Lobelia erinus* “Blue Cascade”\* blue; *Lychnis chalcidonica*\* (orange-red 1x, red 1x); *Lychnis coronaria* red 3x all 1 sec. (not very attractive in scent or nectar evidently); *Lythrum salicaria* purple; *Medicago sativa* violet; *Monarda fistulosa* rose-purple; *Penstemon secundiflorus* purple 5x; *Penstemon virgatus asagravi* lavender-purple; *Petunia hybrida* ~pink 10 sec+ in area with few flowers (did not land on another), *Petunia*\* (dark-red 1x, red 1x); *Philadelphus lemoinei* white; *Phlox ~paniculata* “peppermint twist”\* pink with white stripes; *Phlox divaricata*\* blue 2x; *Phlox paniculata* pink 2x incl. var. Brigadier 5 min. (even stopping wings from fluttering), purple\* 1x; *Platycodon grandiflorus*\* violet; *Prunus cerasus*\* (cherry) white; *Ribes cereum* pinkish-white; *Rosa* cultivated red 6x (one bushy, one had single petals) (two only 2 sec.); *Salvia sclarea* pink 3x (but two only 1 sec. and several sec.); *Saponaria officinalis* pinkish 4x (one var. *caucasica*); *Scabiosa caucasica* whitish; *Scabiosa columbaria* blue; *Scrophularia macrantha* red; *Silybum marianum*\* pink-purple; *Syringa vulgaris* pink-purple (3x, 1x\*); *Tilia americana* yellowish-cream 2x; *Tilia europaea* ochre 4x (two briefly when flowers old); *Verbena wrightii*\* pink; *Viola tricolor* var. *hortensis*\* (purple [yellow around black center] 1x, violet-red outside around yellow and black center 1x); *Zinnia elegans* (crimson 1x, orange and red 4x, orange 2x); mud (7x, 14x\*).

*Papilio pilumnus* Boisduval: mud.

#### PIERIDAE, DISMORPHIINAE

*Leptidea sinapis* Linnaeus (Europe): Lamiaceae blue.

PIERIDAE, COLIADINAE

*Kricogonia lyside* (Godart): mud.

*Nathalis iole* Boisduval prefers yellow flowers, often whitish, sometimes purple/violet/blue: *Achillea millefolium* “*lanulosa*” white; Asteraceae yellow; *Bidens frondosa* yellowish 11x; *Cerastium strictum* “*arvense*” white; *Chrysanthemum Xsuperbum* white; *Chrysothamnus nauseosus* yellow several; *Coreopsis verticillata* var. “Moonbeam” yellow 10x; *Erigeron speciosus* blue; *Euphorbia* “*Agaloma*” *marginata* green and white 2x; *Geranium richardsonii* whitish; *Gutierrezia sarothrae* yellow?; *Heterotheca canescens* yellow 2x; ?*Heliopsis helianthoides* big yellow sunflower 15 cm tall with serrate leaves; ?*Heliopsis helianthoides* yellow 2/3-m “sunflower” with yellow center and serrate oval leaves; *Heterotheca canescens* yellow ~20x; yellow-flowered low bush; *Machaeranthera pattersoni* purple/violet; *Medicago sativa* violet 4x; *Oxalis* ~*stricta* yellow; ?*Pectis angustifolia* (doubtfully *Dyssodia papposa* which has dissected leaves) yellow tiny Asteraceae 10 cm tall with filamentous leaves 2x; *Phyla*=*Lippia lanceolata* bluish-white 4x; *Sedum lanceolatum* yellow; *Solidago* yellow many; *Solidago missouriensis* yellow; *Taraxacum officinale* yellow; *Tribulus terrestris* yellow; *Trifolium repens* whitish; *Verbena hastata* purple; *Viola tricolor* var. *hortensis* ?white to purple; white pea.

*Eurema mexicana* (Boisduval): *Geranium caespitosum* pink ½ sec; *Oxytropis lambertii* reddish-purple; *Penstemon secundiflorus* purple.

*Eurema proterpia* (Fabricius): *Acacia angustissima* spineless white-flowered; *Cnidioscolus angustidens* white; ~*Lathyrus eucosmus* pink pea; *Senecio* yellow; *Solanum* yellow; mud.

*Eurema lisa* (Boisduval and LeConte): *Medicago sativa* violet.

*Eurema nise* (Cramer): *Hymenopappus filifolius* yellow; Pinguinca tree.

*Eurema nicippe* (Cramer) often visits yellow, whitish, and purplish: *Oxalis* ~*stricta* yellow 2x; *Psilostrophe sparsiflora* yellow-flower shrub 30 cm tall with gray-green leaves and 3 rectangular petals with ~3 lobes at end; *Raphanus sativus* bluish-white; *Sedum lanceolatum* yellow; tiny white flower; *Verbena* purplish-blue; *Viola tricolor* var. *tricolor* purple 3 sec.; mud.

*Colias meadii* W. Edwards visits yellow flowers, sometimes blue/purple: *Achillea millefolium* “*lanulosa*” white; *Agoseris glauca* yellow; *Arnica cordifolia* yellow 2x; *Arnica mollis* yellow 6x; *Arnica rydbergii* yellow 17x; *Aster foliaceus* var. *apricus* blue-violet sometimes purple 4x; *Erigeron elatior* pink-purple; *Erigeron pinnatisectus* blue/purple 11x; *Erigeron simplex* usually blue 2x; *Erigeron ursinus* blue 21x; *Haplopappus (Tonestus) pygmaeus* yellow 3x; *Heterotheca pumila* yellow 5x; *Heterotheca villosa* yellow 2x; *Hymenoxys grandiflora* yellow 2x; *Sedum lanceolatum* yellow; *Senecio atratus* yellow; *Senecio crassulus* yellow 21x; *Senecio dimorphophyllus* yellow 3x; *Senecio* yellow; *Solidago multiradiata* yellow; *Solidago simplex* var. *nana*=*decumbens* yellow 7x; sunflower yellow.

*Colias occidentalis chrysomelas* H. Edwards: *Brodiaea pulchella* blue; *Calochortus* ?yellow-orange.

*Colias occidentalis sacajawea* Kohler: *Taraxacum officinale* yellow.

*Colias occidentalis christina* W. Edwards: mud.

*Colias edwardsii edwardsii* W. Edwards (often included in *C. alexandra*): *Chrysothamnus nauseosus* yellow.

*Colias edwardsii altiplano* M. Fisher and Scott visits yellow, sometimes white or blue/purple flowers:

*Astragalus spatulatus* 20 cm blue; *Chrysothamnus viscidiflorus* yellow; *Erigeron pumilus* white; *Erysimum asperum* yellow 4x; *Gaillardia aristata* yellow with red-purple base; *Helianthus annuus* yellow 2x; *Heterotheca villosa* yellow; *Liatris punctata* purplish 8x; *Lobelia siphilitica* violet-blue; *Melilotus officinalis* yellow; *Senecio* ~*integerrimus* yellow; *Townsendia exscapa* white.

*Colias alexandra* W. Edwards visits yellow, blue/purple, sometimes white or reddish flowers, and mud:

*Apocynum androsaemifolium* pinkish-white 4x; *Astragalus laxmannii* “*adsurgens*” usually whitish 8x; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple; *Ceanothus fendleri* white; *Cirsium centaureae* yellowish-white; *Delphinium* ?*ramosum* blue; *Erigeron speciosus* blue 1x; *Eriogonum lobbii* var. *robustius* cream; *Erysimum asperum* yellow; *Erysimum capitatum* orange 2x; *Gaillardia aristata* yellow with red-purple base 7x; *Geranium caespitosum* pink; *Heterotheca villosa* yellow 3x; *Lupinus argenteus* blue; *Medicago sativa* violet 2x; *Oxytropis lambertii* reddish-purple 2x; *Rudbeckia hirta* yellow 3x; *Rudbeckia laciniata ampla* yellow; *Sedum lanceolatum* yellow; *Sisymbrium altissimum* yellow; *Solidago simplex* var. *nana*=*decumbens* yellow; *Trifolium pratense* red-purple 8x; mud 4x.

*Colias eurytheme* Boisduval visits yellow or bluish-purplish, sometimes reddish or white flowers: *Achillea millefolium* cultivated variety rosy to white 1 sec.; *Apocynum androsaemifolium* pinkish-white; *Apocynum cannabinum* whitish 2x; *Aquilegia coerulea* blue; *Arnica mollis* yellow; *Asclepias incarnata* pink 3x; *Asclepias syriaca* pink 2x; *Asclepias tuberosa* orange; *Aster ascendens* usually bluish; *Aster ericoides* white 27x + var. *falcatus* 2x; *Aster pauciflorus* blue-violet 3x; *Aster laevis* var. *geyeri* blue 3x; *Aster lanceolatus hesperius* bluish-white 67x (they prefer *A. hesperius* to *A. ericoides*); *Aster novae-angliae* purple 7x; *Aster porteri* white 7x; *Aster simplex* whitish 4x; *Astragalus agrestis* purple 2x; *Astragalus flexuosus* purple; *Astragalus laxmannii* “*adsurgens*” usually whitish 5x; *Berteroa incana* white; *Bidens cernua* yellowish; *Bidens frondosa* yellowish 5x; *Buddleja davidii* purple; *Carduus nutans* rose-purple 32x; *Centaurea diffusa* (lavender 7x, white 17x); *Centaurea maculosa* lavender 2x; *Chrysanthemum Xsuperbum* white 2x (+once 4 sec.); *Chrysothamnus nauseosus* yellow 324x; *Cirsium arvense* purple 15x + var. *incanum* 23x; *Cirsium discolor* pinkish-violet 3x; *Cirsium ochrocentrum*; *Cirsium vulgare* rose-purple; *Cleome (Peritoma) serrulata* pinkish; *Convolvulus arvensis* whitish 8x (plus 1 sec. for another and <1 sec. for 2x) is not very popular; *Coronilla varia* pink 15x; *Coreopsis grandiflora* yellow; *Echinacea purpurea* (purple 5x, pink 1x) for albino (This Old House TV show); *Erigeron elatior* pink-purple; *Erigeron speciosus* blue 3x; *Erigeron* ~blue; *Eriogonum effusum* white; *Eriogonum umbellatum* yellow 2x; *Erysimum capitatum* (1 yellow, 2 orange); *Gaillardia aristata* yellow with red-purple base 10x; *Gaillardia aristata Xgrandiflora* petals red with yellow tips; *Gaillardia pulchella* reddish with yellow apex 2x; *Geranium caespitosum* pink 2x; *Grindelia squarrosa* yellow 3x; *Gutierrezia sarothrae* yellow 4x; *Helianthus divaricatus* yellow; *Helianthus petiolaris* yellow 6x; *Helianthus pumilus* yellow; *Helianthus tuberosus* yellow 23x; *Helianthus* sp. yellow; ?*Heliopsis helianthoides* yellow 2/3-m “sunflower” with yellow center and serrate oval leaves; *Heterotheca canescens* yellow 4x; *Heterotheca villosa* yellow 36x; *Lathyrus polymorphus incanus* purple and pink; *Liatris punctata* purplish 28x; *Linaria vulgaris* yellow with orange palate; *Lobelia* ~*siphilitica* violet-blue; *Lotus corniculatus* yellow; *Machaeranthera canescens* deep-blue/purple 32x; *Machaeranthera pattersoni* purple/violet blue 19x; *Machaeranthera annua*=*phyllocephala* yellow; *Machaeranthera tanacetifolia* blue-purple; *Medicago sativa* violet 215x; *Melilotus alba* white 3x; *Melilotus officinalis* yellow 2x; *Mentha spicata* pink-white; *Musineon divaricatum* yellow; *Oxytropis lambertii* reddish-purple 3x; *Penstemon virens* blue 2x; *Phlox pilosa* ~pinkish; *Ratibida columnifera* yellow 2x; *Rudbeckia hirta* yellow 6x; *Salvia farinacea* violet; *Scabiosa columbaria* blue; *Sedum lanceolatum* yellow 3x; *Senecio canus* yellow 2x; *Senecio crassulus* yellow; *Senecio fendleri* yellow 4x; *Senecio spartioides* yellow 8x; *Solidago* ~*missouriensis* yellow 3x; *Solidago* ~*altissima* “~*canadensis*” yellow 3x; *Solidago (Euthamia) occidentalis* yellow 2x; *Solidago rigida* yellow; *Solidago* yellow; sunflower big yellow; *Syringa vulgaris* lilac; *Tagetes patula* orange-yellow 2x; *Taraxacum officinale* yellow 17x; *Trifolium hybridum* pinkish-white; *Trifolium pratense* red-purple 58x; *Trifolium repens* whitish 7x; *Verbena hastata* purplish-blue 13x; *Verbesina encelioides* golden-orange 2x; *Viola canadensis scopulorum* violet to white 4x; white flowering plant; *Zinnia elegans* (1x, pink 1x, red “Thumbelina Series” 1x); mud 69x.

*Colias philodice* Godart visits blue/purple and yellow flowers, often whitish, sometimes pinkish/reddish etc. ones, and mud: *Allium textile* white to light-rose; *Arctium minus* rose-purple; *Asclepias incarnata* pink 2x; *Asclepias speciosa* pink; *Aster ascendens* usually bluish 2x; *Aster ericoides* white 49x; *Aster pauciflorus* blue-violet; *Aster glaucodes* white to violet; *Aster laevis* var. *geyeri* blue 3x; *Aster lanceolatus hesperius* bluish-white 145x; *Aster novae-angliae* purple 4x; *Aster porteri* white; *Aster simplex* whitish; Asteraceae yellow abundant; *Astragalus flexuosus* purple; *Astragalus missouriensis* rose-purple; *Berteroa incana* white; *Carduus nutans* rose-purple 5x; *Centaurea maculosa* lavender 2x; *Centaurea* ~*maculosa* (no involucre spines, involucre fringed and green only near midrib) pink; *Centaurea diffusa* (lavender 2x, white 13x); *Chrysothamnus nauseosus* yellow 98x; *Cichorium intybus* blue; *Cirsium arvense* purple (3x + var. *incanum* 4x); *Cirsium discolor* pinkish-violet 4x; *Cirsium vulgare* rose-purple 2x; *Cleome (Peritoma) serrulata* pinkish 2x; *Convolvulus arvensis* whitish 4x plus briefly 3x so an unpopular flower; *Cosmos bipinnatus* ?white; *Delphinium* ~*geyeri* blue; *Dimorphotheca sinuata*=*aurantiaca* orange; ~*Draba* yellow; *Erigeron pumilus* usually white; *Erigeron speciosus* blue; *Erigeron ursinus* blue-purplish 2x; *Eriogonum effusum* white; *Erysimum asperum* yellow 2x; *Erysimum capitatum* (yellow 1x, orange ½ sec.



2x); *Gaillardia aristata* yellow with red-purple base 2x; *Gaillardia pulchella* reddish with yellow apex cultivated; *Grindelia squarrosa* yellow 21x; *Gutierrezia sarothrae* yellow 4x; *Helianthus annuus* yellow; *Helianthus divaricatus* yellow 4x; *Helianthus petiolaris* yellow 3x and 1x only ½ sec.; *Helianthus pumilus* yellow; *Helianthus tuberosus* yellow 4x; *Heterotheca canescens* yellow 5x; *Heterotheca villosa* yellow ~32x; *Lesquerella montana* yellow 5x; *Liatris punctata* purplish 14x; *Linaria genistifolia dalmatica* yellow and redder at apex; *Machaeranthera canescens* deep blue/purple 151x (and var. *rubrotinctus* blue 1x); *Machaeranthera pattersoni* purple/violet blue 55x; *Machaeranthera tanacetifolia* blue-purple; *Malva neglecta* whitish; *Medicago sativa* violet 187x; *Melilotus alba* white 6x; *Melilotus officinalis* yellow; *Oenothera albicaulis* white; *Oxytropis lambertii* purple; *Phlox pilosa* (for *C. philodice*?) ~pinkish; *Polygonum pensylvanicum* pink; *Ratibida pinnata* yellow 2x; *Rorippa sinuata* yellow 2x; *Sedum lanceolatum* yellow 2x; *Senecio canus* yellow 2x; *Senecio fendleri* yellow; *Senecio spartioides* yellow 5x; *Sisyrinchium montanum* deep violet; *Solidago* ~*altissima* “~*canadensis*” yellow 5x; *Solidago* (*Euthamia*) *gymnospermoides* yellow; *Solidago missouriensis* yellow 7x; *Solidago* (*Euthamia*) *occidentalis* yellow; *Solidago rigida* yellow 13x; *Solidago* yellow; *Tagetes patula* orange-yellow; *Taraxacum officinale* yellow 16x; *Townsendia exscapa* white; *Trifolium pratense* red-purple 35x; *Trifolium repens* whitish 4x; *Verbena hastata* purplish-blue 2x; *Verbena stricta* purplish-blue 7x; *Verbesina encelioides* golden-orange 4x; *Vicia americana* purple; *Viguiera* (*Helimeris*) *multiflora* yellow; *Viola nuttallii* yellow; white flowering plant; mud 23x; *philodice*X *eurhytheme* *Helianthus divaricatus* yellow.

*Colias pelidne skinneri* W. Barnes visits yellow flowers at least: *Senecio triangularis* yellow; *Senecio* yellow; *Taraxacum officinale* yellow.

*Colias scudderii scudderii* Reakirt visits mostly Asteraceae, mostly yellow, seldom white or pinkish or blue/purple: *Achillea millefolium* “*lanulosa*” white 2x; *Agoseris glauca* var. *parviflora* yellow; *Arnica cordifolia* yellow 2x; *Arnica mollis* yellow 6x; *Arnica rydbergii* yellow 4x; *Aster foliaceus* var. *apricus* purple 2x; *Barbarea orthoceras* yellow; *Cirsium centaureae* yellowish-white; *Cirsium scariosum*=*coloradense* cream; *Erigeron ursinus* blue 35x; *Haplopappus* (*Pyrocoma*) *lanceolata* yellow; *Polygonum bistortoides* whitish; *Sedum rhodanthum* pink 2x; *Senecio* yellow 2x; *Senecio crassulus* yellow 24x; *Senecio dimorphophyllus* yellow 2x; *Senecio fremontii* var. *blitoides* yellow 4x; *Senecio triangularis* yellow 3x; *Senecio werneriaefolius* yellow; *Solidago simplex* var. *nana*=*decumbens* yellow 5x; *Taraxacum officinale* yellow. *C. scudderii harroweri* Klots: *Sedum roseum integrifolium* dark-rose-purple 2x; *Senecio* yellow 11x.

*Colias behrii* W. Edwards: yellow Asteraceae.

*Zerene cesonia* (Stoll) probably visits flowers of all colors, and mud: *Aster laevis* var. *geyeri* blue; *Carduus nutans* rose-purple 3x; *Clematis* white; *Cnidocolus angustidens* white; *Helianthus nuttallii* yellow; *Medicago sativa* violet 2x (including Michael S. Fisher record); *Oxytropis lambertii* reddish-purple; *Verbena* purplish-blue; white-flowering plant; *Zinnia* ~*elegans* ?pink; mud.

*Phoebis sennae* (Linnaeus) visits all colors, but clearly prefers red and orange flowers, often visits yellow ones, less often visits white and pink, and least often visits purple/blue/violet flowers. It often visits long tubular red flowers, which it can profit from because it (and other *Phoebis*) has a very long proboscis. It visits hummingbird flowers, plus many others. Because its flower preference seems to fit the popular opinion of the flowers that butterflies visit (frequent visits to red tubular flowers, Proctor 1996, Willmer 2011) and is so different from preferences shown by most Colorado butterflies, I researched the literature on this species (and other *Phoebis* spp., which have the same flower preferences) to fully understand this difference. So I added literature records (from Allen 1997, Allen et al. 2005, Bailowitz and Brock 1991, Barcant 1970, Bright and Ogard 2010, Clark 1932, DeVries 1987, Glassberg 1999, 2000, Glassberg et al. 2001, Gochfeld and Burger 1997, Heitzman and Heitzman 1987, Iftner et al. 1992, Minno and Emmel 1993, Monroe and Monroe 2004, Opler and Krizek 1984, Orsak 1977, Shapiro 1966, Smith et al. 1994, Tveten and Tveten 1996) and added several hundred photos of the butterfly feeding on flowers that I found on the internet (of course photos cannot be identified as well as actual plants because different plants sometimes have very similar flowers, but laborious comparison with identified flower photos produces useful results). My meager six records for *Phoebis* have an asterisk\* below. *Phoebis sennae*

visited: *Aloe arborescens* orange; *Alcea rosea* white; *Anisacanthus quadrifidus* var. *wrightii* (orange 2x; orange-red 1x; red 1x); *Antirrhinum majus* red with white lobe; *Aquilegia canadensis* red and yellow; *Aster ericoides* white with yellow disc; *Aureolaria virginica* yellow; *Berberis repens* yellow vertical petals; *Bidens alba* white; *Bidens laevis* yellow; *Bidens leucantha* white with yellow disc; *Bidens mitis* yellow; *Bougainvillea glabra* (purple bracts 3x, small white flowers among many red bracts 1x); *Browallia americana* violet; *Buddleja davidii* white; *Calystegia sepium* white; *Campsis radicans* ~orange 2x; *Canna generalis* “Koenigen Charlotte” red; *Cassia hebecarpa* yellow; *Cassia* (most likely *fasciculata*=*chamaecrista*) yellow 3x; *Castilleja albobarbata* red-brown; ~”*Cercocarpus*”\* (tiny white-yellow-flowered tiny-leaf); *Chamaelaucium uncinatum* (pink form) pink-lavender; *Chrysanthemum* (multipetaled) yellow; *Cirsium arizonica* red 6x; *Cirsium* ~*discolor* (lavender 3x; purple 1x; rose-purple 1x); *Cirsium vulgare* rose-purple 3x; *Cirsium* sp. ~rose-purple 4x; *Cistus?* *crispus?* “silken pink?” (5 pink petals, 2 large sepals translucent with green midrib); *Cistus?* (petals white with yellow base and red line curving across each petal 70% from base, triple-divided stigma, 6 petals, 6 stamens); *Clerodendron speciosissimum* red (petal lobes mostly white but in giant cluster of red flower buds); *Convolvulus* (*Calystegia*) *sepium angulata* white; *Cordia globosa?* white; *Cordia* (probably *sebestena* orange) 2x; *Cornus florida* white; *Crossandra undulifolia* =*infundibuliformis* orange; *Cuphea melvillea* red basally yellow distally 2x; *Delphinium* ?*grandiflorum* blue; *Dianthus barbatus* pink 1x (+ red 2x); ~*Digitalis purpurea* lavender; *Dolichandra cynanchoides* red and orange 2x; *Echinacea purpurea* purple; *Encelia farinosa* yellow; *Epilobium canum*=*Zauschneria californica* red; *Eupatorium* (*Conoclinium*) *coelestinum* (lavender-white 3x, lavender 3x, pink 2x); *Euphorbia milii* red; *Ferocactus wislizenii* red; *Gaillardia aristata* yellow (reddish tops of lateral disc flowers); *Geranium* red (a favorite); *Hamelia patens* (dull yellow with red stems 1x, red 2x); *Helianthus annuus* ~”Pristine Hybrid” yellow with large brown disc; ~*Helianthus tomentosus* yellow with yellow disc; *Hibiscus* ~*moscheutos* white to red (prefers this); *Hibiscus* ~*moscheutos* white 4x; *Hibiscus rosa-sinensis* red 5x; *Hibiscus syriacus* white with red center 3x; *Impatiens capensis* orange; *Impatiens walleriana* red 2x; *Ipomoea alba* (pink 1x, white 1x); *Ipomoea coccinea* red 4x; *Ipomoea congesta* violet; ~*Ipomoea pes-caprae* light-pink; *Ipomoea purpurea* violet with whiter tunnel 2x; *Ipomoea* white or blue 3x; *Ipomopsis aggregata* red; *Ixora coccinea* red 3x; *Justicia* (*Beloperone*) *californica* dull red; *Lantana camara* (orange 2x, orange and yellow 2x, orange [+red flowers] 2x, reddish, red-orange, yellow 3x, yellow and red 3x, yellow among orange and pink, white with yellow center, lilac and pale-yellow); *Lantana involucrata* white; *Liatris punctata* purplish 4x; *Lobelia cardinalis* red 7x; *Lonicera caprifolium* white; *Lonicera flava* yellow; *Lonicera sempervirens* (orange 3x, red 1x); *Lonicera* probably *sempervirens* (orange 2x, reddish 1x); *Lonicera Xtellmanniana* orange; *Magnolia acuminata* yellowish-white raised petals; Malvaceae native white to blue; *Malvaviscus arboreus* red 7x; *Malvaviscus arboreus* var. *drummondii* red 5x; *Merremia* probably *tuberosa* yellow; *Mimulus ringens* lavender; *Mirabilis* ~*jalapa* crimson/white/yellow; *Nemesia nesia* (purple 1x, violet 1x); *Nemesia strumosa* red 2x; *Opuntia* ~*echios* yellow; *Opuntia paraguayensis* orange; *Pelargonium* near *zonale* (Zonal) pink; *Pelargonium* red/pink/purple; *Penstemon barbatus*\* red; *Penstemon eatonii* red; *Penstemon secundiflorus*\* purple; *Pentas lanceolata* (lavender 2x, purplish-pink 2x, red 16x [locally preferred]); *Petunia hybrida* (red 4x, red with white center 1x, red with black around tunnel 1x, pink 1x, purple 1x, violet 1x, unknown color 1x); *Petunia integrifolia*=*violacea* (blue 1x, red 1x); *Phlox divaricata* (pale-blue 2x, lavender-pink 1x, white 1x); *Phlox* ~*drummondii* ~”Neon Pink Star” white with purple 5-rayed star; *Phlox paniculata* (pink 6x, red-pinkish 1x, red 2x); *Plumbago auriculata*=*capensis* (blue 2x, white 3x, ~light blue 1x, purple [whiter rim of petals] 1x); *Poinciana pulcherrima* red with petal tips and stigma yellow; *Prunella vulgaris* pale blue; unidentified red flowers; *Rhaphiolepis umbellata* (pinkish-white with red stamens 1x, white with red stamens 2x); *Rhododendron* (*Azalea*) ~”Exotic” red; *Rhododendron* (*Azalea*) (pinkish-white 1x, white 1x); *Rosa* sp. like *woodsii* (wild) red with white center and yellow stamens; *Ruellia brittoniana* violet; *Salvia* ~*broussonetii* white; *Salvia coccinea* red 5x; *Salvia* ~*confertiflora* dull-red; *Salvia* ~*darcyi* red 2x; *Salvia elegans* red 2x; *Salvia* ~*roemeriana* red; *Salvia splendens* red 2x; *Salvia* sp. (red 1x, unknown color 1x); *Salvia* “Pineapple Sage ‘Golden Delicious’” (P. Allen Smith TV show Garden to Home); *Saponaria officinalis* (lavender 3x, pale-blue 4x, pink 1x, pinkish-white 1x, purplish-white 1x); *Senecio* ?*glabella* yellow; *Senna roemeriana* yellow; *Solidago*

yellow; *Stachytarpheta jamaicensis* blue or purple-blue 2x; sunflower\* yellow; *Tanacetum coccineum* violet-red; *Temnadenia violacea* red with white star; ~*Tithonia rotundifolia* red-orange; ~*Tithonia rotundifolia* with wilted rays orangish-yellow; *Tropaeolum majus* orange; *Valerianella radiata* white; *Verbena nervosa*\* purple 4x; *Vernonia gigantea* pinkish with lilac lateral florets; *Viola tricolor* var. *hortensis* (violet with yellow tube 1x, dark-violet 1x); ~*Watsonia coccinea* red-orange; *Zinnia elegans* 32x (light-orange [peach], orange 7x, orangish-yellow, X“cactus-flowered“ yellow, yellow 2x, pale-yellow, pink 4x, pink with yellow disc 3x, pink with Thumbellina series yellow disc flowers around red disc, purplish-pink with yellow stamens, purplish-pink 3x, purple 2x, red 4x, red with yellow stamens, reddish-orange, red-orange); ~*Zinnia elegans* orange with ray petals wilted and orange disc; *Zinnia haageana* “Aztec Sunset” russet; wet sand/mud 49x; mud 1x\*; garbage; carrion; dung.

*Phoebis philea* (Linnaeus) (all records of *P. philea* [and of *P. argante*, *P. neocypris*, and *P. statira* below] are from literature and internet photos cited under *Phoebis sennae* above); *Bougainvillea glabra* purple 2x; ~*Browallia americana* violet 2x; *Crocasmia Xcurtonus* “Lucifer” red; *Hibiscus ~moscheutos* white to red 2x; *Impatiens walleriana* orange; *Jatropha ~integerrima* red with many yellow stamens 2x; *Lantana camara* orange (+red flowers); *Liatris punctata* purple 2x; *Malvaviscus arboreus* red 3x; *Pentas lanceolata* red; *Rhododendron ~arboreum* red; *Stachytarpheta jamaicensis* dark-purple.

*Phoebis agarithe* (Boisduval): *Bauhinia*; *Bidens alba* white; *Borrchia frutescens* yellow; *Bougainvillea glabra* purple; *Bourreria ovata* white; *Catharanthus roseus* red to white; *Chamaelaucium uncinatum* pink; *Coccoloba diversifolia* whitish-green; *Combretum rotundifolium* red; *Cordia sebestena* orange; *Cordia* probably *sebestena* orange; ?*Cordia globosa* white; *Dicliptera assurgens* red; *Eupatorium coelestinum* lavender 3x; *Eupatorium odoratum* lavender; *Flaveria linearis* yellow; *Hibiscus ~syriacus* white; *Ixora* red; *Lantana camara* yellow; *Lantana involucrata* white; *Liatris punctata* purplish (my only record); *Lobelia ~cardinalis* red; *Lythrum ~salicaria* pink; *Malvaviscus arboreus* var. *drummondii* red; *Metopium toxiferum* white with yellow anthers; *Morinda royoc* white with yellow anthers; *Pithecellobium keyense* white 2x; *Poinciana* red and yellow; *Salvia nemorosa* “Mainacht” dark-violet; *Scandix pectin-venensis* white; *Senecio mexicana* yellow; *Stachytarpheta jamaicensis* blue-purple; *Tournefortia* white; mud 2x.

*Phoebis argante* (Fabricius): *Poinciana pulcherrima* pink and white.

*Phoebis neocypris* Hübner: *Tillandsia ~aeranthos* dark-blue flowers above red unopened flowers.

*Phoebis statira* (Cramer): Asteraceae several ~yellow spp.; *Cordia* probably *sebestena* orange; *Hamelia patens* red-orange.

#### PIERIDAE, PIERINAE, ANTHOCHARINI

*Anthocharis sara coriande* Scott and M. Fisher: mud.

*Euchloe ausonides ausonides* (Lucas) most often visits yellow or white flowers, occasionally orange, but often visits purple-blue-violet flowers as well (Scott 1975a studied this species in Calif.): *Achillea millefolium* “lanulosa” white 7x; *Alcea=Althaea rosea* whitish? 1x; *Brassica nigra* yellow 41x; *Brodiaea pulchella* blue 7x; *Eschscholzia californica* orange 1x; *Erodium ~cicutarium* violet 1x; *Cirsium arvense* purple 8x [does not visit *Cirsium arvense* in Colo.]; *Plantago lanceolata* white 15x; *Ranunculus* sp. yellow buttercup 1x; *Raphanus sativus* bluish-white 26x; *Rubus* sp. (blackberry) white 1x; *Sisyrinchium bellum* blue-violet 2x; *Wyethia helenoides* yellow 1x.

*Euchloe ausonides coloradensis* (H. Edwards) prefers yellow, often white, esp. Brassicaceae, but sometimes orange or purple or blue or red-purple flowers: *Achillea millefolium* “lanulosa” white; *Arabis glabra* (purple, some white) 5x; *Arabis stricta* white; *Arnica cordifolia* yellow 2x; *Barbarea orthoceras* yellow 8x; *Berberis (Mahonia) repens* yellow; *Cardamine cordifolia* white 2x; *Cerastium strictum* “arvense” white 9x +2 sec.; *Draba stenoloba?* yellow; *Erysimum ~capitatum* 12x (orange except 1 yellow-orange and 1 yellow); *Heterotheca villosa* yellow; *Lesquerella montana* yellow; *Mertensia lanceolata* blue; *Potentilla pulcherrima* yellow; *Prunus americana* white; *Senecio canus* yellow 2x; *Senecio crassulus* yellow; *Senecio fendleri* yellow; *Senecio integerrimus* yellow; *Taraxacum officinale* yellow; *Thlaspi arvense* white; *Townsendia hookeri* white 2x; *Trifolium pratense* red-purple; orange flower; mud 2x.

*Euchloe olympia* (W. Edwards) prefers yellow and white flowers esp. Brassicaceae, but also visits blue, purple, pink, and orange: *Allium textile* white to light-rose 9x; *Anaphalis margaritacea* whitish; *Barbarea orthoceras* yellow; *Cerastium strictum* “arvense” white 36x; *Cerastium strictum* “arvense” white 2x; *Chorispora tenella* pink 4x and purple 1x; ~*Draba* yellow tiny; *Erysimum asperum* yellow 10x; *Erysimum* ~*capitatum* yellow 6x; *Erysimum capitatum* orange 3x; *Lathyrus polymorphus incanus* purple and pink; *Lepidium campestre* white; *Lesquerella montana* yellow 16x; *Linum lewisii* blue 4x; *Mertensia lanceolata* blue; *Penstemon virens* blue briefly; *Physaria* ~*vitulifera* yellow; *Sedum lanceolatum* yellow; *Thlaspi arvense* white 6x; *Viola nuttallii* yellow 3x.

#### PIERIDAE, PIERINAE, PIERINI

*Neophasia menapia* (C. Felder and R. Felder) visits whitish, yellow, blue/purple/violet, and sometimes reddish flowers: *Achillea millefolium* “lanulosa” white 1x and another only ½ sec.; *Aster laevis* var. *geyeri* blue 9x; *Aster porteri* white 3x; *Berteroa incana* white; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple; *Centaurea diffusa* white 7x; *Cirsium arvense* purple 7x; *Cleome* (*Peritoma*) *serrulata* pinkish 3x; *Erigeron speciosus* blue 5x; *Grindelia squarrosa* yellow 2x; *Heterotheca villosa* yellow 6x; *Lepidium montanum* white; *Machaeranthera pattersoni* purple/violet 3x; “Aster” prob. *Machaeranthera bigelovii* purple/violet; *Raphanus sativus* bluish-white; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow 6x; *Solidago missouriensis* yellow 3x; *Solidago* yellow 2x; sunflower yellow 2x.

*Pieris rapae* (Linnaeus) visits all colors of flowers, more often on yellow and whitish than other colors, though not often on red; it often visits small Lamiaceae flowers (especially *Nepeta*), and as Opler and Krizek (1984) note, it seldom visits *Asclepias* and large-headed Asteraceae such as *Cirsium*, *Carduus*, and *Gaillardia*: *Anchusa azurea* blue; *Apocynum androsaemifolium* pinkish-white 3x; *Apocynum cannabinum* whitish 19x; *Arctium minus* red-violet 20x; *Asclepias speciosa* pink 2x (one had pollinia on leg and the other was dead caught by proboscis with 4 pollinia on legs); *Asclepias syriaca* pink (had pollinia on leg); *Aster ericoides* white (10x and var. *falcatus* 3x); *Aster lanceolatus hesperius* bluish-white 33x; *Aster novae-angliae* purple 6x; *Aster porteri* white 5x; *Aster simplex* whitish 5x; *Barbarea orthoceras* yellow 6x; *Berteroa incana* white 7x; *Bidens cernua* yellowish 3x; *Bidens frondosa* yellowish 2x; *Brassica nigra* yellow; *Brickellia californica* greenish-white; *Buddleja davidii* violet/purple 10x white 3x; *Carduus nutans* rose-purple 3x (another only hovered over); *Caryopteris clandonensis* blue 3x; *Centaurea diffusa* white 14x; *Centranthus ruber* red 4x; *Cerastium* ~*strictum*? white did not land on; *Chrysanthemum leucanthemum* white; *Chrysanthemum Xsuperbum* white; *Chrysothamnus nauseosus* yellow 23x; *Cirsium arvense* purple 60x + var. *incanum* 10x; *Cirsium vulgare* rose-purple 2x; *Cleome* (*Peritoma*) *serrulata* pinkish; *Convolvulus arvensis* whitish 7x (+ 4 only 1 sec., one only 6 sec., one only 30 sec.); *Conyza canadensis* whitish; *Coronilla varia* pink; *Cryptantha virgata* white 50 cm tall; *Cucumis sativus* yellow 5x (proboscis sucking) + one only 1 sec; *Cucurbita maxima* yellow ½ sec; *Cuphea rosea* purple 10x; *Delphinium ajacis* (violet 2x [+ one only 1 sec.], pink 1x); *Dipsacus fullonum* var. *sylvestris* white to lilac; *Epilobium brachycarpum*=*paniculatum* pink tiny flowers; *Erigeron speciosus* blue; *Eriodictyon* white to lavender; *Eupatorium rugosum* white; *Gazania* orange-yellow with uv middle landed on and flew (poor nectar); *Geranium caespitosum* pink 2x; *Geranium hybrida* orange 3x; *Grindelia squarrosa* yellow 11x; *Hesperis matronalis* pink 30x + several only 3 sec.; *Heterotheca* ~*canescens* yellow; *Heterotheca pumila* yellow; *Heterotheca villosa* yellow 3x; *Lactuca serriola* yellow 4x; *Lavandula angustifolia* light-purple 13x; *Lepidium campestre* white 4x; *Lepidium montanum* white; *Lepidium* ?*ramosissimum* white; *Lepidium* ?*virginicum* white; *Lesquerella montana* yellow; *Liatris punctata* purplish; *Linaria genistifolia dalmatica* yellow but red at apex; *Lycium barbarum halimifolium* violet 4x a long time; (Lazri and Barrows 1984 observed them on *Lythrum*); *Machaeranthera canescens* deep blue/purple; *Machaeranthera pattersoni* purple/violet blue 5x; *Machaeranthera annua*=*phyllocephala* yellow; *Marrubium vulgare* cream 23x; *Matricaria inodora* white; *Medicago sativa* violet 229x; *Mentha arvensis* pink 4x; *Mertensia lanceolata* blue; *Monarda fistulosa* rose-purple 1 sec. then flew; *Nasturtium officinale* white 23x; *Nepeta cataria* white 93x (+7x only a few sec. each on old flowers lacking nectar); *Nepeta Xfaassenii* (blue/pink-violet 59x, white 1x); *Origanum vulgare* purplish-pink 4x; *Perovskia atriplicifolia* blue 4x; *Phaseolus vulgaris* whitish only 1 sec.; *Plantago lanceolata* ~whitish; *Polygonum*

*amphibium coccineum* pink; *Polygonum pensylvanicum* pink 11x; *Potentilla fruticosa* yellow; *Potentilla norvegica* yellow 3x; *Ranunculus macounii* yellow 3x; *Raphanus sativus* bluish-white 6x (Lazri and Barrows 1984 found they transported pollen of this enough to possibly pollinate); *Ribes cereum* pinkish-white 2x; *Rubus idaeus melanolasius* white; *Rudbeckia hirta* yellow; *Salvia nemorosa* blue 3x; *Salvia sclarea* pink <1 sec. (not popular); *Scabiosa columbaria* blue-lilac 2x; *Sedum* cultivated bluish-pink 2x; *Sedum* “Hen and Chickens” pink; *Sedum lanceolatum* yellow 3x; *Senecio spartioides* yellow 3x; *Sisymbrium altissimum* yellow 7x; *Solanum dulcamara* violet with green spots; *Solidago* ~*altissima* “~*canadensis*” yellow 4x; *Solidago* ~*missouriensis* yellow; *Solidago* (*Euthamia*) *gymnospermoides* yellow; *Solidago* (*Euthamia*) *occidentalis* yellow; *Stachys olympica* blue ½ sec.; *Syringa vulgaris* pink-purple; *Taraxacum officinale* yellow 29x; *Teucrium chamaedrys*=Germander red-purple; *Thlaspi arvense* white; *Trifolium pratense* red-purple 5x; *Trifolium repens* whitish 7x + another only 1 sec.; *Verbena bracteata* bluish-purple; *Verbena hastata* purplish-blue 7x; *Verbena stricta* purplish-blue; *Verbena* sp. purple; *Verbena Xhybrida* “Imagination” purple 2x; *Veronica catenata* pale-blue or white; *Viguiera* (*Heliomeris*) *multiflora* yellow; *Viola tricolor* var. *tricolor* purple; *Zinnia elegans* pink 2x red 1x; mud 11x. Theis (2006) reports that it helps pollinate *Cirsium arvense*.

*Pieris marginalis mcdunnoughii* C. Remington visits all flower colors except red: *Achillea millefolium* “*lanulosa*” white 3x; *Arnica cordifolia* yellow 5x; *Arctium minus* rose-purple; *Aster ascendens* bluish; *Aster glaucodes* white to violet; *Astragalus alpinus* purple; *Cardamine cordifolia* white 2x; *Erigeron coulteri* white; *Erigeron elatior* pink-purple 2x; *Erigeron ursinus* blue-purplish 9x; *Eriogonum subalpinum* cream; *Fragaria virginiana glauca* white 2x; *Geranium caespitosum* pink 2x; *Geranium richardsonii* white; ?*Monarda fistulosa* rose-purple; *Oxypolis fendleri* white a bit; *Senecio atratus* yellow; *Senecio crassulus* yellow 8x; *Senecio triangularis* yellow many and 11x; *Senecio* yellow; *Smilacina* (*Maianthemum*) *stellata* white; *Solidago simplex* var. *nana*=*decumbens* yellow 2x; *Taraxacum officinale* yellow 4x.

*Pontia protodice* (Boisduval and LeConte) visits all colors of flowers except perhaps pure red, and rarely visits catkins and mud: *Abronia elliptica* white; *Achillea millefolium* “*lanulosa*” white; *Allium textile* white to light-rose; *Apocynum androsaemifolium* pinkish-white; *Apocynum cannabinum* whitish 3x; *Arctium minus* rose-purple; *Arnica mollis* yellow 2x; *Asclepias speciosa* pink; *Aster ericoides* white 12x + var. *falcatus* 4x; *Aster lanceolatus hesperius* bluish-white 5x; *Aster porteri* white 5x; *Astragalus laxmannii* “*adsurgens*” usually whitish; *Berteroa incana* white 3x; *Bidens frondosa* yellowish 2x; *Campanula rotundifolia* blue briefly; *Centaurea diffusa* ~lavender; *Centaurea scabiosa* blue; *Chorispora tenella* purple-rose 2x; *Chrysanthemum* orange; *Chrysothamnus nauseosus* yellow 14x; *Cirsium arvense* purple 12x + var. *incanum* 1x; *Cirsium undulatum* rose-purple; *Cirsium vulgare* rose-purple; *Cleome* (*Peritoma*) *serrulata* pinkish 7x; *Convolvulus arvensis* whitish 5x; *Cosmos bipinnatus* white (filiform leaves 2m plants); *Cryptantha jamesii* white 8x; *Delphinium ajacis* violet 2x; *Descurainia pinnata* yellow; *Echinacea purpurea* purple; *Epilobium* (*Chamerion*) *danielsi*=*angustifolium* red-purple 2x; *Erigeron divergens* rose-purple to white; *Erigeron pumilus* white 3x; *Erigeron* ~*simplex* violet hairy-leaf; *Erigeron speciosus* blue-pink 2x; *Erigeron ursinus* blue-purplish 2x; *Erigeron* ~blue Janet Chu; *Eriogonum effusum* white; *Eriogonum umbellatum* yellow 3x; *Erysimum asperum* yellow; *Euryops pectinatus* “*viridis*” yellow; *Grindelia squarrosa* yellow 4x; *Helianthus pumilus* yellow 2x; *Helianthus tuberosus* yellow 2x; *Hesperis matronalis* pink 4x; *Heterotheca canescens* yellow 2x; *Heterotheca villosa* yellow 11x incl. Janet Chu; *Hymenopappus filifolius* yellow 3x; *Lavandula angustifolia* light-purple; *Lepidium campestre* white 5x; *Lepidium montanum* white; *Lepidium* white tall; *Limonium latifolium* violet-blue; *Linum lewisii* blue (1x, + another only 1 sec.); *Lygodesmia juncea* pink; *Machaeranthera canescens* deep blue/purple; *Machaeranthera pattersoni* purple/violet; *Machaeranthera tanacetifolia* blue-purple; *Medicago sativa* violet 64x; ~*Melephora crocea* yellow ~Aizoaceae; *Melilotus alba* white 2x incl. Janet Chu; *Melilotus officinalis* yellow; *Nepeta Xfaassenii* violet; *Potentilla fruticosa* yellow 2x; *Potentilla pulcherrima* yellow; *Potentilla* sp. yellow herb with very large lvs. in garden; *Psoralea tenuiflora* blue-purple 2x; *Salvia nemorosa* “East Friesland” blue; *Sedum lanceolatum* yellow 2x; *Senecio fendleri* yellow 7x; *Senecio spartioides* yellow; *Senecio tridenticulatus* yellow; *Solidago* ~*simplex* var. *nana*=*decumbens* yellow; *Solidago* yellow Janet Chu; *Solidago* (*Euthamia*) *occidentalis* yellow;

*Sphaeralcea coccinea* orange; *Spiraea* ~*japonica* var. *ovalifolia* white; big yellow sunflower; *Tagetes patula* 1x + yellow with red center 2x; *Taraxacum officinale* yellow 5x; *Thelesperma filifolium* yellow; *Tribulus terrestris* yellow 2x; *Verbena hastata* purplish-blue; *Verbesina encelioides* golden-orange 2x; *Veronica* ?*americana* blue or nearly white; white flowering plant; *Zinnia elegans* Thumbelina pink; catkin *Salix*; mud.

*Pontia callidice occidentalis* (Reakirt) visits yellow and white and violet-blue-purplish flowers, rarely pinkish, and rarely visits catkins: *Achillea millefolium* “*lanulosa*” white; *Aster ericoides* white 4x + var. *falcatus* 1x; *Aster glaucodes* white to violet 2x; *Aster lanceolatus hesperius* bluish-white 3x; *Berteroa incana* white 2x; *Chrysothamnus nauseosus* yellow 2x; *Cleome* (*Peritoma*) *serrulata* pinkish 2x; *Erigeron pumilus* white; *Erigeron speciosus* blue; *Erigeron ursinus* blue-purplish; *Heterotheca pumila* yellow 3x; *Heterotheca villosa* yellow 3x; ~? *Heuchera* ~greenish/yellowish; *Hymenoxys* (*Tetranneuris*) *acaulis* yellow; *Leucelene ericoides*=*Aster arenosus* white; *Ligusticum tenuifolium* white; *Machaeranthera pattersoni* purple/violet 2x; *Medicago sativa* violet 9x; *Potentilla pulcherrima* yellow; *Raphanus sativus* bluish-white; *Senecio canus* yellow; *Senecio crassulus* yellow; *Senecio fendleri* yellow 3x; catkin of *Salix planifolia*.

*Pontia sisymbrii* (Boisduval) visits mostly whitish flowers, sometimes other colors, rarely mud: *Arabis fendleri* blue 1x + pinkish-white 1x; *Arabis glabra* pink-purple 4x; *Arabis pycnocarpa* “*hirsuta*” white 2x; Brassicaceae yellow 3x; *Cerastium strictum* “*arvense*” white; *Claytonia rosea* pinkish-white; *Collinsia parviflora* tiny 4 mm blue-white; *Lathyrus leucanthus* white; *Lesquerella montana* yellow; *Lomatium marginatum* yellow or reddish-purple; *Lomatium orientale* white 2x; *Thlaspi arvense* white 18x; *Thlaspi* (*Noccaea*) *fendleri* “*montanum*” white 5x; *Viola nuttallii* yellow 3x; mud.

*Pontia beckerii* (W. Edwards) visits flowers of all colors except perhaps pure red: *Centaurea repens* blue; *Chrysothamnus nauseosus* yellow; *Cleome* (*Peritoma*) *serrulata* pinkish; *Cryptantha* white; *Eriogonum lonchophyllum* white 10x; *Medicago sativa* violet; *Phlox longifolia* lavender; sunflower yellow; tiny white flower.

*Ascia monuste* (Linnaeus): Pinguinca tree.

#### NYMPHALIDAE, LIBYTHEINAE

*Libythea carinenta* (Cramer) usually visits white flowers, often yellow, occasionally visits pink or purple, and rarely visits orange or blue or red or greenish. *Ssp. bachmanii*: Asteraceae yellow shrub; *Boltonia asteroides* white; *Polygonum* ?*pensylvanicum* pink; *Senecio spartioides* yellow; *Solidago* yellow 2x; *Trifolium repens* whitish 6x; mud 4x. *Ssp. larvata*: *Baccharis* whitish; ~*Baccharis sarothroides* whitish very common; *Medicago sativa* violet; tiny white-yellow-flowered tiny-leaf “*Cercocarpus*” common; white flowered shrub similar to *Amelanchier*; white flowering plant; mud 3x. This species represents the basal subfamily of Nymphalidae, so to confirm its color preference I added the following flower visits compiled from Shields (1985), Kawahara and Dirig (2006), Allen (1997), Bailowitz and Brock (1991), Bright and Ogard (2010), Emmel and Emmel (1973), Harris (1972), Iftner et al. (1992), Nielsen (1999), Opler and Krizek (1984), Shapiro (1966), and internet photos: *Ssp. bachmanii*: *Anredera cordifolia* white; *Anredera leptostachys* white; *Apocynum cannabinum* whitish; *Apocynum* whitish 2x; *Asclepias* pink; *Asclepias incarnata* pink; *Asclepias syriaca* pink 2x; *Aster pilosus* white; *Aster vimineus* white; *Aster* white with yellow disc; *Aster* whitish or bluish 2x; *Avicennia germinans* white or yellow; *Baccharis halimifolia* whitish or yellowish; *Berteroa incana* white; *Bidens alba* var. *radiata* white and yellow; *Bidens aristosa* yellow; Brassicaceae yellow; *Buddleja davidii* white; *Bumelia lanuginosa* white; *Centaurea maculosa* purple; *Cephalanthus occidentalis* white; *Chrysanthemum* yellow and pink; *Cicuta maculata* white; *Cirsium arvense* purple 2x; *Cirsium* purple 2x; *Clematis drummondii* white; *Clematis viorna* “*vitalba*” purple?; *Clethra alnifolia* white (pink); *Cordia* white pink or red; *Cornus* white (pinkish) 4x; *Croton* white?; *Daucus carota* white 3x; ?*Dithyrea wislizenii* white; *Erica cinerea* purple; ?*Eriogonum* white; *Eupatorium altissimum* white; *Eupatorium fistulosum* pink or purple; *Eupatorium perfoliatum* whitish; *Eupatorium* white to purple; *Gomphrena globosa* white or red; *Humulus lupulus* cream; *Isocoma acradenia* cream-yellow; Lamiaceae with orange flowers at top; Lamiaceae with white flowers at top; *Lantana* yellow/red; legume yellow; *Ligustrum vulgare* white; *Lobelia cardinalis* red;

?*Lythrum salicaria* pink; *Melilotus alba* white; *Melilotus officinalis* yellow; *Mentha arvensis* white or pink; *Mentha* purplish or white; *Oreganum vulgare* white; *Pastinaca sativa* yellow; *Philadelphus coronarius* white; *Potentilla fruticosa* yellow; *Prunus* (plum) ~whitish; *Prunus americana* white; *Prunus caroliniana* white; *Prunus persica* pink; *Psilostrophe sparsiflora* yellow; *Pycnanthemum tenuifolium* “*flexuosum*” white or purple-dotted; *Rhus copallina* yellow; *Rhus typhina* greenish-white; *Rubus* sp. white 3x; *Rubus idaeus* white; *Rubus* [*Potentilla*?] “*fruticosus*” white; *Salvia guaranitica* purple; *Senecio* yellow; *Solidago* (*Euthamia*) *tenuifolia* yellow; *Sium suave* white; *Solidago* yellow 5x; *Solidago canadensis* yellow; *Sorghum* greenish; *Spiraea latifolia* white or pinkish; *Tilia* sp. ochre; *Tournefortia hirsutissima* white; *Verbena bonariensis* purple; *Verbesina virginica* white; mud 5x; dead wood (for moisture?, Bright and Ogard 2010 p. 219); perspiration salts . Ssp. *larvata*: *Aloysia* white or pink; *Aster* white; *Baccharis glutinosa* white; *Baccharis sarothroides* whitish; *Chrysothamnus* incl. *nauseosus* yellow 3x; *Condalia* yellow; *Eriogonum* sp. cream 2x; *Eysenhardtia polystachya* white; *Eysenhardtia texana* white or yellow; *Heteropogon contortus* greenish grass regularly; *Isocoma acradenia* pale yellow; *Senecio flaccidus* var. *douglasii* yellow; *Senecio* yellow; *Verbesina encelioides* yellow.

#### NYMPHALIDAE, DANAINAE

*Danaus plexippus* (Linnaeus) visits flowers of all colors, rarely even red: *Achillea millefolium* “*lanulosa*” white; *Asclepias incarnata* pink 36x; *Asclepias speciosa* pink 10x; *Asclepias syriaca* pink; *Asclepias tuberosa* orange; *Aster ericoides* white; *Aster lanceolatus hesperius* bluish-white 2x; *Aster novae-angliae* purple 2x; *Aster simplex* whitish 8x; *Buddleja davidii* (violet 5x, purple 2x, white 6x); *Chrysanthemum* ~white; *Chrysothamnus nauseosus* yellow 67x; *Carduus nutans* rose-purple 2x; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple 5x; *Cirsium arvense* purple 10x; *Cirsium* ~*canescens* white; *Cirsium discolor* pinkish-violet 14x; *Cirsium ochrocentrum* rose-purple; *Cirsium parryi* yellowish; *Cirsium vulgare* rose-purple 5x; *Cirsium* prob. rose-purple; *Cleome* (*Peritoma*) *serrulata* pinkish 2x; *Cosmos bipinnatus*; *Dipsacus fullonum* var. *sylvestris* violet-pink 4x; *Echinacea angustifolia* purple; *Echinacea purpurea* purple 4x; *Echinocystus lobata* cream 1 sec.; *Eupatorium maculatum* reddish 5x; *Eupatorium rugosum* white 2x; *Helianthus annuus* yellow 2x; *Helianthus tuberosus* yellow 3x; *Liatris punctata* purplish 3x; *Lonicera tatarica* pink; ?*Machaeranthera bigelovii* blue; *Medicago sativa* violet 13x; *Pastinaca sativa* yellow; *Phlox paniculata* (pink 5x, white 2x); *Phlox pilosa* ~pinkish; *Polygonum amphibium coccineum* pink 2x; *Ratibida columnifera* yellow; *Senecio* ~*pauperculus* yellow, leaves coarsely serrate; *Senecio spartioides* yellow 4x; *Solidago* yellow; *Solidago* ~*altissima* “~*canadensis*” yellow 2x; *Solidago* (*Euthamia*) *occidentalis* yellow 4x; *Solidago rigida* yellow; *Sonchus uliginosus* yellow 2x; sunflower big yellow; *Symphoricarpos* ~*occidentalis* pink; *Tagetes patula* orange 1x (+ another 3 sec.); *Taraxacum officinale* yellow 4x; *Trifolium pratense* red-purple 14x; *Verbena* “Purple Top” purplish-blue; *Verbena hastata* purple 3x; ~*Vicia* tall skinny “wild pea” ?blue or purple; *Zinnia elegans* (?pink 1x, pink 1x); mud. Wikipedia adds these flowers: *Apocynum cannabinum* whitish; *Asclepias californica* purplish; *Daucus carota* white; *Conyza canadensis* whitish; *Eupatorium perfoliatum* white; *Hesperis matronalis* pink; *Syringa vulgaris* pink-purple; *Vernonia altissima* purple.

*Danaus gilippus* (Cramer) visits flowers of all colors: *Apocynum cannabinum* whitish; *Asclepias incarnata* pink 2x; *Asclepias speciosa* pink 4x; *Asclepias tuberosa* orange; *Aster laevis* var. *geyeri* blue; Asteraceae yellow shrub; *Baccharis* whitish; ~*Baccharis sarothroides* whitish 4x; *Carduus nutans* rose-purple; *Chrysothamnus nauseosus* yellow; *Cirsium arvense* purple; *Clematis* white; *Medicago sativa* violet; *Rudbeckia hirta* yellow; *Tamarix chinensis*=*ramosissima* rosy-white; yellow-flowered tiny-leaf “*Cercocarpus*”; white flowering plant; mud 6x.

#### NYMPHALIDAE, SATYRINAE

Many Satyrinae seldom visit flowers, but *Coenonympha*, *Cercyonis*, and *Erebia* often visit flowers.

*Lethe anthedon* A. Clark: female probed dirt for moisture.

*Lethe eurydice fumosus* (Leussler) seldom visits flowers, but when it does it seems to prefer pink *Asclepias*, no doubt in part because they are frequent in its moist habitat: *Asclepias syriaca* pink 4x including male with pollinia on leg; *Asclepias incarnata* pink or *A. syriaca* pollinia on leg of 2 males (one had 3 pollinia

on each middle leg); *Asclepias incarnata* pink 6x including pollinia on leg of 3 adults; *Asclepias speciosa* pink; *Cirsium arvense* var. *incanum* purple 6x; *Nasturtium officinale* white; probing red ribbon with proboscis; dung; mud.

*Coenonympha haydenii* (W. Edwards): *Achillea millefolium* "lanulosa" white; *Senecio* yellow.

*Coenonympha tullia* (Müller) visits almost only yellow or sometimes white flowers, rarely pink or orange etc.

*Coenonympha tullia ochracea* W. Edwards: *Antennaria parvifolia* whitish 8x; *Arnica rydbergii* yellow; *Astragalus laxmannii* "adsurgens" white; *Barbarea orthoceras* yellow 3x; *Ceanothus fendleri* white 3x; *Cerastium ~strictum* "arvense" white 12x; *Chrysothamnus nauseosus* yellow; *Cryptantha jamesii* white; *Erigeron divergens* rose-purple to white 2x; *Erigeron pumilus* 4x (+ 2x bluish-white + 4x white); *Eriogonum subalpinum* [pinkish]-cream; *Eriogonum umbellatum* yellow 6x; *Erysimum capitatum* orange; *Geranium caespitosum* pink; *Harbouria trachypleura* yellow 5x; *Helianthus?* yellow; *Heterotheca villosa* yellow 5x; *Hymenopappus filifolius* yellow 3x; *Lesquerella montana* yellow 7x; *Potentilla fissa* yellow; *Potentilla gracilis* yellow; *Prunus virginiana* white; *Purshia tridentata* pale-yellow; *Rubus deliciosus* white; *Sedum lanceolatum* yellow 27x; *Senecio* yellow; *Senecio canus* yellow 2x plus one only ½ sec.; *Senecio ~dimorphophyllus* yellow; *Senecio fendleri* yellow 15x; *Senecio streptanthifolius* yellow; mud 4x.

*Coenonympha tullia* ssp: Ssp. *california* Westwood: *Achillea millefolium* "lanulosa" white 5x; Asteraceae small yellow common; Asteraceae shrub yellow; *Brassica nigra* yellow 23x; orange flower; *Ranunculus* sp. yellow buttercup 2x; Rosaceae shrub white; *Wyethia helenoides* yellow 3x. Ssp. *ampelos* W. Edwards: *Eriogonum compositum* cream "dense *Eriogonum* vaguely like *effusum*" few. Ssp. *inornata* W. Edwards: *Achillea millefolium* "lanulosa" white.

*Cyllopsis pertepida* (Dyar) never visits flowers. A female was seen on sap of *Salix*, a male on dry cow manure, one on mud.

*Cercyonis pegala* (Fabricius) visits flowers of all colors, in contrast with *C. oetus*, and they particularly often visit sap: *Apocynum androsaemifolium* pinkish-white 5x (male proboscis caught by stamens on one); *Apocynum cannabinum* whitish 8x; *Asclepias speciosa* pink; *Aster ascendens* usually bluish; *Aster ericoides* white; *Aster laevis* var. *geyeri* blue 4x; *Aster lanceolatus hesperius* bluish-white; *Aster porteri* white 5x; *Carduus nutans* rose-purple 4x; "*Cirsium vulgare*" probably *Carduus nutans* rose-purple 16x; *Centaurea diffusa* (lavender 5x, white 8x); *Chrysothamnus nauseosus* yellow 15x; *Cirsium arvense* purple 34x + var. *incanum* 5x; *Cirsium undulatum* rose-purple; *Cirsium vulgare* rose-purple; *Clematis ligusticifolia* white 8x; *Cleome (Peritoma) serrulata* pinkish 2x; *Dipsacus fullonum* var. *sylvestris* white to lilac; *Echinacea angustifolia* purple; *Erigeron speciosus* blue 4x; *Eriogonum effusum* white 2x; *Gaillardia aristata* yellow with red-purple base; *Geranium caespitosum* pink 6x; *Heterotheca villosa* yellow 2x; *Liatris punctata* purplish 18x; *Lobelia siphilitica* violet-blue 2x; *Lythrum salicaria* purple 3x; *Medicago sativa* violet 110x; *Mentha arvensis* pink-violet 4x; *Monarda fistulosa* rose-purple 89x; *Nasturtium officinale* white Janet Chu; *Nepeta cataria* white 8x; *Pericome caudata* yellow 4x; *Rhus glabra* whitish or greenish-yellow; *Rosa* pink 2" flower 1 sec.; *Rudbeckia hirta* yellow 2x; *Rudbeckia laciniata ampla* yellow; *Solidago ~altissima* "*~canadensis*" yellow 21x; *Solidago ~missouriensis* yellow 7x; *Symphoricarpos ~occidentalis* pink several; *Tamarix chinensis*=*ramosissima* rosy-white 30x; *Verbena hastata* purplish-blue; *Verbena stricta* purplish-blue; sucking berries *Rubus deliciosus*; rotten fruit (bananas-peaches) 7x; sap of *Ulmus pumila* 83x; sap of *Salix amygdaloides* 3x; dung 3x incl. horse; urine; mud 6x.

*Cercyonis sthenele behrii* F. Grinnell: ?*Eriodictyon californicum* white to lavender .

*Cercyonis sthenele masoni* Cross: *Chrysothamnus nauseosus* yellow 12x.

*Cercyonis meadii meadii* (W. Edwards) mostly visits white or yellow flowers, sometimes pink or purple ones: *Achillea millefolium* "lanulosa" white 2x (+ once only ½ sec.); *Aster porteri* white 34x; Asteraceae shrub yellow 6x; *Chrysothamnus nauseosus* yellow 4x; *Cirsium arvense* purple (1x, var. *incanum* 1x); *Geranium caespitosum* pink only ½ sec.; *Grindelia squarrosa* yellow (two for only 1 sec.); *Heterotheca villosa* yellow 350x; *Senecio spartioides* yellow (2x, but ignored it 3x); *Solidago missouriensis* yellow 2x; mud 3x and probed ground and cones etc. after a slight rain.

*Cercyonis meadii alamosa* T. Emmel and J. Emmel: *Chrysothamnus nauseosus* yellow 29x.



*Cercyonis oetus charon* (W. Edwards) usually visits yellow flowers, often white, seldom pink or blue/purple.

It seldom visits *Medicago sativa* because it occurs in natural habitats, whereas *Cercyonis pegala* often occurs in human-disturbed habitats and often visits *M. sativa*: *Achillea millefolium* “lanulosa” white 4x; *Anaphalis margaritacea* whitish; *Apocynum androsaemifolium* pinkish-white 3x; *Arnica mollis* yellow ~20x; *Aster ascendens* blue 4x; *Aster ericoides* var. *falcatus* white; *Aster laevis* var. *geyeri* blue 23x incl. Janet Chu; *Aster porteri* white 50x; *Berteroa incana* white 23x; *Ceanothus fendleri* white 2x; *Centaurea diffusa* white 31x; *Chrysothamnus nauseosus* yellow 32x; *Cirsium arvense* (purple 16x, white 1x, var. *incanum* purple 3x); “*Cirsium vulgare*” probably *Carduus nutans* rose-purple; *Clematis ligusticifolia* white 12x; *Erigeron* ~*glabellus* blue hairy; *Erigeron pumilus* usually white; *Erigeron speciosus* blue 34x; *Erigeron ursinus* blue-purplish; *Eriogonum flavum* yellow 19x; *Eriogonum jamesii* cream 2x; *Eriogonum subalpinum* [pinkish]-cream; *Eriogonum umbellatum* yellow 19x incl. Janet Chu; *Geranium caespitosum* pink 2x; *Grindelia squarrosa* yellow Janet Chu; *Gutierrezia sarothrae* yellow; *Heterotheca villosa* yellow 148x (they prefer *Aster porteri*); Lamiaceae (for *Cercyonis oetus oetus*); *Medicago sativa* violet; *Melilotus alba* white 2x; *Melilotus officinalis* yellow; *Mentha arvensis* pink 10x; *Monarda fistulosa* rose-purple (proboscis must be too small for this); *Potentilla fruticosa* yellow 4x; *Rudbeckia hirta* yellow 12x; *Rudbeckia laciniata ampla* yellow 40x; *Senecio* yellow; *Sisymbrium altissimum?* yellow; *Solidago altissima* “canadensis” yellow 14x; *Solidago missouriensis* yellow 3x; *Solidago nana* yellow sprawling low mat 6x; *Solidago* yellow; *Tetradymia canescens* yellow 6x; *Viguiera* (*Heliomeris*) *multiflora* yellow 3x; fruit bait (visited by female); carrion (dead deer leg) 3x; dung horse; mud 30x.

*Gyrocheilus patrobas* (Hewitson): mud 2x.

*Erebia magdalena magdalena* Strecker visits low flowers of most colors based on few observations: *Dryas octopetala* white; *Erigeron simplex* usually blue; *Haplopappus* (*Tonestus*) *pygmaeus* yellow; *Silene acaulis* pink/purplish 11x.

*Erebia epipsodea* Butler prefers white and yellow flowers, and sometimes visits pink or bluish etc. colors: *Achillea millefolium* “lanulosa” white 2x; *Agoseris glauca* yellow 2x; *Allium geyeri* violet; *Arnica cordifolia* yellow 3x; *Arnica mollis* yellow 21x (incl. 2 *E. epipsodea* form *brucei*); *Arnica rydbergii* yellow 9x; *Aster foliaceus* var. *apricus* purple 2x (for form *brucei*); *Barbarea orthoceras* yellow 12x; *Caltha* “*Psychrophila*” *leptosepala* white; *Cerastium strictum* “arvense” white 5x; *Cryptantha virgata* white; *Erigeron pumilus* bluish-white 1x; *Erigeron ursinus* blue-purplish 14x (including 5x for form *brucei*); *Eriogonum subalpinum* [pinkish]-cream 4x; *Euphorbia esula* yellow-green; *Geranium richardsonii* white 2x; *Helianthus pumilus* yellow; *Jamesia americana* white; *Leucocrinum montanum* white; *Medicago sativa* violet; *Physocarpus monogynus* white; *Polygonum bistortoides* whitish 3x; *Rubus idaeus melanolasius* white; *Saxifraga* (*Micranthes*) *rhomboidea* white; *Sedum lanceolatum* yellow 3x; *Sedum roseum integrifolium* dark-rose-purple; *Senecio atratus* yellow 2x (including form *brucei* 1x); *Senecio canus* yellow 2x; *Senecio crassulus* yellow 32x (incl. form *brucei* 2x); *Senecio dimorphophyllus* yellow 2x; *Senecio fendleri* yellow; *Senecio fremontii* var. *blitoides* yellow 4x (incl. form *brucei* 1x); *Senecio integerrimus* yellow; *Senecio triangularis* yellow 4x (incl. form *brucei* 1x); *Solidago multiradiata* yellow; *Symphoricarpos rotundifolius* pink 7x; *Taraxacum officinale* yellow 3x; mud 4x.

*Erebia stubbendorffii* “theano” *ethela* W. Edwards visits were mostly to yellow or white flowers, some to pink or red-purple ones: *Achillea millefolium* “lanulosa” white 4x; *Epilobium* (*Chamerion*) *danielsi*=*angustifolium* red-purple 2x; *Sedum lanceolatum* yellow 8x; *Solidago simplex* var. *nana*=*decumbens* yellow 60x; sunflower yellow two species. *E. stubbendorffii* “theano” *demmia* visits: *Sedum rhodanthum* pink; *Senecio dimorphophyllus* yellow.

*Erebia callias* W. Edwards frequents mud, and usually visits yellow flowers, sometimes white or blue/purple ones: *Achillea millefolium* “lanulosa” white; *Agoseris glauca dasycephala* yellow; *Arnica cordifolia* yellow; *Arnica mollis* yellow; *Erigeron melanocephalus* (black phyllaries) white; *Erigeron pinnatisectus* blue/purple 3x; “*Aster*” probably *Erigeron ursinus* blue-purplish blue; *Heterotheca pumila* yellow; *Hymenoxys grandiflora* yellow 2x (one male of these covered with pollen); *Potentilla* ~*diversifolia* yellow; *Sedum lanceolatum* yellow 7x; *Senecio canus* yellow; “*aster*” prob. *Senecio* yellow; *Solidago simplex* var. *nana*=*decumbens* yellow; dung many; mud 67x.

*Neominois ridingsii* (W. Edwards) seldom visits flowers (yellow, often white, sometimes cream) (Scott 1973d studied this species): *Achillea millefolium* “lanulosa” white 2x; *Astragalus miser* white; *Chrysothamnus nauseosus* yellow 3x; *Cryptantha jamesii* white; *Eriogonum flavum* yellow-cream 2x; *Eriogonum lonchophyllum* white 6x; *Eriogonum subalpinum* [pinkish]-cream; *Eriogonum umbellatum* yellow; *Helianthus pumilus* yellow 3x; *Heterotheca villosa* yellow 5x; *Hymenopappus filifolius* yellow 4x; *Hymenoxys (Tetranuris) acaulis* yellow; *Melilotus alba* white; *Penstemon albidus* white with violet guide lines; *Sedum lanceolatum* yellow; *Senecio* small yellow.

*Neominois ridingsii wyomingo* Scott: *Chrysothamnus nauseosus* yellow 5x; *Heterotheca villosa* yellow.

*Oeneis* visit flowers infrequently:

*Oeneis uhleri* (Reakirt) visits yellow and whitish flowers, and frequents mud: *Eriogonum subalpinum* [pinkish]-cream 2x; *Prunus virginiana* white 2x; *Senecio fendleri* yellow 3x; *Thermopsis divaricarpa* yellow; mud 215x incl. females (10 flew down-valley to seek mud).

*Oeneis chryxus* (E. Doubleday) prefers yellow and white flowers, and often visits mud: *Aletes acaulis* yellow; *Aletes anisatus* yellow; *Allium textile* white to light-rose; *Antennaria parvifolia* whitish; *Arnica mollis* yellow; *Ceanothus fendleri* white; *Eriogonum umbellatum* yellow ~5x 12 minutes; *Helianthus pumilus* yellow 3x; *Heracleum sphondylium montanum=lanatum* white; *Jamesia americana* white; *Rudbeckia hirta* yellow 4x; *Rudbeckia laciniata ampla* yellow; *Sedum lanceolatum* yellow 3x; *Senecio canus* yellow 3x; *Senecio fendleri* yellow 4x; mud 17x (incl. 5 females).

*Oeneis calais altacordillera* Scott visits yellow and white flowers, sometimes blue-purplish, and often visits mud: *Achillea millefolium* “lanulosa” white 3x (+ two 1/3 sec., and several a few sec.); *Antennaria parvifolia* white 5 sec.; *Arnica cordifolia* yellow 3x; *Arnica rydbergii* yellow 2x; *Erigeron ursinus* blue-purplish 4x; *Eriogonum subalpinum* [pinkish]-cream often; *Heterotheca pumila* yellow 2x; *Potentilla fruticosa* yellow; *Sedum lanceolatum* yellow 3x; *Senecio atratus* yellow 5x; *Senecio crassulus* yellow 2x; *Solidago simplex* var. *nana=decumbens* yellow 2x; *Taraxacum officinale* yellow 12x; mud 2x (both were females visiting 3 min. and a minute).

*Oeneis calais ivallda* (Mead): male covered with yellow pollen evidently from Asteraceae.

*Oeneis alberta* Elwes: mud abundant ~50x (Scott and Scott 1978).

*Oeneis bore taygete* Geyer (ssp. *edwardsi* dos Passos): sunflower yellow.

*Oeneis jutta* (Hübner): *Arnica mollis* yellow sucking it from below; *Geranium caespitosum* pink.

*Oeneis melissa lucilla* W. Barnes and McDunnough: no observations! They rarely feed on flowers.

*Oeneis polixenes brucei* (W. Edwards) visits white and yellow flowers: *Arenaria (Eremogone) fendleri* white; *Dryas octopetala* white 2x; *Haplopappus (Tonestus) pygmaeus* yellow.

*Lasiommata megera* Linnaeus (Europe): “*Epilobium*”-like.

#### NYMPHALIDAE, CHARAXINAE

*Anaea andria* Scudder never feeds on flowers, but visits mud sometimes, and often visits *Salix* [probably *amygdaloides*] sap 3x and *Populus [deltoides monilifera]* sap 3x (Scott and Scott 1978).

#### NYMPHALIDAE, NYMPHALINAE, LIMENITIDINI

*Limenitis archippus* (Cramer) visits pink, whitish, yellowish, and purple flowers: *Asclepias incarnata* pink; *Asclepias syriaca* pink; *Bidens cernua* yellowish; *Cleome (Peritoma) serrulata* pinkish 2x; *Echinacea angustifolia* purple; *Polygonum pennsylvanicum* pink; *Tamarix chinensis=ramosissima* rosy-white.

*Limenitis arthemis* (Drury): Ssp. *arizonensis* W. Edwards white flowering plant. Ssp. *astyanax* (Fabricius): fruit of *Aesculus glabra* var. *arguta*; mud.

*Limenitis weidemeyerii* W. Edwards feeds on all colors of flowers and also often visits sap and mud etc.: *Apocynum androsaemifolium* pinkish-white 16x; *Asclepias speciosa* pink many pollinia on leg; *Aster laevis* var. *geyeri* blue 2x; *Buddleja davidii* violet; *Carduus nutans* rose-purple 2x; *Ceanothus fendleri* white 2x; *Chrysothamnus nauseosus* yellow; *Clematis ligusticifolia* white; *Conium maculatum* white; *Helianthus petiolaris* yellow?; *Heracleum sphondylium montanum=lanatum* white (photo in “Colorado’s Best Wildflower Hikes. The Front Range” 1998); *Jamesia americana* white 3x; *Lupinus argenteus* blue fed on; *Medicago sativa* violet; *Monarda fistulosa* rose-purple 3x; *Oxypholis fendleri* white; *Physocarpus*

*monogynus* white 6x; *Rhus glabra* greenish flowers 2x; *Rudbeckia hirta* yellow; *Senecio spartioides* yellow; *Senecio triangularis* yellow; *Solidago ~altissima* “~*canadensis*” yellow; *Tilia europaea* ochre; *Crataegus erythropoda* immature fruit; sap of *Populus tremula tremuloides* upside down on; sap of *Salix amygdaloides* 3x; sap probed *Quercus gambelii* and *Pseudotsuga menziesii* twigs for sap; coccids white (sucking something from fungus-infested [orange-yellow spots] leaf of *Crataegus macracantha* that had curled edge and white coccids in curl of underside); “carrion” sucking inside of a dead pupa; dung of coyote Janet Chu; mud 10x incl. female.

*Limenitis lorquini* Boisduval: *Eriodictyon* white to lavender; *Heracleum sphondylium montanum=lanatum?* white.

*Adelpha eulalia* (E. Doubleday): white flowering plant; mud 73x.

*Adelpha californica* (Butler): My few records were mostly on whitish flowers, although Shapiro (2007) records it on reddish/blue *Cirsium/Carduus/Silybum*, and notes that it prefers sap, rotting fruit, dung, and carrion. *Aesculus californica* whitish 3x; *Asclepias speciosa* pink; *Baccharis salicifolia* whitish; *Eriodictyon* white to lavender; aphid honeydew.

#### NYMPHALIDAE, NYMPHALINAE, HELICONIINI

*Dione vanillae* (Linnaeus): *Asclepias pollinia* on leg; *Cirsium vulgare* rose-purple; *Clematis* white; Lamiaceae red.

*Euptoieta claudia* (Cramer) visits all colors: *Agoseris glauca* yellow; *Allium textile* white to light-rose 2x; *Apocynum androsaemifolium* pinkish-white; *Arctium minus* rose-purple; *Arnica [cordifolia or fulgens]* yellow 2x Anne U. White and Janet Chu; *Asclepias speciosa* pink 1 sec. then 1 sec. (proboscis too short?); *Aster ericoides* white; *Aster lanceolatus hesperius* bluish-white; *Aster porteri* white 2x; *Bahia dissecta* yellow; *Bidens cernua* yellowish 2x; *Carduus nutans* rose-purple 5x; *Centaurea diffusa* white; *Centaurea maculosa* lavender 2x; *Chaenactis alpina* white; *Chrysothamnus nauseosus* yellow 25x; *Cirsium arvense* purple 8x; *Comandra umbellata* whitish 2x; *Convolvulus arvensis* whitish 3x + 2x briefly; *Cosmos sulphureus* coppery; *Cryptantha jamesii* white 3x; *Cryptantha virgata* white; *Delphinium ajacis* violet; *Echinacea purpurea* purple 3x; *Erigeron pumilus* 3x (+ 1x bluish-white, 1x white); *Erigeron ursinus* blue-purplish; *Eriogonum effusum* white 2x; *Eriogonum flavum* yellow-cream 3x; *Erysimum asperum* yellow 5x; *Erysimum ~capitatum* yellow, orange 2x; *Euphorbia “Agaloma” marginata* green and white ½ sec.; *Gaillardia aristata* yellow with red-purple base 11x incl. Janet Chu; *Gaura coccinea* white, pink, or red 2x; *Geranium caespitosum* pink; *Grindelia squarrosa* yellow 6x incl. Janet Chu (but one approached it but did not land); *Gutierrezia sarothrae* yellow 4x; *Harbouria trachypleura* yellow 2 sec; *Helianthus pumilus* yellow 6x; *Helianthus tuberosus* yellow 3x; *Heterotheca canescens* yellow 2x; *Heterotheca pumila* yellow; *Heterotheca villosa* yellow 20x incl. Janet Chu; *Hymenopappus filifolius* yellow 2x; *Lesquerella montana* yellow 3x; *Liatris punctata* purplish 15x; *Linaria genistifolia dalmatica* yellow and redder at apex ½ sec; *Linum lewisii* blue; *Lobelia siphilitica* violet-blue 12x; *Machaeranthera pattersoni* purple/violet; *Medicago sativa* violet 24x; *Melilotus alba* white; *Monarda fistulosa* rose-purple (hanging below flower maybe caught by predator); *Paeonia lactiflora* white and yellow-centered; *Penstemon secundiflorus* purple ½ sec; *Physocarpus monogynus* white 3x; *Polygonum amphibium coccineum* pink; *Psilostrophe sparsiflora* yellow-flower shrub 30 cm tall with gray-green leaves and 3 rectangular petals with ~3 lobes at end 5x; *Psoralea tenuiflora* blue-purple; *Ratibida pinnata* yellow; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow; *Salvia farinacea* purple-blue; *Sedum lanceolatum* yellow 11x; *Senecio canus* yellow 2x; *Senecio fendleri* yellow 9x; *Senecio spartioides* yellow; small primrose violet; *Solidago missouriensis* yellow; *Tagetes patula* orangish 3x; *Taraxacum officinale* yellow 20x + one only 1 sec.; *Thlaspi (Noccaea) fendleri “montanum”* white; *Townsendia grandiflora* bluish-white; *Trifolium pratense* red-purple 4x; *Trifolium repens* whitish; *Verbena* purple; *Verbena stricta* purplish-blue; *Viola nuttallii* yellow 5x; *Zinnia grandiflora* 5-10 cm roadside yellow-with-orange-center sunflowers; mud 6x.

*Euptoieta hegesia* (Cramer): *Zinnia ~elegans* ?pink several.

*Argynnis (Speyeria) cybele* (Fabricius) visits pinkish and purplish flowers, sometimes blue yellow white etc. Ssp. *cybele*: *Asclepias incarnata* pink; *Asclepias speciosa* pink pollinia on leg; *Asclepias syriaca* pink 4x;

*Buddleja davidii* pink (This Old House TV show); *Carduus nutans* rose-purple 3x; *Echinacea purpurea* purple (This Old House TV show); *Trifolium hybridum* pinkish-white; mud 2x. Ssp. *leto* (Behr): *Cirsium neomexicanum* ~pink-cream; *Medicago sativa* violet 24x; *Monarda* ~rose-purple. Ssp. *carpenterii* (W. Edwards): sunflower yellow. Ssp. *charlottii* (W. Barnes): *Agastache urticifolia* pinkish; *Cirsium ~centaureae* yellowish-white; *Cirsium undulatum* rose-purple; *Helianthus ~petiolaris* yellow; *Erigeron speciosus* blue; *Nepeta cataria* white; sap sugary viscous stuff on *Quercus gambelii* leaves.

*Argynnis (Speyeria) aphrodite* (Fabricius). Ssp. *whitehousei* (Gunder) = *ethne* (Hemming) greatly prefers rose-purple *Monarda fistulosa*, and otherwise visits all colors (even orange and reddish) esp. purplish: *Achillea millefolium* “*lanulosa*” white 2x; *Agoseris glauca* yellow; *Apocynum androsaemifolium* pinkish-white 29x; *Arctium minus* rose-purple 7x; *Asclepias speciosa* pink 4x (one has pollinia on leg); *Asclepias tuberosa* orange; *Aster laevis* var. *geyeri* blue 11x; *Aster porteri* white 3x; *Buddleja davidii* white 3x; *Carduus nutans* rose-purple 73x; *Ceanothus fendleri* white; *Centaurea diffusa* (lavender 6x, white 2x); *Chrysothamnus nauseosus* yellow 45x; *Cirsium arvense* purple 12x + var. *incanum* 4x; *Cirsium canescens* whitish; *Cirsium undulatum* rose-purple; *Cirsium vulgare* rose-purple 5x; *Cleome (Peritoma) serrulata* pinkish?; *Dipsacus fullonum* var. *sylvestris* white to lilac Anne U. White; *Echinacea purpurea* purple 2x; *Epilobium (Chamerion) danielsi*=~*angustifolium* red-purple; *E. (C.) danielsi* (or *leptophyllum*?) red-purple; *Erigeron speciosus* blue; *Eriogonum effusum* white; *Eriogonum flavum* yellow; *Eriogonum umbellatum* yellow some; *Erysimum ~capitatum* yellow; *Eupatorium maculatum* reddish; *Gaillardia aristata* yellow with red-purple base 19x; *Geranium caespitosum* pink 2x; *Grindelia squarrosa* yellow; *Heterotheca villosa* yellow 5x; *Jamesia americana* white; *Liatris ligulistylis* purplish; *Liatris punctata* purplish 54x; *Machaeranthera canescens* deep blue/purple; *Machaeranthera pattersoni* purple/violet; *Medicago sativa* violet 4x; *Monarda fistulosa* rose-purple 608x; *Nepeta cataria* white; *Rhus aromatica trilobata* yellowish repeatedly flying into it, perhaps getting sap on seed bunches Janet Chu; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow 9x; *Sedum lanceolatum* yellow 3x; *Senecio fendleri* yellow; *Solidago altissima* “*canadensis*” yellow; *Solidago missouriensis* yellow 2x; *Symphoricarpos ~occidentalis* pink; *Trifolium pratense* red-purple 11x (one only 1 sec.); *Verbena* bluish-purple Janet Chu; *Verbena stricta* purplish-blue 5x; *Verbesina encelioides* golden-orange; *Zinnia ~elegans* orange; carrion (dead deer); dung of dog and horse; sap of *Salix amygdaloides*; mud 7x. Ssp. *byblis*: *Cirsium ~centaureae* yellowish-white.

*Argynnis (Speyeria) nokomis* (W. Edwards) (mostly ssp. *nokomis*) evidently visits all colors of flowers, plus mud: *Arctium minus* rose-purple 2x; *Aster novae-angliae* purple 3x; blue Lamiaceae; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple 34x; *Chrysothamnus nauseosus* yellow 11x; *Cirsium ~canescens* white 6x; *Cirsium vulgare* rose-purple 64x; *Cirsium* prob. rose-purple; *Cirsium* tall whitish-blue; *Cleome (Peritoma) serrulata* pinkish; *Dipsacus fullonum* var. *sylvestris* white to lilac 2x; *Helianthus annuus* yellow 2x; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow; *Trifolium pratense* red-purple 8x; yellow sunflower (perhaps *Helenium autumnale* which is frequent in *nokomis* meadows) 2x; mud visit by female. Ssp. near-*apacheana* (Skinner): *Cirsium* 2x.

*Argynnis (Speyeria) idalia* (Drury) visits all colors, based on few observations: *Asclepias syriaca* pink; *Carduus nutans* rose-purple often; *Cirsium undulatum* pale-purple 6x; *Echinacea angustifolia* purple 2x; *Lobelia siphilitica* violet-blue. *Asclepias* and *Cirsium* are favorites. Dunford (2007) compiled the following nectar sources: *Apocynum* pinkish-white; *Asclepias syriaca* pink; *A. tuberosa* orange 2x; *Centaurea maculosa* white to purple; *Chrysanthemum leucanthemum* white; *Cirsium discolor* light-purplish; *Cirsium pumilus* purple; *Coronilla varia* yellow; *Dianthus armeria* roseate dotted with white; *Echinacea purpurea* purple; *Liatris punctata* purple; *Liatris pycnostachya* purple; *Medicago sativa* violet; *Monarda fistulosa* pink; “black sampson” (?*Psoralea psoraloides* lilac-purple); *Rudbeckia hirta* yellow; *Rubus* blackberry white. Opler and Krizek (1984) reported: *Asclepias sullivantii* purplish to whitish; *Pycnanthemum* whitish or purplish; *Trifolium pratense* red-purple.

*Argynnis (Speyeria) mormonia eurynome* (W. Edwards) visits flowers of all colors (even part-red) but usually yellow, and mud: *Achillea millefolium* “*lanulosa*” white 2x; *Agoseris aurantiaca* burnt-orange 4x; *Agoseris glauca* yellow 5x and var. *parviflora* 1x; *Arenaria (Eremogone) fendleri* white; *Arnica cordifolia* yellow 3x; *Arnica mollis* yellow 74x; *Arnica parryi* (rayless) yellow 2x; *Arnica rydbergii*

yellow 14x; *Aster foliaceus* var. *apricus* purple 2x; *Aster laevis* var. *geyeri* blue; *Carduus nutans* rose-purple; *Chrysothamnus nauseosus* yellow 2x; cushion plant blue flower; *Dryas octopetala* white; *Erigeron coulteri* white; *Erigeron elatior* pink-purple 3x; *Erigeron simplex* blue; *Erigeron speciosus* blue 16x; *Erigeron ursinus* blue 69x; *Eriogonum subalpinum* cream; *Gaillardia aristata* yellow with red-purple base; *Geranium richardsonii* white; *Haplopappus (Oreochrysum) parryi* yellow 20x; *Haplopappus (Tonestus) lyallii* yellow; *Heterotheca pumila* yellow 32x; *Hymenoxys grandiflora* yellow 2x; *Hymenoxys (Tetraneuris) brevifolia* yellow; *Medicago sativa* violet 2x; *Potentilla pulcherrima* yellow 3x; *Rudbeckia hirta* yellow 2x; *Senecio atratus* yellow 13x; *Senecio canus* yellow; *Senecio crassulus* yellow 9x; *Senecio dimorphophyllus* yellow 3x; *Senecio fremontii* var. *blitoides* yellow 2x; *Senecio integerrimus* yellow 19x; *Senecio pseud aureus* orange-red; *Senecio triangularis* yellow 27x; *Senecio* yellow 4x; *Solidago ~altissima* “~canadensis” yellow; *Solidago multiradiata* yellow; *Solidago simplex* var. *nana=decumbens* yellow 6x (one after passing over 10 *Achillea millefolium* “lanulosa” white); sunflower yellow; *Taraxacum officinale* yellow 13x; *Trifolium pratense* red-purple; *Trifolium repens* whitish 9x; mud.

*Argynnis (Speyeria) mormonia luski* (W. Barnes and McDunnough): *Cirsium ?arvense* small blue head; *Rudbeckia hirta* yellow.

*Argynnis (Speyeria) hydaspe rhodope* (W. Edwards) probably visits all colors and mud like other *Argynnis (Speyeria)*: *Aster glaucodes* white to violet 2x; *Heterotheca villosa* yellow; Lamiaceae some; *Senecio integerrimus* yellow 2x; *Senecio* yellow 3x; thistles ?purple Ore.; mud.

*Argynnis (Speyeria) callippe* (Boisduval) visits yellow and white flowers especially, often purplish, and sometimes reddish and orange and violet ones, and visits mud. Ssp. *meadii* (W. Edwards): *Achillea millefolium* “lanulosa” white; *Agastache urticifolia* pink 2x; *Agoseris aurantiaca* orange; *Allium textile* white to light-rose; *Apocynum androsaemifolium* pinkish-white 57x; *Aster glaucodes* white to violet 3x; Asteraceae yellow; *Berberis (Mahonia) repens* yellow; Brassicaceae yellow 2x; *Carduus nutans* rose-purple 18x; *Ceanothus fendleri* white 4x; *Centaurea diffusa* white; *Cirsium arvense* purple 5x; *Cirsium canescens* whitish; *Cirsium ochrocentrum* rose-purple; *Cirsium scariosum=coloradense* whitish; *Cirsium ?undulatum* purple; *Clematis ligusticifolia* white 3x; *Crepis acuminata* yellow; *Erigeron pumilus* usually white; *Eriogonum flavum* yellow 20x; *Eriogonum subalpinum* [pinkish]-cream 4x; *Eriogonum umbellatum* yellow 8x; *Erysimum asperum* yellow; *Erysimum capitatum* (yellow 2x, orange 9x); *Gaillardia aristata* yellow with red-purple base 14x; *Geranium caespitosum* pink; *Grindelia squarrosa* yellow; *Harbouria trachypleura* yellow; *Helianthus ~petiolaris* yellow ~10x; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow 21x; *Jamesia americana* white 10x; *Medicago sativa* violet; Lamiaceae; *Monarda fistulosa* rose-purple 22x; *Nepeta cataria* white; *Oxytropis lambertii* reddish-purple; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow 33x; *Sedum lanceolatum* yellow 27x; *Senecio canus* yellow 2x; *Senecio fendleri* yellow 5x (incl. much pollen on body); *Senecio triangularis* yellow; *Senecio* yellow; *Solidago altissima* “canadensis” yellow 2x; *Symphoricarpos albus* pink; *Trifolium repens* whitish; spit of human; mud 12x. Ssp. *nevadensis* (W. Edwards): *Eriogonum lobbii* var. *robustius* cream. Ssp. *calgariana* (McDunnough): *Arnica mollis* yellow; *Cirsium centaureae* yellowish-white; *Eriogonum subalpinum* [pinkish]-cream. Ssp. *shasta* J. Emmel, T. Emmel, and Mattoon: *Calyptidium umbellatum* white 2x; Lamiaceae. Ssp. *juba* (Boisduval): *Calyptidium umbellatum* white some. Ssp. near-*callippe*: Lamiaceae; *Eriodictyon* white to lavender.

*Argynnis (Speyeria) atlantis sorocko* Scott, Kondla and Spomer visits yellow flowers the most, often white or purple ones, occasionally all other colors: *Achillea millefolium* “lanulosa” white; *Agastache urticifolia* pinkish; *Agoseris aurantiaca* orange; *Agoseris glauca* yellow 19x; *Apocynum androsaemifolium* pinkish-white; *Arnica mollis* yellow; *Aster foliaceus* purple; *Cirsium canescens* whitish; ~*Cirsium centaureae* “thistle” low white; *Erigeron speciosus* blue 2x; *Galium ~septentrionale* white; *Heterotheca villosa* yellow; *Monarda fistulosa* rose-purple; *Potentilla gracilis* yellow; *Rudbeckia hirta* yellow 31x; *Rudbeckia laciniata ampla* yellow 6x; *Senecio triangularis* yellow ~4x; *Taraxacum officinale* yellow 2x; *Trifolium pratense* red-purple.

*Argynnis (Speyeria) hesperis* (W. Edwards) visits flowers of all colors except perhaps pure red: Ssp. *hesperis*: *Achillea millefolium* “lanulosa” white 2x; *Agoseris aurantiaca* orange; *Agoseris glauca* yellow 8x; *Anaphalis margaritacea* whitish 2x; *Anemone cylindrica* greenish-white; *Apocynum*

*androsaemifolium* pinkish-white 47x; *Arctium minus* rose-purple 42x; *Asclepias speciosa* pink pollinia on leg; *Aster laevis* var. *geyeri* blue 29x; *Aster porteri* white 3x; *Buddleja davidii* white; *Carduus nutans* rose-purple 28x; *Ceanothus fendleri* white 6x; *Centaurea diffusa* lavender 10x (+ two <1/2 sec.) + white 27x; *Chrysothamnus nauseosus* yellow; *Cirsium arvense* purple 21x + var. *incanum* 11x; *Cirsium vulgare* rose-purple; *Clematis ligusticifolia* white; *Conium maculatum* white; *Dipsacus fullonum* var. *sylvestris* white to lilac Anne U. White; *Erigeron speciosus* blue 5x; *Eriogonum flavum* yellow 8x; *Euphorbia esula* yellow-green 4x; *Gaillardia aristata* yellow with red-purple base 25x incl. 1x ray bases orange then yellow beyond and 10x red-centered; *Geranium caespitosum* pink 3x; *Grindelia squarrosa* yellow; *Heracleum sphondylium montanum=lanatum* white 7x; *Heterotheca villosa* yellow 14x + 1x briefly; *Holodiscus discolor* whitish; *Jamesia americana* white 3x; *Liatris ligulistylis* purplish 10x; *Monarda fistulosa* rose-purple 118x incl. Anne U. White and Janet Chu; *Nepeta cataria* white 12x; *Physocarpus monogynus* white; *Prunus virginiana* white; *Rhus glabra* greenish flower 6x; *Rudbeckia hirta* yellow 40x; *Rudbeckia laciniata ampla* yellow (favorite) 134x; *Sedum lanceolatum* yellow; *Senecio fendleri* yellow; *Senecio* yellow many 2x; *Solidago altissima* “*canadensis*” yellow 11x; *Solidago missouriensis* yellow; *Solidago* yellow; *Symphoricarpos ~albus* pink; *Taraxacum officinale* yellow; *Trifolium pratense* red-purple 3x; *Viguiera (Heliomeris) multiflora* yellow 3x; sap of *Salix amygdaloides*; dung of horse; mud 6x. Other *A. hesperis* ssp.: *Agastache urticifolia* pinkish; *Arnica mollis* yellow; *Aster ascendens* usually bluish; *Aster foliaceus* purple; *Calyptridium umbellatum* white 2x; *Carduus nutans* rose-purple; *Cirsium arvense* purple 2x; *Cirsium* prob. rose-purple; *Cirsium* small blue head ?*arvense*; *Cirsium* white several; *Erigeron speciosus* blue 2x; *Erigeron ursinus* blue; *Haplopappus (Oreochrysum) parryi* yellow; Lamiaceae 2x; *Monarda fistulosa* rose-purple several; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow 21x; *Senecio* yellow; *Senecio triangularis* yellow ~2x; sunflowers orange and yellow many; *Viguiera (Heliomeris) multiflora* yellow 2x; mud.

*Argynnis (Speyeria) egleis* (Behr). Ssp. *secretata* dos Passos and Grey: *Agastache urticifolia* whitish; mud. Ssp. *mcDunnoughi*: *Senecio* yellow 12x. Ssp. *egleis*: *Calyptridium umbellatum* white many; Lamiaceae. Ssp. *oweni* (W. Edwards): Asteraceae yellow, *Calyptridium umbellatum* white; *Prunus ~virginiana* white. *Argynnis (Speyeria) zerene* (Boisduval). Ssp. *sinope* dos Passos and Grey visits all colors of flowers except red, esp. yellow: *Agastache urticifolia* pinkish 3x; *Arnica mollis* yellow 6x; *Aster foliaceus* purple; *Berteroa incana* white 2x; *Cardamine cordifolia* white 2x; *Ceanothus velutinus* white; *Chrysothamnus nauseosus* yellow 4x; *Cirsium arvense* purple 2x; *Cirsium scariosum=coloradense* whitish; *Erigeron speciosus* blue 4x; *Eriogonum brevicaulis* yellow; *Eriogonum umbellatum* yellow; *Heterotheca villosa* yellow; *Medicago sativa* violet 55x; *Rudbeckia laciniata ampla* yellow 8x; *Senecio integerrimus* yellow 3x; *Senecio triangularis* yellow 10x; *Senecio* yellow 21x; *Taraxacum officinale* yellow 3x; *Trifolium pratense* red-purple; dog turd. Ssp. *platina* (Skinner): *Eriogonum subalpinum* [pinkish]-cream; *Senecio eremophilus kingi* pinnate yellow. Ssp. *picta* (McDunnough): ~*Eriogonum compositum* whitish “dense *Eriogonum* vaguely like *effusum*”. Ssp. *gunderi* (J. Comstock): *Chrysothamnus nauseosus* yellow 2x; *Cirsium* prob. rose-purple; Lamiaceae some. Ssp. *malcolmi* (J. Comstock): *Chrysothamnus nauseosus* yellow 2x; *Eriogonum lobbii* var. *robustius* cream. Ssp. *zerene*: *Calyptridium umbellatum* white, Lamiaceae several.

*Argynnis (Speyeria) coronis* (Behr) mostly visits yellow and white flowers, and often purplish/blue ones. Ssp. *halcyone* (W. Edwards): *Apocynum androsaemifolium* pinkish-white 14x; *Aster glaucodes* white to violet; *Aster laevis* var. *geyeri* blue 2x; *Aster porteri* white; *Astragalus laxmannii* “*adsurgens*” usually whitish; *Barbarea orthoceras* yellow; *Carduus nutans* rose-purple 29x; *Centaurea diffusa* white 2x; *Chrysothamnus nauseosus* yellow 19x; *Cirsium arvense* purple; *Cirsium canescens* whitish 2x; *Cirsium vulgare* rose-purple; “thistle” low white; *Erigeron speciosus* blue; *Eriogonum umbellatum* yellow; *Erysimum ~capitatum* (yellow 2x, orange 6x); *Gaillardia aristata* yellow with red-purple base; *Heracleum sphondylium montanum=lanatum* white; *Heterotheca villosa* yellow 3x; *Jamesia americana* white 4x; *Lesquerella montana* yellow; *Liatris punctata* purplish 3x; *Medicago sativa* violet ~9x; *Monarda fistulosa* rose-purple 5x; *Oxytropis lambertii* reddish-purple; *Physocarpus monogynus* white; *Sedum lanceolatum* yellow; *Senecio fendleri* yellow 2x; *Senecio triangularis* yellow; *Senecio* yellow 3x; *Solidago ~altissima* “~*canadensis*” yellow; *Taraxacum officinale* yellow 2x; *Verbena stricta* purplish-

blue 3x; visiting plant 6" tall with leaves like elm and tiny white bell flowers; mud 4x. Ssp. *snyderi* (Skinner): *Brassica* ~yellow. Ssp. *coronis*: Lamiaceae. Ssp. *carolae* dos Passos and Grey (an unconvincing majority of traits suggest *carolae* belongs to *S. zerene*, but mtDNA study of C. Guppy and N. Kondla suggest it is actually *S. coronis carolae*): *Heterotheca villosa* yellow several; *Solidago* yellow many.

*Argynnis* (*Speyeria*) *edwardsii* (Reakirt) visits flowers of all colors (even red) and dung and mud: *Agoseris glauca* yellow; *Apocynum androsaemifolium* pinkish-white 10x + one very brief; *Astragalus spatulatus* 20 cm blue; *Buddleja davidii* pink-purple; *Carduus nutans* rose-purple 47x; *Ceanothus fendleri* white; *Ceanothus velutinus* white; *Centaurea diffusa* lavender; *Chrysothamnus nauseosus* yellow 21x; *Cirsium arvense* purple M. Fisher; *Cirsium canescens* whitish 4x; *Cirsium ochrocentrum* rose-purple 3x; *Cirsium undulatum* rose-purple 2x; *Eleagnus angustifolia* yellow; *Eriogonum effusum* white; *Eriogonum umbellatum* yellow; *Erysimum ~capitatum* yellow + 1 sec twice; *Erysimum capitatum* orange 16x + one red-orange; *Eupatorium maculatum* reddish 2x; *Gaillardia aristata* yellow with red-purple base 2x; *Grindelia squarrosa* yellow 2x; *Harbouria trachypleura* yellow; *Heracleum sphondylium montanum=lanatum* white; *Hesperis matronalis* var. *alba* white; *Heterotheca villosa* yellow 3x; *Jamesia americana* white 10x incl. Janet Chu; *Liatrix punctata* purplish 9x; *Lithospermum multiflorum* yellow; *Medicago sativa* violet; *Melilotus alba* white 2x; *Monarda fistulosa* rose-purple 8x; *Onopordum acanthium* rose-purple; *Oxytropis lambertii* reddish-purple; *Penstemon secundiflorus* purple; *Prunus virginiana* white; ~*Rudbeckia laciniata hortensis* (yellow with yellowish centers); *Rorippa sinuata* yellow; *Sedum lanceolatum* yellow 3x; *Senecio "fendleri"* yellow; *Symphoricarpos rotundifolius* pink 2x; *Trifolium pratense* red-purple; *Verbena bracteata* bluish-purple; *Verbena stricta* purplish-blue 5x; *Verbesina encelioides* golden-orange; dung 2x; mud 5x.

*Boloria alaskensis* ["*napaea*"] *halli* Klots: *Erigeron ?ursinus* short blue sometimes; sometimes *Polygonum bistortoides* whitish; often *Senecio* 30 cm yellow.

*Boloria eunomia caelestis* (Hemming) visits many colors, most often yellow. *Arnica cordifolia* yellow; *Arnica mollis* yellow 3x; *Caltha "Psychrophila" leptosepala* whitish 2x; *Cardamine cordifolia* white; *Castilleja rhexifolia* lavender ½ sec; *Delphinium ramosum* blue; *Erigeron ursinus* blue-purplish 14x; *Polygonum bistortoides* whitish 16x; *Potentilla diversifolia* yellow; *Potentilla fruticosa* yellow 3x; *Sedum rhodanthum* pink ~30x (incl. Richard O. Bray); *Sedum roseum integrifolium* dark-rose-purple; *Senecio canus* yellow; *Senecio crassulus* yellow; *Senecio dimorphophyllus* yellow; *Senecio fremontii* var. *blitoides* yellow; *Senecio triangularis* yellow 5x; *Trifolium dasyphyllum* purple/pink.

*Boloria selene* (Schifferrmüller). Ssp. *nebraskensis* (W. Holland): *Asclepias syriaca* pink, male has pollinia on leg; *Helianthus divaricatus* yellow; *Verbena hastata* purplish-blue. Ssp. *tollandensis*: *Erigeron ursinus* blue-purplish; *Senecio integerrimus* yellow 2x; *Verbena ~stricta* purplish-blue. Ssp. *mtn.-sabulocollis* Kohler: *Solidago* yellow Las Animas Co. Colo.

*Boloria epithore* (W. Edwards): *Calyptidium umbellatum* white; *Senecio* yellow 2x.

*Boloria bellona* (Fabricius): *Penstemon confertus procerus* tiny blue flowers 6x; *Senecio triangularis* yellow; mud.

*Boloria frigga sagata* (W. Barnes and Benjamin) visits whitish flowers and probably all other colors: *Cardamine cordifolia* white 3x; *Pedicularis groenlandica* reddish-purple to dark-rose; *Polygonum bistortoides* whitish; *Sedum rhodanthum* pink 5x; *Valeriana capitata acutiloba* pinkish-white 5 min; catkin? of *Salix ?planifolia* whitish; catkin (dry) of *Salix* so flew after ~1 sec.; mud.

*Boloria improba acrocneema* Gall and Sperling (Scott 1982 studied this species): *Erigeron ursinus* blue; *Hymenoxys grandiflora* yellow; *Phlox multiflora* [white-pink-blue]; *Silene acaulis* pink/purplish pink 3x; sunflower yellow 1x; soil moisture 2x.

*Boloria improba harryi* Ferris: *Erigeron ~simplex* bluish-white with rosette of basal leaves 5 cm; *Polygonum bistortoides* whitish cream; *Salix arctica* female flowers ~whitish; *Silene acaulis* pink/purplish pink 4x; wet soil 2x.

*Boloria freija browni* (Higgins): *Arnica cordifolia* yellow; *Caltha "Psychrophila" leptosepala* white; *Draba lanceolata* white; *Oreoxis alpina* yellow; *Pulsatilla patens multifida* purplish-white; *Salix planifolia* male catkin; mud.

*Boloria titania helena* (W. Edwards) visits all colors, mostly yellow and white: *Achillea millefolium* “lanulosa” white; *Agoseris glauca* yellow; *Arnica cordifolia* yellow 3x; *Arnica mollis* yellow 73x; *Arnica rydbergii* yellow 3x; *Aster foliaceus* var. *apricus* purple; *Caltha* “*Psychrophila*” *leptosepala* white 2x; *Cardamine cordifolia* white 4x (and one only 3 sec); *Cirsium scopulorum* yellowish-white; *Erigeron elatior* pink-purple 8x; *Erigeron* ~*simplex* violet hairy-leaf; *Erigeron speciosus* blue; *Erigeron ursinus* blue 79x; *Erigeron* “*Aster*”; *Hymenoxys grandiflora* yellow; ?*Ligusticum porteri* white; *Polygonum bistortoides* whitish 10x; *Potentilla diversifolia* yellow 2x; *Ranunculus adoneus*? yellow (not “*Silene acaulis* pink/purplish”) (pinnate leaf and yellow buttercup flower); *Saxifraga* (*Micranthes*) *oregana* white; *Sedum lanceolatum* yellow; *Sedum rhodanthum* pink 5x; *Senecio atratus* yellow; *Senecio crassulus* yellow-orange 7x; *Senecio crocatus* orange-red to yellow; *Senecio dimorphophyllus* yellow 11x; *Senecio fremontii* var. *blitoides* yellow 3x; *Senecio integerrimus* yellow; *Senecio triangularis* yellow 22x; *Senecio* yellow 2x; *Solidago multiradiata* yellow 2x; *Solidago simplex* var. *nana*=*decumbens* yellow 2x; sunflower yellow 2x; *Taraxacum* ~*officinale* yellow 3x; mud.

#### NYMPHALIDAE, NYMPHALINAE, APATURINI

*Asterocampa celtis* (Boisduval and LeConte) visits all flower colors but prefers whitish and yellow colors, and mostly visits tree sap. *A. celtis celtis*: *Centaurea americana* white and pink. *A. celtis jeffermont* Scott and M. Fisher: *Cirsium arvense* purple several; *Cirsium vulgare* rose-purple Janet Chu; *Clematis ligusticifolia* white 2x; *Eriogonum flavum* yellow; *Helianthus pumilus* yellow 3x; *Holodiscus discolor* whitish 2x; *Jamesia americana* white often; *Monarda fistulosa* rose-purple 2x; *Solidago altissima* “*canadensis*” yellow; *Tilia americana* yellowish-cream; honeydew of aphids proboscis repeatedly touching aphids on *Cirsium vulgare* seeking ‘aphid-honeydew’ Janet Chu; berries *Rubus deliciosus*; rotting bananas-peaches 6x; sap of *Acer negundo*; sap of *Robinia neomexicana* Janet Chu; sap of *Salix amygdaloides* 29x; sap of *Ulmus pumila* 73x; mud 6x.

*Asterocampa leilia* (W. Edwards): Asteraceae shrub yellow.

*Asterocampa clyton* (Boisduval and LeConte) probed my red truck.

#### NYMPHALIDAE, NYMPHALINAE, NYMPHALINI

In late summer all the species (except *Junonia*) frequent *Chrysothamnus nauseosus* yellow bushes.

*Vanessa-Aglais-Nymphalis* seldom visit red flowers, perhaps because *Vanessa atalanta* supposedly cannot see red (Zaccardi et al. 2006) (but it visits red flowers, see below). *Polygonia* seem to prefer yellow and white flowers.

*Vanessa virginiensis* (Drury) visits flowers of all colors except red, and mud: *Agoseris glauca* yellow; *Apocynum androsaemifolium* pinkish-white 3x; *Aster laevis* var. *geyeri* blue; *Aster* Michaelmas Daisy purple (P. Allan Smith TV show); Asteraceae yellow several; *Astragalus drummondii* white; *Bidens cernua* yellowish?; *Buddleja davidii* pink (This Old House TV show); *Carduus nutans* rose-purple; *Centaurea diffusa* white; *Chrysothamnus nauseosus* yellow 17x; *Cirsium arvense* purple 4x and var. *incanum* 1x; *Erigeron speciosus* blue; *Eriogonum umbellatum* yellow 2x; *Fagopyrum esculentum* (Polygonaceae) white (P. Allen Smith TV show); *Helianthus tuberosus* yellow; Lamiaceae blue; *Lepidium campestre* white; *Liatris punctata* purplish; *Lobelia siphilitica* violet- *Lupinus argenteus* blue; *Monarda fistulosa* rose-purple 2x; *Oxytropis lambertii* reddish-purple; *Penstemon alpinus* blue-purplish; *Raphanus sativus* bluish-white 2x; *Rudbeckia hirta* yellow 5x; *Rudbeckia laciniata ampla* yellow 3x; *Senecio* yellow; sunflower big yellow; *Taraxacum officinale* yellow 2x; *Trifolium pratense* red-purple 2x; *Trifolium repens* whitish; *Verbena* purple; *Verbena* purplish-blue 11x; white bushy flower; *Zinnia grandiflora* yellow-with-brown-red-center low 10 cm roadside sunflower; dung male near horse turds; mud 3x.

*Vanessa cardui* (Linnaeus) visits flowers of all colors even some red ones, plus fruit, sap, dung, and mud. It depends on *Taraxacum officinale* during spring northward migrations, and *Chrysothamnus nauseosus* in late summer (when southward migrants are rarely seen): *Achillea millefolium* “lanulosa” white 4x + one only ½ sec.; *Ajuga reptans* blue; *Allium sibiricum* violet; *Alyssoides utriculata* light-yellow; *Alyssum saxatile* yellow 4x; *Anchusa azurea* blue; *Anemone canadensis* white found dead with proboscis wrapped



around *A. canadensis* peduncle; *Antirrhinum majus* white 4x; *Apocynum androsaemifolium* pinkish-white 12x; *Apocynum cannabinum* whitish 10x; *Arctostaphylos uva-ursi* whitish; *Arnica cordifolia* yellow; *Arnica mollis* yellow 28x; *Arnica rydbergii* yellow; *Asclepias incarnata* pink 15x; *Asclepias speciosa* pink 2x; *Aster ericoides* white 9x; *Aster novae-angliae* purple 4x; *Aster novi-belgii* (purple 1x, white 10x); *Aster* “Pixie Park” purple 2x; *Astragalus drummondii* white 5x; *Astragalus flexuosus* purple 3x; *Astragalus laxmannii* “*adsurgens*” usually whitish 6x; *Barbarea orthoceras* yellow 3x; *Berberis* (*Mahonia*) *repens* yellow 2x; *Berteroa incana* white; *Buddleja davidii* color not stated 8x + purple 20x + violet 10x + white 61x; *Calyptridium umbellatum* white; *Cardaria* (*Lepidium*) *latifolium* white; *Carduus nutans* rose-purple 42x; *Ceanothus fendleri* white; *Centaurea diffusa* (lavender 10x + white 67x); *Centaurea maculosa* lavender 6x; *Centaurea scabiosa* blue; *Centranthus ruber* red; *Ceratostigma plumbaginoides* violet 2x; *Chrysanthemum Xsuperbum* white 5x; *Chrysanthemum* “Corinne” white; *Chrysanthemum* “Megan” purple; *Chrysanthemum* “Melanic” ?white; *Chrysanthemum* (yellow 6x, yellow with orange center 1x, yellowish 2x); *Chrysothamnus nauseosus* yellow 1062x; *Cirsium arvense* purple 32x (+ var. *incanum* 10x); *Cirsium discolor* pinkish-violet 95x; *Cirsium eatonii tweedyi*; *Cirsium parryi* yellow; *Cirsium* prob. rose-purple; *Cirsium scariosum* lavender-white; *Cirsium scopulorum* yellowish-white; *Cirsium undulatum* rose-purple; *Cirsium vulgare* rose-purple 3x; *Cleome* (*Peritoma*) *serrulata* pinkish; *Convolvulus arvensis* whitish 2x; *Cosmos bipinnatus* (orange 8x, white/pink 1x, white 1x, purple 3x, briefly 1x); *Cryptantha minima* white 2x; *Cryptantha virgata* white 2x; *Delphinium ajacis* violet 3x + 1/3 sec.; *Descurainia pinnata* yellow; *Dianthus* ~*barbatus* red; *Dipsacus fullonum* var. *sylvestris* violet-pink 15x; *Dryas octopetala* white 12x; *Echinacea angustifolia* purple 11x; *Echinacea purpurea* purple 188x; *Erigeron compositus* white to rose-blue finely divided 3x; *Erigeron speciosus* blue 3x; *Erigeron ursinus* blue-; 7x; *Eriogonum jamesii* cream; *Eriogonum lonchophyllum* white; *Eriogonum umbellatum* yellow 4x; *Erysimum asperum* yellow 15x; *Erysimum capitatum* (orange 6x yellow 3x); *Eupatorium perfoliatum* white; *Euphorbia esula* yellow-green 3x; *Euryops pectinatus* “*viridis*” yellow; *Gazania longiscapa* yellow; *Gomphrena globosa* purple some; *Grindelia squarrosa* yellow; *Gutierrezia sarothrae* yellow (1x + another only 1 sec.); *Haplopappus* (*Tonestus*) *pygmaeus* yellow; *Helianthus* ~*annuus* spatulate leaf yellow; *Helianthus nuttallii* yellow; *Helianthus petiolaris* yellow; *Helianthus tuberosus* yellow 8x; ~*Helianthella uniflora* yellow; *Hesperis matronalis* pink 4x; *Heterotheca pumila* yellow; *Heterotheca villosa* yellow 11x; *Hymenoxys grandiflora* yellow; *Hymenoxys richardsoni* yellow; *Jamesia americana* white 11x; *Lavandula angustifolia* light-purple 2x; *Lesquerella montana* yellow; *Liatriis punctata*; 21x; *Lobelia siphilitica* violet-blue Lamiaceae 3x; *Lonicera tatarica* pink many; *Machaeranthera pattersoni* purple/violet 4x; *Medicago lupulina* yellow Janet Chu; *Medicago sativa* violet 113x; *Mertensia lanceolata* blue; *Monarda fistulosa* rose-purple 12x; *Muscari botryoides* deep-blue 32x; *Nasturtium officinale* white; *Nepeta Xfaassenii* violet; *Onopordum acanthium* rose-purple; *Osteospermum* near “Buttermilk” whitish petals lavender at base; *Oxytropis lambertii* reddish-purple 11x; *Penstemon secundiflorus* purple 6x; *Penstemon virens* blue 2x; *Pericome caudata* yellow 3x; *Perovskia atriplicifolia* blue; *Petunia hybrida* pink 1 sec.; *Phacelia heterophylla* ~pinkish; *Phlox pilosa* ~pinkish; *Phlox subulata* var. *nelsonii* pink; *Physocarpus monogynus* white 3x; *Polygonum pensylvanicum* pink; *Prunus americana* white 3x; *Prunus cerasus* white 24x; *Prunus maackii* white; *Prunus pissardi rosea* white 2x; *Prunus virginiana* white 17x; *Pyrus malus* white 2x; *Pyrus* crabapple (1x + pink 3x); *Pyrus* double-flowered crabapple pink 6x; *Pyrus floribunda* pinkish-white; *Ranunculus* yellow; *Raphanus sativus* bluish-white common; *Rorippa sinuata* yellow 2x; *Rubus deliciosus* white; *Rudbeckia hirta* yellow 4x; *Rudbeckia laciniata ampla* yellow 4x; *Salvia farinacea* “Blue Bedder” violet-blue; *Salvia nemorosa* “Mainacht” purple 4x; *Scabiosa columbaria* lilac 6x; *Sedum lanceolatum* yellow 5x; *Senecio atratus* yellow 2x; *Senecio canus* yellow; *Senecio crassulus* yellow 34x; *Senecio dimorphophyllum* yellow; *Senecio fendleri* yellow 17x; *Senecio integerrimus* yellow gray-leafed 4x; *Senecio triangularis* yellow 4x; *Senecio* yellow many; *Silene acaulis* pink 19x; *Solidago altissima* “*canadensis*” yellow 2x; *Solidago rigida* yellow; *Solidago simplex* var. *nana*=*decumbens* yellow; *Sonchus uliginosus* yellow; *Spiraea japonica* pink; *Stachys olympica* pinkish; *Symphoricarpos albus* pink; *Symphoricarpos occidentalis* pink 2x; *Symphoricarpos rotundifolius* pink; *Syringa vulgaris* pink-purple 49x (+ one only 1 sec.) white form *alba* 1x; *Tagetes patula* yellow-orange 13x; *Taraxacum officinale* yellow 182x; *Thlaspi*

*arvense* white 4x; *Thlaspi* (*Noccaea*) *fendleri* “*montanum*” white; *Tilia americana* yellowish-cream; *Tilia europaea* ochre 2x; *Tragopogon dubius major* lemon-yellow; *Trifolium pratense* red-purple 73x; *Trifolium repens* whitish 22x; *Verbascum thapsus* yellow only ½ sec; *Verbena nervosa* purple 7x; *Verbena rigida* bluish-purple 5x; *Verbena Xhybrida* “*Imagination*” purple 10x; *Verbena* “*Purple Top*” purple 17x; *Verbena* purple; *Verbesina encelioides* golden-orange; *Viburnum carlesii* white 2x; *Vicia cracca* bluish-purple; *Vinca minor* blue; *Viola ~odorata* blue 2x; white bushy flower; *Zinnia elegans* 64x (incl. white 1x, yellow 11x, yellow Thumbelina 1x, orangish-yellow 1x, orangish 2x, orange Thumbelina 1x, pink 8x, pink Thumbelina 11x, red 10x, red with yellow centers [yellow and white ones ignored] 3x, purple 1x, red center yellow outer 2x); *Zinnia* small hybrids white; *Zinnia* ?pink 6x; *Zinnia grandiflora* 5-10 cm roadside yellow-with-orange-center sunflowers; dense white flowers; fruit broken apple; sap? from *Cirsium ochrocentrum* rose-purple phyllaries; dung of dog; mud 8x.

*Vanessa carye annabella* (W. D. Field) visits all colors of flowers except perhaps pure red: *Aesculus californica* whitish; *Apocynum androsaemifolium* pinkish-white; *Arnica mollis* yellow 2x; *Aster ericoides* white 2x; *Aster lanceolatus hesperius* bluish-white 7x; *Calyptridium umbellatum* white 2x; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple; *Chrysanthemum parthenium* white (yellow center); *Chrysanthemum* yellow; *Chrysothamnus nauseosus* yellow 33x; *Cirsium arvense* purple 2x; *Dahlia X* “*Karma*” rose 1 sec.; *Dianthus* “*Pink Delight*” pink; *Echinacea purpurea* purple; *Machaeranthera bigelovii* purple/violet; *Medicago sativa* violet 13x; *Melilotus alba* white; *Perovskia atriplicifolia* blue a long time; *Raphanus sativus* bluish-white 2x; *Rudbeckia hirta* yellow 2x; *Salvia nemorosa* “*Mainacht*” purple 2x; *Scabiosa columbaria* blue-lilac much (a long time); *Senecio crassulus* yellow; *Senecio triangularis* yellow; *Solidago* (*Euthamia*) *occidentalis* yellow 2x; *Solidago* yellow; sunflower big yellow; sunflower yellow; *Tagetes ~erecta* orangish large petaly marigold; *Taraxacum officinale* yellow; *Trifolium pratense* red-purple; *Verbena* purplish-blue; *Zinnia elegans* white (yellow center) 2x.

*Vanessa atalanta* (Linnaeus) visits flowers of all colors even red sometimes, and often visits sap and fruit bait and mud: *Apocynum androsaemifolium* pinkish-white 5x; *Apocynum cannabinum* whitish 6x; *Arnica mollis* yellow 7x; *Asclepias speciosa* pink 2x; *Asclepias syriaca* pink male had pollinia on leg; *Aster laevis* var. *geyeri* blue 2x; *Aster novae-angliae* purple 2x; *Aster porteri* white; *Berteroa incana* white 2x; *Buddleja davidii* white; *Centaurea diffusa* white; *Chrysothamnus nauseosus* yellow 35x; *Cirsium arvense* purple 26x + var. *incanum* 78x; *Cirsium ochrocentrum* rose-purple; *Clematis ligusticifolia* white; *Cornus sericea*=*stolonifera* white 2x; *Coronilla varia* pink 3x; *Echinacea purpurea* purple; *Erigeron speciosus* blue; *Eriogonum umbellatum* yellow 2x; *Geranium caespitosum* pink; *Gutierrezia sarothrae* yellow; *Helianthus tuberosus* yellow; *Hydrophyllum fendleri* white; *Jamesia americana* white 4x; *Machaeranthera pattersoni* purple/violet; *Medicago sativa* violet 4x; *Monarda fistulosa* rose-purple 4x; *Nepeta cataria* white; *Phacelia heterophylla* white probing with proboscis; *Physocarpus monogynus* white 14x; *Prunus americana* white; *Prunus cerasus* white; *Prunus virginiana* white 9x; *Ratibida columnifera* yellow; *Rhus glabra* green flowers 3x; *Ribes cereum* pinkish-white 3x; *Rorippa sinuata* yellow 2x; *Rosa ~woodsii* pink flower 5 cm wide; *Rosa* red giant with few petals; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow 6x; *Senecio crassulus* yellow; *Senecio ~spartioides* yellow; *Solidago altissima* “*canadensis*” yellow 4x; *Solidago missouriensis* yellow; *Stachys olympica* pinkish; *Symphoricarpos albus* pink 26x; *Symphoricarpos occidentalis* pink; *Symphoricarpos rotundifolius* pink; *Syringa vulgaris* pink-purple 2x; *Thlaspi* (*Noccaea*) *fendleri* “*montanum*” white; *Tilia americana* yellowish-cream 6x; *Tilia europaea* ochre; *Trifolium pratense* red-purple 47x; *Vicia cracca* bluish-purple; sucking diseased black small *Cirsium ochrocentrum* unexpanded flower head; *Pinus edulis* cones; sap of *Populus tremula tremuloides*; sap of *Ulmus pumila* 2x; sap of *Salix amygdaloides* 4x; rotten apple 2x; fruit bait 4x; mud 13x. Theis (2006) reports that it helps pollinate *Cirsium arvense*.

*Inachis io* Linnaeus (Europe): *Taraxacum officinale* yellow.

*Aglais milberti* (Godart) feeds on yellow or white flowers, seldom on blue-purple: *Achillea millefolium* “*lanulosa*” white; *Allium sibiricum* violet big clump of flowers; *Anaphalis margaritacea* whitish; *Apocynum androsaemifolium* pinkish-white; *Arctostaphylos uva-ursi* whitish 3x; *Arnica cordifolia* yellow; *Arnica mollis* yellow 15x; *Arnica rydbergii* yellow 29x; *Barbarea orthoceras* yellow 9x; *Ceanothus velutinus* white; *Chrysothamnus nauseosus* yellow 23x; *Cirsium arvense* purple 1x + var.

*incanum* 1x; *Cirsium* ?rose-purple; *Cirsium scariosum* lavender-white; *Cryptantha virgata* white tall; *Erigeron ursinus* blue-purplish 4x; *Eriogonum lobbii* var. *robustius* cream; *Erysimum asperum* yellow; *Heterotheca villosa* yellow; *Jamesia americana* white 3x; *Medicago sativa* violet 2x; Lamiaceae ?*Monarda* ~rose-purple; mustard? white tiny; *Prunus americana* white 4x; *Sedum lanceolatum* yellow 5x; *Senecio canus* yellow 2x; *Senecio crassulus* yellow; *Senecio fendleri* yellow; *Senecio integerrimus* yellow 2x; *Senecio triangularis* yellow 2x; *Senecio* yellow; *Solidago simplex* var. *nana*=*decumbens* yellow; sunflower yellow 2x; *Taraxacum officinale* yellow 4x; catkin *Salix monticola* male catkin 5x; sap of *Salix amygdaloides*; mud 10x.

*Nymphalis californica* (Boisduval) prefers whitish, sometimes yellow, flowers: *Calyptridium umbellatum* white; *Ceanothus fendleri* white; *Eriogonum umbellatum* yellow; *Prunus americana* white 2x; *Prunus virginiana* white; *Rhus aromatica trilobata* yellowish; mud 8x.

*Nymphalis antiopa* (Linnaeus) visits flowers less often than most butterflies; it visits whitish and yellow flowers, sometimes ochre, pink, and purple ones. It also visits catkins, and frequents tree sap and fruit and fruit bait, and visits mud. *Arctostaphylos* (manzanita, Calif. photo); *Asclepias speciosa* pink; *Asclepias syriaca* pink; *Chrysothamnus nauseosus* yellow 10x; *Cirsium arvense* purple; mustard? tiny white; *Physocarpus monogynus* white; *Prunus americana* white 17x; *Prunus domestica* white; *Prunus virginiana* white 3x; *Tilia americana* yellowish-cream; *Tilia europaea* ochre 4x; yellow fungusy stuff exuding from *Salix irrorata* trunk base; *Salix exigua* [catkin] 2x Anne U. White; *Salix monticola* catkin 5x; sap of *Populus angustifolia*; sap of *Populus deltoides monilifera*; sap of *Populus tremula tremuloides* 6x (at least one observed upside down there, thus approaching from above); sap of *Salix amygdaloides* 6x; sap of *Salix exigua* 3x (one aimed down, one sideways, one landed head-up then flew); sap of *Ulmus pumila*; apples rotten and vinegary 2x; fruit bait of peach etc. 6x; mud 5x.

*Polygonia interrogationis* (Fabricius): *Chrysothamnus nauseosus* yellow; *Monarda fistulosa* rose-purple; *Nepeta cataria* white; *Tilia americana* yellowish-cream; rotten *Pyrus malus* crabapple; mud 4x. Internet photos show it on sap.

*Polygonia comma* (T. Harris): *Asclepias syriaca* pink; *Chrysanthemum* hybrid ~white; *Cirsium arvense* purple. Internet photos show it on sap.

*Polygonia satyrus* (W. Edwards) visits yellow and white and sometimes purple flowers, frequents tree sap and fruit bait, and visits Salicaceae catkins and mud: *Arctium minus* rose-purple 3x; *Barbarea orthoceras* yellow; *Berberis (Mahonia) repens* yellow; *Chrysothamnus nauseosus* yellow; *Cirsium arvense* purple 1x + var. *incanum* 1x; *Crataegus erythropoda* white; mustard? white tiny; *Physocarpus monogynus* white 2x; *Prunus virginiana* white; *Taraxacum officinale* yellow; catkin *Salix monticola* 6x; sap of trees (of *Salix amygdaloides* 2x, of *Salix bebbiana* 1x, of *Salix exigua* 2x, of *Populus deltoides monilifera* 1x, of *Ulmus pumila* 1x); fruit bait 208x; mud 7x.

*Polygonia oreas* (W. Edwards) visits flowers and mud and frequents fruit bait. Ssp. *satellow*: *Chrysothamnus nauseosus* yellow popular (Scott 1984); *Ribes inerme* pinkish? Ssp. *nigrozephyrus*: mud. Ssp. *satellow*, *nigrozephyrus*, and *oreas* visited fruit bait 33x.

*Polygonia gracilis zephyrus* (W. Edwards) visits yellow and white flowers, sometimes blue and purple and pink, frequents fruit bait and sap (even dung and honeydew) and mud: *Anaphalis margaritacea* whitish 4x; *Antennaria parvifolia* whitish 4x; *Apocynum androsaemifolium* pinkish-white 2x; *Arctostaphylos uva-ursi* whitish; *Arnica cordifolia* yellow 4x; *Arnica mollis* yellow 2x; *Aster ascendens* usually bluish; *Aster glaucodes* white to violet; *Aster laevis* var. *geyeri* blue; *Aster porteri* white; Asteraceae yellow 2x; *Barbarea orthoceras* yellow 4x; *Berberis (Mahonia) repens* yellow; *Calyptridium umbellatum* white; *Ceanothus fendleri* white 4x; *Centaurea diffusa* white; *Chrysothamnus nauseosus* yellow 194x; *Cirsium arvense* purple 2x; *Cirsium scopulorum* yellow-white; *Erigeron compositus* white to rose-blue; *Erigeron ursinus* blue-purplish; *Eriogonum flavum* yellow; *Eriogonum umbellatum* yellow; *Erysimum* ~*capitatum* yellow; *Geranium caespitosum* pink; ?*Heterotheca villosa* yellow Asteraceae; *Jamesia americana* white; mustard? white tiny; *Physocarpus monogynus* white 2x; *Prunus americana* white 7x; *Ribes cereum* pinkish-white 10x incl. Janet Chu; *Rubus idaeus melanolasius* white; *Rudbeckia laciniata ampla* yellow 4x; *Sedum lanceolatum* yellow; *Senecio canus* yellow 12x (one male had yellow pollen on uns); *Senecio integerrimus* yellow “canus”; *Senecio triangularis* yellow 2x; *Senecio* yellow 3x; *Solidago altissima*

“canadensis” yellow 3x; *Solidago* ~missouriensis yellow; *Solidago simplex* var. *nana*=*decumbens* yellow; sunflower yellow; *Taraxacum officinale* yellow 11x (one covered with dandelion pollen); *Thermopsis divaricarpa* yellow; *Thlaspi* (*Noccaea*) *fendleri* “montanum” white; *Wyethia amplexicaulis* yellow; *Salix monticola* catkin 4x; dung of dog; algae-water; aphid honeydew sucking on *Salix lemmonii* ~5x; berries ripe of *Rubus deliciosus* often; sap of *Salix amygdaloides* 2x; fruit bait 45x; mud 19x.

*Polygonia faunus* (W. Edwards) (mostly ssp. *hylas* [W. Edwards]) visits flowers of all colors except perhaps pure red, frequents tree sap and fruit bait and mud: *Achillea millefolium* “lanulosa” white; *Arctostaphylos uva-ursi* whitish; *Aster laevis* var. *geyeri* blue 3x; *Aster foliaceus* purple [for form *silvius*]; Asters blue some; Asteraceae yellow many (preferred); *Barbarea orthoceras* yellow; *Chrysothamnus nauseosus* yellow 10x [incl. *P. faunus* form *silvius*]; *Cirsium arvense* purple 2x; *Erigeron speciosus* blue; *Machaeranthera bigelovii* purple/violet 3x; *Ribes inerme* pinkish; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow; *Solidago altissima* “canadensis” yellow; sunflower yellow 11x; *Taraxacum officinale* yellow 14x; catkin *Salix monticola* 9x; sap of *Populus tremula tremuloides* 5x; sap of *Salix bebbiana*; fruit bait 33x; mud 11x. Ssp. *cenveray* Scott visited: *Senecio triangularis* yellow; bait 50x.

*Junonia coenia* Hübner visits all colors of flowers (Scott 1975c studied this species but listed no specific flowers visited): *Achillea millefolium* “lanulosa” white 9x; *Aesculus californica* whitish 1x; *Asclepias incarnata* pink 2x; *Aster* ?*chilensis* bluish; *Aster ericoides* var. *falcatus* white; Asteraceae blue 1x; Asteraceae shrub yellow 3x; *Baccharis salicifolia* whitish 10x; *Brassica nigra* yellow 119x; *Brodiaea pulchella* blue zero visits; *Centranthus ruber* blue-red tall 25x; *Chrysothamnus nauseosus* yellow 2x; *Cirsium arvense* purple 48x; *Eriodictyon* white to lavender; *Eriogonum latifolium* white 16x; *Erodium* ~*cicutarium* violet 2x; *Eschscholzia californica* orange 1x; *Geranium* ?*carolinianum* red; *Grindelia stricta* yellow 3x; Lamiaceae violet 2x; *Lupinus* blue sp. 2x; *Lythrum salicaria* purple; *Medicago sativa* violet 7x; ?*Melilotus officinalis* yellow 10x; *Plantago lanceolata* white 4x; *Polygonum pensylvanicum* pink; *Pycnanthemum tenuifolium* white; *Ranunculus* yellow ~15x; *Raphanus sativus* bluish-white 3x; *Sisyrinchium bellum* blue-violet 2x; small primrose violet; sunflower big yellow; tall white flower 1x; *Taraxacum officinale* yellow 3x; *Trifolium repens* whitish 3x; *Wyethia helenoides* yellow 52x; *Zinnia* ~*elegans* small hybrids white; mud 3x.

*Junonia evarete nigrosuffusa* W. Barnes and McDunnough and hybrids: yellow *Lantana*-type flower with legume leaves; small primrose violet; *Ranunculus* yellow ~7x; *Zinnia grandiflora* 5-10 cm roadside yellow-with-orange-center sunflowers 10x.

#### NYMPHALIDAE, NYMPHALINAE, MELITAEINI

*Euphydryas colon wallacensis* Gunder: mud.

*Euphydryas chalcedona* (E. Doubleday) (Calif. area) mostly visits whitish flowers: *Aesculus californica* whitish 2x; *Carduus* ~purple several; *Cirsium canescens* whitish; *Eriodictyon* white to lavender; *Heracleum sphondylium montanum*=*lanatum*? white; Lamiaceae 2x; *Nasturtium officinale* white; sunflowers yellow; mud.

*Euphydryas chalcedona sierra* (W. Wright): *Calyptridium umbellatum* white many; Lamiaceae purple many.

*Euphydryas anicia brucei* (W. Edwards) visits whitish and yellow, and less often blue and purplish flowers etc.: *Cirsium scariosum* lavender-white; *Dryas octopetala* white; *Erigeron pinnatisectus* blue; *Erigeron ursinus* blue-purplish 2x; *Haplopappus* (*Tonestus*) *pygmaeus* yellow; *Hymenoxys* (*Tetraneuris*) *brevifolia* yellow; *Hymenoxys grandiflora* yellow 7x (and male thorax uns covered with its pollen); *Ipomopsis globularis* purplish-white; *Mertensia alpina* blue 2x; *Senecio canus* yellow; *Senecio crassulus* yellow 2x; *Silene acaulis* pink/purplish 3x; *Thlaspi* (*Noccaea*) *fendleri* “montanum” white 2x; *Tragopogon dubius major* lemon-yellow.

*Euphydryas anicia* ssp. visit yellow and whitish flowers, sometimes orange or pink: *Achillea millefolium* “lanulosa” white 2x; *Anaphalis margaritacea* whitish 2x; *Antennaria parvifolia* whitish; *Apocynum androsaemifolium* pinkish-white 119x (12 were caught by proboscis stuck in stamen column slits, most dead); *Asclepias speciosa* pink (2 pollinia on leg); *Astragalus* yellow; *Ceanothus fendleri* white 17x; *Cerastium strictum* “arvense” white; *Crepis* (*Psilochenia*) *atribarba* yellow; *Cryptantha virgata* white 9x; *Erigeron compositus* white to rose-blue dissected 2x; *Erigeron pumilus* usually white; *Eriogonum*

*flavum* yellow 3x; *Eriogonum umbellatum* yellow 19x; *Erysimum capitatum* (yellow 2x, orange 5x); *Euphorbia esula* yellow-green 4x; *Gaillardia aristata* yellow with red-purple base 38x (6 had yellow thorax due to *Gaillardia* pollen); *Galium septentrionale* white; *Geum aleppicum* yellow; *Harbouria trachypleura* yellow 2x; *Helianthus pumilus* yellow 15x; *Heterotheca villosa* yellow 25x; *Hymenoxys grandiflora* yellow; *Jamesia americana* white 15x; *Lesquerella montana* yellow; *Machaeranthera pinnatifida*=*Haplopappus spinulosus* yellow; *Physocarpus monogynus* white 19x; *Potentilla fissa* yellow (and 1 briefly); *Prunus virginiana* white 10x; *Rubus deliciosus* white 2x; *Rudbeckia hirta* yellow 4x; *Sedum lanceolatum* yellow 49x incl. one dead on flower; *Senecio canus* yellow 14x; *Senecio fendleri* yellow 63x; *Senecio integerrimus* yellow 2x; *Senecio* yellow 2x; sunflower yellow; *Symphoricarpos albus* pink 3x; mud 84x.

*Euphydryas bernadetta* Leussler including ssp. *rorina* Scott and M. Fisher: small *Arnica mollis* yellow; *Aster glaucodes* white to violet 2x; *Eriogonum subalpinum* [pinkish]-cream 2x; *Eriogonum umbellatum* yellow; *Oxytropis sericea* whitish; *Senecio canus* yellow 5x; *Taraxacum officinale* yellow 2x; mud 4x (3 flew down-valley apparently to seek mud).

*Euphydryas editha* (Boisduval) seems to prefer yellow and white flowers. Ssp. *editha*: *Achillea millefolium* “*lanulosa*” white; *Eriodictyon californicum* white to lavender 2x. Ssp. *rubidunda*: Asteraceae yellow, *Mimulus ?guttatus* yellow with red spots. Ssp. *lehmani*: Asteraceae (body covered with yellow Asteraceae pollen); *Eriogonum subalpinum* (pinkish)-cream. Ssp. *hutchinsi*: *Lesquerella parvula* yellow; *Senecio fendleri* yellow; sunflower yellow 4” (not *Psilostrophe bakeri*?).

*Euphydryas gillettii* (W. Barnes): *Rosa* ~pink sp.; mud.

*Poladryas minuta near-minuta* (W. Edwards) (NE New Mex.) visits yellow flowers: Asteraceae yellow 8x; *Gaillardia* ~*aristata* yellow with orange base; *Gutierrezia sarothrae* yellow none or maybe once; *Heterotheca villosa* yellow; *Senecio spartioides* yellow; *Senecio*-type yellow; ~*Stephanomeria*? yellow; *Thelesperma megapotamicum* yellowish.

*Poladryas minuta arachne* (W. Edwards): usually visits yellow flowers, sometimes white, orange, pink, blue, or purple flowers, and strangely NO records on mud! (Scott 1974a studied this species): *Apocynum androsaemifolium* pinkish-white 2x; *Asclepias speciosa* pink; *Aster ascendens* blue 6x; Asteraceae yellow; *Ceanothus fendleri* white 4x; *Cirsium arvense* purple; *Clematis ligusticifolia* white; *Cryptantha jamesii* white 4x; *Erigeron pumilus* 2x + white 3x + bluish-white 14x; ~*Erigeron ursinus* blue 2x; *Erigeron* ~blue; *Eriogonum effusum* white; *Eriogonum umbellatum* yellow 2x; *Erysimum capitatum* usually orange 1x + yellow 1x; *Grindelia subalpina* yellow; *Harbouria trachypleura* yellow; *Heterotheca villosa* yellow 91x; *Hymenopappus filifolius* yellow 4x; *Hymenoxys (Tetraneuris) acaulis* yellow; *Machaeranthera pattersoni* purple/violet 1 sec.; *Mertensia ?lanceolata* blue; *Potentilla* ~*hippiana* yellow 4x; *Potentilla fissa* yellow; *Sedum lanceolatum* yellow 15x; *Senecio canus* yellow 2x; *Senecio fendleri* yellow 16x; *Senecio integerrimus* yellow; *Senecio* yellow small; *Senecio?* yellow 10x; *Solidago (Euthamia) occidentalis* yellow; *Solidago simplex* yellow 3x; *Tagetes patula* orange; yellow flowers 2x.

*Poladryas minuta monache* (J. Comstock): *Achillea millefolium* “*lanulosa*” white 9x.

*Microtia dymas* (W. Edwards): Asteraceae shrub yellow; *Baccharis* whitish 20x; *Polygonum ?pensylvanicum* pink some; tiny white-yellow-flowered tiny-leaf “*Cercocarpus*” several; *Valeriana* ~white/rose some.

*Microtia (Texola) elada* (Hewitson): *Baccharis* whitish 30x; *Polygonum ?pensylvanicum* pink many; *Senecio* yellow; sunflower yellow; *Valeriana* ~white/rose some.

*Chlosyne janais* (Drury): sunflower yellow several.

*Chlosyne definitiva* (E. Aaron): yellow Asteraceae.

*Chlosyne endeis* (Godman and Salvin): sunflower yellow several.

*Chlosyne chinatiensis* (Tinkham): *Helianthus nuttallii* yellow 2x.

*Chlosyne leanira fulvia* (W. Edwards) prefers yellow or white flowers: *Allium textile* white to light-rose 2x; Asteraceae white shrub many; Asteraceae yellow 6x; *Ceanothus fendleri* white; *Heterotheca villosa* yellow several; *Nasturtium officinale* white.

*Chlosyne leanira alma* (“Strecker”) =*flavodorsalis* (Austin and M. Smith): *Leucelene ericoides*=*Aster arenosus* white.

*Chlosyne leanira leanira* (C. Felder and R. Felder): *Achillea millefolium* “lanulosa” white 6x; Asteraceae yellow.

*Chlosyne nycteis drusius* (W. Edwards) visits whitish/yellow flowers especially of its hostplant *Rudbeckia laciniata*: *Apocynum androsaemifolium* pinkish-white 9x; *Cirsium arvense* purple; *Eriogonum umbellatum* yellow 2x; *Gaillardia aristata* yellow with red-purple base; *Heracleum sphondylium montanum*=*lanatum* white; *Jamesia americana* white 2x incl. Janet Chu; *Melilotus officinalis* yellow; *Prunus virginiana* white; *Rudbeckia hirta* yellow 9x; *Rudbeckia laciniata ampla* yellow 23x; *Senecio triangularis* yellow 10x; mud.

*Chlosyne gorgone* (Hübner) visits yellow and less often white flowers, seldom bluish or light reddish, and often visits mud: *Agoseris glauca* yellow (gray thistle-like leaf); *Allium textile* white to light-rose 10x; *Antennaria parvifolia* whitish; *Apocynum androsaemifolium* pinkish-white 2x; *Arnica fulgens* yellow; *Aster lanceolatus hesperius* bluish-white; Asteraceae yellow 2x; *Astragalus parryi* whitish; *Barbarea orthoceras* yellow 12x; *Bidens cernua* yellowish; *Buddleja davidii* pink-purple 5 min.; *Ceanothus fendleri* white; *Cerastium strictum* “arvense” white 5x; *Chrysanthemum leucanthemum* white; *Cirsium arvense* var. *incanum* purple; *Cleome (Peritoma) serrulata* pinkish; *Crepis (Psilochenia) atribarba* yellow; *Erigeron pumilus* usually white 5x; *Eriogonum effusum* white; *Eriogonum jamesii* cream 2x; *Eriogonum umbellatum* yellow 3x; *Erysimum asperum* yellow 2x; *Gaillardia aristata* yellow with red-purple base 3x; *Helianthus annuus* yellow 2x; *Helianthus petiolaris* yellow 2x; *Helianthus pumilus* yellow 5x; *Heracleum sphondylium montanum*=*lanatum* white; *Heterotheca canescens* yellow; *Heterotheca villosa* yellow 7x; *Jamesia americana* white; *Lepidium montanum* white; *Lesquerella montana* yellow 2x; *Malva neglecta* whitish; *Medicago sativa* violet 2x; *Monarda fistulosa* rose-purple; *Phacelia heterophylla* ~pinkish 2x; *Physocarpus monogynus* white 16x; *Polygonum pennsylvanicum* pink 2x; *Potentilla fissa* yellow 6x; *Prunus virginiana* white 8x; *Ranunculus acris* yellow; *Rhus aromatica trilobata* yellowish 2x; *Rubus deliciosus* white an unpopular flower (one 1/3 sec, another hovered over 1 sec then flew); *Rudbeckia hirta* yellow 3x; *Sedum lanceolatum* yellow 4x; *Senecio canus* yellow 22x; *Senecio fendleri* yellow 51x; *Senecio integerrimus* yellow 5x; *Senecio spartioides* yellow; *Senecio* yellow 3x; *Solidago altissima* “canadensis” yellow 3x; *Solidago missouriensis* yellow 2x; *Solidago (Euthamia) occidentalis* yellow 2x; *Taraxacum officinale* yellow 7x; *Thalictrum dasycarpum* whitish; *Thlaspi (Noccaea) fendleri* “montanum” white; *Verbescina encelioides* golden-orange 7x; dung 11x (1-2 of human, 1 of horse, but usually of dog [3 males found dead on one dog dung that evidently killed them]); mud 115x.

*Chlosyne whitneyi damoetas* (Skinner) visits yellow, bluish, and sometimes pinkish or white flowers: *Arnica rydbergii* yellow 4x; *Erigeron leiomeris* blue 5x; *Erigeron pinnatisectus* blue/purple; *Erigeron pygmaeus* blue/purple; *Erigeron* ~*simplex* usually white; *Haplopappus (Tonestus) lyallii* yellow; *Polygonum bistortoides* whitish-pink landed on 1/3 sec. left quickly; *Potentilla* ~yellow; *Senecio fremontii* var. *blitoides* yellow 5x; *Senecio* yellow 4x; *Silene acaulis* pink/purplish 4x; sunflower yellow 1x.

*Chlosyne whitneyi whitneyi* (Behr): “Aster” sunflower with wavy leaves yellow; *Erigeron compositus* blue to pinkish or white; *Wyethia* ~*angustifolia* yellow.

*Chlosyne sterope acastus* (W. Edwards): mud 2x.

*Chlosyne sterope arkanyon* M. Fisher and Scott: *Erysimum asperum* yellow 4x; *Prunus virginiana* white; *Schoenocrambe linifolia* yellow 18x.

*Chlosyne palla* (Boisduval) ssp. visit yellow and white flowers, seldom bluish or pinkish: Ssp. *calydon* (W. Holland): *Apocynum androsaemifolium* pinkish-white; *Ceanothus fendleri* white; *Erigeron speciosus* blue; *Helianthus pumilus* yellow; *Jamesia americana* white; *Rudbeckia hirta* yellow 3x; *Sedum lanceolatum* yellow; *Senecio fendleri* yellow 2x; *Senecio triangularis* yellow several; mud 2x. Ssp. *flavula*: *Erigeron speciosus* blue; *Eriogonum subalpinum* [pinkish]-cream; *Senecio triangularis* yellow 4x. Ssp. *palla*: *Allium* sp. ?pale-pinkish; *Ceanothus* white; *Eriodictyon* white to lavender; *Ranunculus* yellow. Ssp. *australomontana*: *Achillea millefolium* “lanulosa” white some; *Taraxacum officinale* yellow; *Trifolium* ?whitish-pinkish some.

*Chlosyne hoffmannii* (Behr): *Calyptidium umbellatum* white; *Senecio* yellow.

*Phyciodes texana* (W. Edwards): Asteraceae shrub yellow; ~*Baccharis sarothroides* whitish many.

*Phyciodes mylitta* (W. Edwards) visits whitish and yellow flowers at least: *Aesculus californica* whitish; *Baccharis salicifolia* whitish; *Cirsium canescens* whitish; *Gutierrezia sarothrae* yellow; sunflower yellow for *P. mylitta arizonensis* (like *Helianthus pumilus* but leaves hairless).

*Phyciodes pallida* (W. Edwards) mostly visits yellow flowers, seldom white/blue/violet, and visits mud: *Barbarea orthoceras* yellow 2x; *Ceanothus fendleri* white; *Erigeron flagellaris* white; *Eriogonum umbellatum* yellow; *Grindelia squarrosa* yellow; *Heterotheca villosa* yellow 2x; *Lupinus argenteus* blue 2 caught by crab spider on; *Medicago sativa* violet; *Melilotus officinalis* yellow; *Potentilla hippiana* yellow; *Rudbeckia hirta* yellow 4x; *Rudbeckia laciniata ampla* yellow; *Sedum lanceolatum* yellow 2x; *Senecio canus* yellow; *Senecio fendleri* yellow; *Sisymbrium altissimum* yellow; *Solidago altissima* “canadensis” yellow 2x; *Taraxacum officinale* yellow; mud 4x.

*Phyciodes orseis* (W. Edwards): Ssp. *orseis* visited *Calyptidium umbellatum* white; *Senecio* yellow. Ssp. *herlani* Bauer visited *Phacelia* violet.

*Phyciodes tharos orantain* Scott visits all colors except perhaps pure red: *Aster ericoides* white 12x; *Aster laevis* var. *geyeri* blue 2x; *Aster lanceolatus hesperius* bluish-white 6x; *Bidens cernua* yellowish 4x; *Cirsium arvense* var. *incanum* purple; *Euphorbia* “*Agaloma*” *marginata* green and white 2x; *Gaillardia aristata* yellow with red-purple base; *Heterotheca* ~*canescens* yellow; *Machaeranthera canescens* deep blue/purple; *Medicago sativa* violet 4x; *Senecio* ~*spartioides* yellow 2x; *Solidago altissima* “canadensis” yellow; *Solidago missouriensis* yellow; *Solidago (Euthamia) occidentalis* yellow 3x; *Taraxacum officinale* yellow; *Trifolium fragiferum* pink; *Verbena hastata* purplish-blue 2x.

*Phyciodes tharos tharos* (Drury) visits all colors of flowers except perhaps pure red, and mud: *Asclepias incarnata* pink; *Asclepias syriaca* pink (pollinia on leg); *Aster ericoides* white ~5x; *Aster simplex* whitish; ~*Astragalus gracilis* var. *parviflorus* purple 2x; *Cirsium arvense* purple; *Echinacea angustifolia* purple; *Helenium autumnale* yellow 4x; *Helianthus annuus* yellow 2x; *Helianthus tuberosus* yellow 31x; *Heterotheca canescens* yellow; *Medicago sativa* violet 9x; *Melilotus officinalis* yellow; *Prunus virginiana* white; *Ranunculus* yellow; *Rudbeckia hirta* yellow 2x (This Old House TV show); *Solidago altissima* “canadensis” yellow; *Solidago* yellow; *Trifolium repens* whitish 9x; *Viola* ornamental blue briefly; *Valeriana* ~white/rose; mud 4x.

*Phyciodes cocyta selenis* (W. Kirby) visits nearly all colors especially yellow, and mud: *Apocynum androsaemifolium* (the favorite) pinkish-white 59x; *Arnica mollis* yellow 2x; *Aster ericoides* white 2x; *Aster laevis* var. *geyeri* blue; *Barbarea orthoceras* yellow 2x; *Bidens* ~*cernua* yellowish; *Bidens* ~*frondosa* yellowish; *Ceanothus fendleri* white 3x; *Cirsium arvense* purple; *Crepis (Psilochenia) atribarba* yellow briefly; *Erigeron formosissimus* lavender; *Erigeron speciosus* blue (some violet-white) 4x; *Eriogonum umbellatum* yellow 3x; *Erysimum capitatum* orange; *Euphorbia esula* yellow-green 3x; *Gaillardia aristata* yellow with red-purple base 2x; *Grindelia squarrosa* yellow; *Hackelia floribunda* bluish-white; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow 7x; *Monarda fistulosa* rose-purple 2x; *Rudbeckia hirta* yellow 41x; *Sedum lanceolatum* yellow 3x; *Senecio fendleri* yellow 5x; *Senecio pseudoreus* yellow; *Senecio triangularis* yellow 2x; *Solidago altissima* “canadensis” yellow; *Taraxacum officinale* yellow; *Verbena hastata* purplish-blue; mud 12x.

*Phyciodes diminutor diminutor* Scott (S Minn.) visits yellow flowers (sometimes white), and carrion and mud: *Erigeron philadelphicus* white 14x; *Helianthus divaricatus* yellow; *Helianthus tuberosus* yellow; *Heliopsis helianthoides* yellow 47x; *Pastinaca sativa* yellow; *Senecio aureus* yellow; *Taraxacum officinale* yellow; *Trifolium repens* whitish; carrion (dead all-brown hawk 3x); mud 2x.

*Phyciodes batesii* (Reakirt) (ssp. *apsaalooke* Scott and *anasazi* Scott) visits most colors (yellow white blue purple and violet) of flowers, except perhaps red: Ssp. *apsaalooke* visited *Achillea millefolium* “lanulosa” white; *Aster glaucodes* white to violet; *Grindelia squarrosa* yellow; *Medicago sativa* violet 10x; mud. Ssp. *anasazi* visited *Aster glaucodes* white to violet 2x; *Cirsium arvense* purple 3x; *Erigeron speciosus* blue 2x; *Eriogonum umbellatum* yellow; *Machaeranthera grindelioides* yellow; *Medicago sativa* violet 2x; *Rudbeckia laciniata ampla* yellow 11x; *Viguiera (Helimeris) multiflora* yellow; carrion (dead cow in shade); mud 2x.

*Phyciodes pulchella camillus* W. Edwards visits all colors including yellow, white, and blue-purple, except perhaps red, especially of its hostplant *Aster*, and frequents mud: *Achillea millefolium* “lanulosa” white

2x; *Allium textile* white to light-rose 6x; *Antennaria parvifolia* whitish 11x; *Apocynum androsaemifolium* pinkish-white 2x (one had proboscis caught by stamens); *Arnica mollis* yellow 4x; *Aster ascendens* blue 15x; *Aster ericoides* white 68x + var. *ericoides* 1x + var. *falcatus* 28x; *Aster fendleri* blue-violet; *Aster glaucodes* white to violet; *Aster laevis* var. *geyeri* blue 4x; *Aster lanceolatus hesperius* bluish-white 24x; *Aster porteri* white 112x; *Astragalus agrestis* purple 1x plus another 2 sec; *Astragalus drummondii* white; *Barbarea orthoceras* yellow 13x; *Berteroa incana* white 2x; *Bidens cernua* yellowish; *Ceanothus fendleri* white 3x; *Centaurea diffusa* (lavender 4x, white 7x); *Cerastium strictum* “arvense” white; *Chrysothamnus nauseosus* yellow 35x; *Cirsium arvense* purple 2x; *Comandra umbellata* whitish; *Cryptantha jamesii* white; *Erigeron divergens* rose-purple to white 2x; *Erigeron elatior* pink-purple; *Erigeron pumilus* bluish-white 104x; *Erigeron speciosus* blue 7x; *Erigeron ursinus* blue-purplish 7x; *Eriogonum effusum* white 3x; *Eriogonum flavum* yellow 2x; *Eriogonum subalpinum* [pinkish]-cream 6x; *Erysimum asperum* yellow; *Erysimum capitatum* orange 2x; *Eupatorium maculatum* blue; *Galium septentrionale* white; *Grindelia squarrosa* yellow 4x; *Gutierrezia sarothrae* yellow; *Harbouria trachyleura* yellow 2x; *Helianthus ~petiolaris* yellow; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow 37x; *Hymenopappus filifolius* yellow 2x; *Hymenoxys (Tetraneuris) acaulis* yellow; *Lesquerella montana* yellow; *Liatris punctata* purplish; *Linum lewisii* blue 1x + one only ½ sec.; *Machaeranthera canescens* deep blue/purple blue 2x and var. *rubrotinctus* blue 2x; *Machaeranthera pattersoni* purple/violet 17x; *Machaeranthera pinnatifida* = *Haplopappus spinulosus* yellow; *Medicago sativa* violet 10x; *Musineon divaricatum* yellow; *Phyla=Lippia cuneifolia* white 5x; *Physocarpus monogynus* white 2x; *Potentilla* yellow; *Prunus virginiana* white 2x; *Ranunculus* ~yellow; *Rorippa sinuata* yellow; *Rudbeckia hirta* yellow 3x; *Sedum lanceolatum* yellow 7x; *Senecio canus* yellow 19x; *Senecio fendleri* yellow 53x; *Senecio integerrimus* yellow 2x; *Senecio spartioides* yellow 2x; *Senecio tridenticulatus* yellow; *Senecio* yellow 2x; *Solidago ~missouriensis* yellow; *Solidago (Euthamia) occidentalis* yellow; *Taraxacum officinale* yellow 5x; *Thlaspi (Noccea) fendleri* “montanum” white; *Trifolium pratense* red-purple; *Trifolium repens* whitish; mud 170x.

*Phyciodes pulchella* (Boisduval) ssp. Ssp. *montana* (Behr): *Senecio* yellow. Ssp. *deltarufa* Scott: *Aster chilensis* bluish some; purple flower. Ssp. *pulchella*: Asteraceae yellow; *Cirsium arvense* purple-blue. *Phyciodes picta* (W. Edwards) evidently visits all colors of flowers: *Aster ericoides* white; *Cirsium arvense* var. *incanum* purple; *Heterotheca villosa* yellow 4x; *Medicago sativa* violet 20x; *Solidago ~missouriensis* yellow; *Valeriana* ~white/rose.

#### LYCAENIDAE, RIODININAE

*Calephelis nemesis* (W. Edwards): *Asclepias tuberosa* orange; *Baccharis sarothroides* whitish; *Clematis* white.

*Calephelis rawsoni arizonensis* McAlpine: *Asclepias* red; aster white 2x; *Baccharis* whitish; ~*Lathyrus eucosmus* pink pea; sunflower yellow; sunflower yellow hispid-leaved.

*Lasaia maria* Clench: *Acacia greggii* yellow.

*Emesis zela cleis* (W. Edwards): *Baccharis* whitish 3x; ~*Baccharis sarothroides* white; *Erigeron speciosus* blue; *Polygonum ?pensylvanicum* pink; mud.

*Emesis ares* (W. Edwards): yellow sunflower (like *Helianthus pumilus* yellow but leaves hairless) 2x; mud.

*Apodemia* prefers white or yellow flowers.

*Apodemia mormo* (C. Felder and R. Felder) ssp.: *A. mormo langei* J. Comstock: *Eriogonum latifolium* whitish 22x. *A. mormo mormo*: *Chrysothamnus nauseosus* yellow; ~*Eriogonum compositum* cream “dense *Eriogonum* vaguely like *effusum*” 11x; *Eriogonum* white (bluish-gray plant with no or small leaves, bushy 1.5’ tall); *Eriogonum corymbosum* var. *orbiculatum* white 12x; *Eriogonum lonchophyllum* var. *lonchophyllum* cream many; *Eriogonum wrighti* white 18x. *A. mormo pueblo* Scott: *Ceanothus fendleri* white; *Cryptantha fendleri* white; *Eriogonum jamesii* cream ~49x; *Heterotheca villosa* yellow 2x; white flower.

*Apodemia virgulti duryi* (W. Edwards): Asteraceae yellow; *Eriogonum wrighti* white several.

*Apodemia nais* (W. Edwards) clearly prefers the white flowers of its caterpillar hostplant *Ceanothus fendleri*: *Apocynum androsaemifolium* pinkish-white 10x; *Ceanothus fendleri* white ~74x; *Eriogonum jamesii*



yellow-cream; *Eriogonum flavum* yellow; *Heterotheca villosa* yellow several; *Holodiscus discolor* whitish; *Rudbeckia hirta* yellow; *Rudbeckia laciniata ampla* yellow; *Sedum lanceolatum* yellow; mud 10x.

*Apodemia palmerii* (W. Edwards): *Baccharis*? shrub white; *Eriogonum wrighti* white.

*Lymnas cephise cephise* and many other butterfly species fed on rayless Asteraceae with long heads of flowers on bush.

#### LYCAENIDAE, LYCAENINAE, LYCAENINI

*Lycaena phlaeas arctodon* Ferris: "Aster" *Erigeron ?ursinus* blue; *Mertensia ~lanceolata* blue.

*Lycaena cupreus snowi* visits yellow flowers almost exclusively, rarely white or purple: *Arnica cordifolia* yellow; *Arnica mollis* yellow; *Arnica rydbergii* yellow; Asteraceae yellow 2x; *Erigeron simplex* purple (rarely white); *Geum (Acomastylis) rossii turbinatum* yellow 2x; *Haplopappus (Tonestus) lyallii* yellow; *Haplopappus (Tonestus) pygmaeus* yellow; *Potentilla diversifolia* yellow; *Senecio dimorphophyllus* yellow 3x; *Senecio fremontii* var. *blitoides* yellow 14x; *Senecio werneriaefolius*=yellow; *Senecio* yellow; yellow flowers. *L. cupreus cupreus*: *Calyptidium umbellatum* white.

*Lycaena mariposa* (Reakirt): *Senecio* yellow.

*Lycaena nivalis* (Boisduval) visits whitish and yellow flowers. Ssp. *browni*: *Anaphalis margaritacea* whitish; *Antennaria parvifolia* whitish; *Galium* whitish; *Rudbeckia hirta* yellow; *Sedum lanceolatum* yellow; *Senecio* yellow. Ssp. *nivalis*: *Calyptidium umbellatum* white some; mud.

*Lycaena helleoides* (Boisduval) visits whitish and yellow, sometimes purple/violet and pink flowers: *Apocynum androsaemifolium* pinkish-white; *Aster* "asters white" Ore.; *Aster ericoides* white 10x; *Aster glaucodes* white to violet; *Aster lanceolatus hesperius* bluish-white 24x; *Baccharis salicifolia* whitish; *Bidens cernua* yellowish 5x; *Bidens frondosa* yellowish 35x; *Chrysothamnus nauseosus* yellow 3x; *Cirsium arvense* purple 3x + var. *incanum* 1x; *Croton texensis* whitish; *Eriogonum umbellatum* yellow; *Grindelia squarrosa* yellow; *Lepidium virginicum* white 6x; *Machaeranthera canescens* deep blue/purple 15x; *Machaeranthera pattersoni* purple/violet blue 9x; *Medicago sativa* violet 5x; *Melilotus officinalis* yellow; *Mentha arvensis* pink; *Polygonum amphibium coccineum* pink 85x; *Polygonum pensylvanicum* pink 6x; *Senecio spartioides* yellow 2x; *Solidago altissima* "canadensis" yellow; *Solidago (Euthamia) occidentalis* yellow 4x.

*Lycaena florus* (W. Edwards) visits yellow, bluish, whitish, sometimes purple etc. flowers (Scott 1978 studied this species): *Achillea millefolium* "lanulosa" white 26x (+ frequently, Scott 1978); *Anaphalis margaritacea* whitish 20x; *Antennaria parvifolia* whitish; *Antennaria rosea* rosy-whitish 7x; *Arnica parryi* (rayless) yellow 7x + 1 sec.; *Arnica rydbergii* yellow 2x; *Aster ascendens* usually bluish; *Aster foliaceus* var. *apricus* blue-violet sometimes purple 3x; *Aster laevis* var. *geyeri* blue common; Asteraceae yellow several; *Chrysothamnus nauseosus* yellow; *Cirsium arvense* purple; *Cirsium clavatum*=*centaureae* yellowish-white; *Erigeron* ~blue; *Erigeron elatior* pink-purple 8x; *Erigeron ~speciosus* bluish 34x (+ frequently, Scott 1978); *Erigeron ursinus* blue/violet 76x; *Eriogonum subalpinum* cream 9x; *Fragaria virginiana glauca* white; *Galium* ~whitish; *Haplopappus (Oreochrysum) parryi* yellow fls. dark stem 51x; *Heterotheca pumila* yellow 39x; *Heterotheca villosa* yellow; *Potentilla fruticosa* yellow 16x; *Potentilla gracilis* yellow 4x; *Potentilla pulcherrima* yellow 23x + 1/3 sec.; *Potentilla* sp. yellow 2x; *Pseudocymopterus montanus* yellow 1x + 1 sec.; *Rudbeckia hirta* yellow 15x; *Sedum lanceolatum* yellow; *Senecio atratus* yellow 21x; *Senecio* tall yellow 2x; *Solidago* ~*altissima* "canadensis" yellow; *Solidago multiradiata* yellow 4x; *Solidago simplex* var. *nana*=*decumbens* yellow 5x + another only 1-2 sec.

*Lycaena hyllus* (Cramer) =*thoe* Guérin Méneville visits yellow or whitish, sometimes purple/violet/blue or pink, flowers: *Apocynum androsaemifolium* pinkish-white several; *Apocynum cannabinum* whitish; *Asclepias speciosa* pink 9x (incl. pollinia on leg 4x); *Aster ericoides* white 3x; *Aster lanceolatus hesperius* bluish-white 2x; *Bidens frondosa* yellowish 8x; ~*Carduus nutans* rose-purple; *Cirsium arvense* purple 3x; *Helianthus nuttallii* yellow; *Helianthus tuberosus* yellow 2x; *Heliopsis helianthoides* yellow; Lamiaceae small pale violet flowered; *Polygonum amphibium coccineum* pink 11x; *Solidago altissima*

- “*canadensis*” yellow; *Solidago missouriensis* yellow 2x; *Solidago (Euthamia) occidentalis* yellow 2x; *Solidago (Oligoneuron) rigida* yellow; *Verbena hastata* purplish-blue.
- Lycaena gorgon* (Boisduval): *Achillea millefolium* “*lanulosa*” white; *Aesculus californica* whitish 3x; *Eriodictyon* white to lavender.
- Lycaena heteronea* Boisduval visits yellow (esp. the hostplant) and whitish, sometimes blue/purple/violet or pink flowers, and often visits mud: *Achillea millefolium* “*lanulosa*” white 4x; *Anaphalis margaritacea* whitish 3x; *Apocynum androsaemifolium* pinkish-white 6x; Aster blue some; *Aster porteri* white; *Ceanothus fendleri* white 3x; *Chrysothamnus nauseosus* yellow 16x (a dozen had pollen on thorax uns); *Cirsium arvense* purple >102x; *Conium maculatum* white; *Erigeron speciosus* pink-blue 6x; *Erigeron ursinus* blue 19x; *Eriogonum flavum* yellow 29x; *Eriogonum subalpinum* [pinkish]-cream 25x; *Eriogonum umbellatum* yellow 60x [incl. Janet Chu] and var. *porteri* 1x; *Haplopappus (Oreochrysum) parryi* yellow; *Heterotheca pumila* yellow 16x; *Heterotheca villosa* yellow? 15x; *Medicago sativa* violet 2x; *Melilotus alba* white; *Potentilla fruticosa* yellow 4x; *Rudbeckia laciniata ampla* yellow; *Senecio* yellow; *Senecio atratus* yellow 9x; *Solidago* yellow; *Solidago altissima* “*canadensis*” yellow 17x; *Solidago missouriensis* yellow 13x; *Solidago simplex* var. *nana=decumbens* yellow; *Tamarix chinensis=ramosissima* rosy-white; *Tetradymia canescens* yellow sunflower; sap of *Salix amygdaloides*; mud 14x incl. female.
- Lycaena rubidus* (Behr) visits yellow or whitish, sometimes bluish/violet/purple or pink, flowers: *Achillea millefolium* “*lanulosa*” white 8x; *Anaphalis margaritacea* whitish 4x; *Apocynum androsaemifolium* pinkish-white 4x; *Apocynum cannabinum* whitish; *Asclepias speciosa* pink 5x; *Aster ascendens* usually bluish; *Aster foliaceus* var. *apricus* purple; *Aster glaucodes* white to violet; *Aster porteri* white; *Berteroa incana* white 4x; *Centaurea diffusa* lavender; *Chrysothamnus nauseosus* yellow; *Cirsium arvense* purple 8x; *Cirsium* prob. rose-purple; *Cleome (Peritoma) serrulata* pinkish; *Erigeron* ~blue; *Erigeron elatior* pink-purple 8x; *Erigeron speciosus* blue 2x; *Erigeron ursinus* blue-purplish 11x; *Eriogonum umbellatum* yellow; *Euphorbia esula* yellow-green tiny yellow flowers many; *Helianthus petiolaris* yellow 4x; *Heterotheca villosa* yellow 9x; *Medicago sativa* violet; *Melilotus alba* white 2x; *Melilotus officinalis* yellow 3x; *Potentilla fruticosa* yellow 2x; *Potentilla gracilis* yellow 3x; *Potentilla pulcherrima* yellow 2x; *Psoralea tenuiflora* blue-purple; *Rudbeckia hirta* yellow; *Sedum lanceolatum* yellow; *Senecio atratus* yellow 2x; *Senecio triangularis* yellow 2x; *Solidago missouriensis* yellow; *Solidago multiradiata* yellow 2x; *Solidago simplex* var. *nana=decumbens* yellow; mud 2x.
- Lycaena dione* (Scudder) visits purple, blue/violet, pink, or whitish flowers, seldom yellow: *Apocynum androsaemifolium* pinkish-white 2x; *Apocynum cannabinum* whitish 3x; *Asclepias incarnata* pink; *Asclepias speciosa* pink 32x; *Carduus nutans* rose-purple 4x; *Cirsium arvense* purple 24x + var. *incanum* 1x; *Clematis ligusticifolia* white; *Medicago sativa* violet 5x; *Ratibida columnifera* yellow; *Symphoricarpos albus* pink; *Symphoricarpos occidentalis* pink; *Trifolium fragiferum* pink; *Verbena hastata* purplish-blue.
- Lycaena xanthoides* (Boisduval) ssp. visit yellow, sometimes whitish/blue/red: Ssp. *nigromaculata* J. Emmel and Pratt (Scott and Opler 1975 studied this): *Brassica nigra* yellow 3x; *Centranthus ruber* bluish-red 6x; *Dipsacus fullonum* var. *sylvestris* blue-white 15x; *Foeniculum vulgare* yellow; *Grindelia stricta* yellow ~135x. Shapiro (2007) notes that it prefers *Apocynum* (esp. *A. cannabinum*) pinkish-white, *Grindelia* (only *G. camporum*) yellow, *Marrubium vulgare* cream, *Lepidium latifolium* white, and *Oenanthe* white or reddish, *Tamarix* pink. Ssp. *xanthoides*: *Potentilla* yellow.
- Lycaena xanthoides editha*X*xanthoides*=“*pseudonexa*” J. Emmel and Pratt: *Eriogonum umbellatum* yellow.
- Lycaena xanthoides* “*editha*” vurali Kocak =*montana* W. Field visits yellow or whitish flowers, often blue and sometimes pink: *Achillea millefolium* “*lanulosa*” white 7x; *Anaphalis margaritacea* whitish 4x; *Arnica mollis* yellow; *Chrysothamnus nauseosus* yellow 4x; *Cirsium clavatum=centaureae* yellowish-white; *Erigeron ursinus* blue 8x; *Geranium caespitosum* pink 1 sec.; *Heterotheca villosa* yellow; *Melilotus officinalis* yellow 2x; *Potentilla fruticosa* yellow; *Potentilla* sp. yellow; *Rudbeckia hirta* yellow; *Solidago* ~*altissima* “~*canadensis*” yellow; *Solidago* ~*multiradiata* yellow.
- Lycaena arota* (Boisduval) prefers white and yellow flowers, and occasionally visits blue purple pink ones (Scott 1974b studied this species): *Achillea millefolium* “*lanulosa*” white; *Allium textile* white; *Apocynum*

*androsaemifolium* pinkish-white pinkish-white 21x; *Arctium minus* rose-purple; *Asclepias speciosa* pink 2x; *Aster laevis* var. *geyeri* blue 5x; *Aster porteri* white 9x; *Chrysothamnus nauseosus* yellow 28x; *Clematis ligusticifolia* white cream-white 14x; *Cryptantha jamesii* white 2x; *Erigeron elatior* (not *Aster novae-angliae* purple) bluish-white (some lavender) 11x; *Erigeron pumilus* white; *Erigeron speciosus* blue common; *Eriogonum jamesii* cream 97x; *Helianthus pumilus* yellow 5x; *Heterotheca villosa* yellow 17x; *Hymenoxys richardsoni* yellow pollinating it covered with the pollen; *Linaria vulgaris* yellow with orange palate 3x (one probed flower base 1-2 min.); *Melilotus alba* white 20x; *Nepeta cataria* white; *Pericome caudata* yellow 130x; *Ribes leptanthum* pinkish-white; *Rubus deliciosus* white 2x; *Rudbeckia laciniata ampla* yellow 11x; *Solidago* ~*altissima* “~*canadensis*” yellow; *Solidago* (*Euthamia*) *occidentalis* yellow 395x; *Symphoricarpos albus* pink; *Viguiera* (*Helioomeris*) *multiflora* yellow; *Rubus deliciosus* juices of ripe purple berries 13x; mud 5x.

#### LYCAENIDAE, LYCAENINAE, THECLINI

*Hypaurotis crysalus* (W. Edwards) feeds on oak sap, raindrops, occasionally mud, never on flowers (Scott 1974c, Scott and Scott 1978): 18+ adults of both sexes sucking sap oozing from *Quercus gambelii* twigs (seeping knobs including one where a leaf fell off) and sap from new acorns, many on one 5m tree; some sucked raindrops on leaves; wet sand 8x.

*Habrodais grunus* (Boisduval): mud.

#### LYCAENIDAE, LYCAENINAE, EUMAEINI

Some Eumaeini such as *Callophrys* and *Strymon melinus* seem to feed on Asteraceae flowers much less than other Eumaeini.

*Atlides halesus* (Cramer) mostly visits whitish flowers: *Aesculus californica* whitish 1x; *Baccharis salicifolia* whitish 3x; *Baccharis* whitish; sunflower big yellow; white flowering plant abundant; mud (Scott 1973b). To confirm color choice I gathered records from Allen (1997), Bailowitz and Brock (1991), Bright and Ogard (2010), Brown et al. (1992) Clark and Clark ((1951), Iftner et al. (1992), Monroe and Monroe (2004), Opler and Krizek (1984), Orsak (1977), Shapiro (2007, and website), Tveten and Tveten (1996), and internet photos: *Aesculus californica* white; Apiaceae ~whitish/yellow; *Apocynum* whitish; *Aralia spinosa* whitish; *Asclepias* ~pink; *Asclepias texana* ~white; *Asclepias* white; Asteraceae rayless pink; Asteraceae rayless yellow; *Baccharis sarothroides* cream; *Baccharis* whitish; *Bidens pilosa* white to yellowish or purplish; *Chrysothamnus* yellow; *Clethra acuminata* white; *Clethra alnifolia* white (pink); *Eriogonum* whitish; resembles *Eriophyllum jepsonii* Texas white; *Eupatorium serotinum?* white; *Isocoma acradenia* white-yellow; Lamiaceae white flowers on top; *Lantana* yellow; *Lepidium latifolium* white; *Lepidospartum squamatum* yellow; *Leucelene?* whitish with orangish disc; *Melilotus alba* white; *Mikania scandens* ?white; “*Penstemon*” yellow; *Phoradendron flavescens* inconspicuous greenish flowers; *Pluchea sericea* pink to rose; *Polygonum* (*Bistorta*) white; *Prosopis* yellowish and other leguminous shrubs; *Prunus americana* white; *Senecio* yellow 2x; *Solidago* yellow 5x; *Verbesina virginica* white; white flowers; *Xanthoxylum clava-herculis* greenish or whitish; *Zinnia* ~white. So they do prefer white but often visit yellow and occasionally visit pinkish or greenish flowers. Adults fly down-valley to seek flowers and mud (Scott 1973b).

*Satyrium fuliginosum semiluna* Klots visits yellow and sometimes whitish flowers: *Arnica mollis* yellow ~10x; *Eriogonum subalpinum* [pinkish]-cream 24x; *Eriogonum umbellatum* yellow 22x; *Purshia tridentata* yellow; *Tetradymia canescens* yellow sunflower 9x.

*Satyrium behrii* (W. Edwards) usually visits whitish and yellow flowers, sometimes purple or pink, and occasionally visits mud: *Achillea millefolium* “*lanulosa*” white 3x; *Apocynum androsaemifolium* pinkish-white 18x; *Arnica rydbergii* yellow; *Asclepias speciosa* pink 8x; *Aster glaucodes* white to violet; *Astragalus drummondii* white; *Berteroa incana* white 3x; *Ceanothus fendleri* white 30x; *Cirsium arvense* purple 3x; *Clematis ligusticifolia* white; *Conium maculatum* white big umbel 2x; *Eriogonum flavum* yellow 8x; *Eriogonum jamesii* cream; *Eriogonum lobbii* var. *robustius* cream several; *Eriogonum lonchophyllum* white 2x; *Eriogonum umbellatum* yellow 28x; *Heterotheca villosa* yellow 4x; *Holodiscus discolor* whitish 2x; Lamiaceae abundant; *Medicago sativa* violet; *Melilotus alba* white many; *Monarda*

*fistulosa* rose-purple 3x; *Rhus glabra* green flowers 2x; *Rudbeckia laciniata ampla* yellow; *Solidago ~altissima* “~*canadensis*” yellow 4x; *Solidago missouriensis* yellow 3x; *Tetradymia canescens* yellow sunflower 9x; sap *Salix amygdaloides*; mud 3x.

*Satyrium liparops aliparops* (LeConte) visits whitish flowers, sometimes purple and pink and yellow:

*Apocynum androsaemifolium* pinkish-white 4x; *Apocynum cannabinum* whitish 4x; *Asclepias speciosa* pink pollinia on leg; *Asclepias syriaca* pink; *Ceanothus fendleri* white Janet Chu; *Cirsium arvense* purple 4x; *Clematis ligusticifolia* white 3x; *Euphorbia ~esula* yellow-green; *Melilotus alba* white; *Monarda fistulosa* rose-purple 3x; *Solidago ~altissima* “~*canadensis*” yellow 13x; *Solidago ~missouriensis* yellow 2x; *Symphoricarpos albus* pink; sap? female probing young 2 cm *Prunus virginiana* white leaf for ?aphid sap for a minute or two (a little black beetle was on leaf too) but no sap seen.

*Satyrium calanus godarti* (W. Field) visits yellow and whitish flowers, sometimes pink or purple: *Apocynum androsaemifolium* pinkish-white 7x; *Asclepias incarnata* pink; *Asclepias syriaca* pink pollinia on leg; *Centaurea diffusa* white; *Cirsium arvense* purple 2x; *Heracleum sphondylium montanum=lanatum* white; *Melilotus alba* white; *Melilotus officinalis* yellow many; *Rudbeckia hirta* yellow 2x; *Rudbeckia laciniata ampla* yellow 5x; *Solidago ~altissima* “~*canadensis*” yellow 10x; *Solidago ~missouriensis* yellow; sap of *Quercus gambelii* female sucking an acorn.

*Satyrium edwardsii* (Grote and Robinson): *Asclepias syriaca* pink ~7x.

*Satyrium auretteorum* (Boisduval): *Aesculus californica* whitish 32x; *Asclepias* pink; Brassicaceae like *Brassica* yellow; mud.

*Satyrium saepium* (Boisduval) visits whitish and yellow flowers, occasionally whitish and pink and purple/blue: *Achillea millefolium* “*lanulosa*” white 3x; *Aesculus californica* whitish; *Anaphalis margaritacea* whitish; *Apocynum androsaemifolium* pinkish-white 17x; *Asclepias* pink; *Asclepias speciosa* pink 2x; *Aster laevis* var. *geyeri* blue 2x; *Aster porteri* white 6x; *Baccharis salicifolia=viminea* whitish many; *Berteroa incana* white 2x; *Ceanothus fendleri* white 7x; *Cirsium arvense* purple 5x + var. *incanum* 2x; *Erigeron speciosus* blue 2x; *Eriodictyon californicum* white to lavender 2x; *Eriogonum effusum* white; *Eriogonum flavum* yellow 55x; *Eriogonum umbellatum* yellow 31x; *Heterotheca villosa* yellow 5x; Lamiaceae 5x; *Monarda fistulosa* rose-purple 2x + 3x only 1-2 sec. (proboscis too short); *Potentilla fruticosa* yellow 14x; *Rhus glabra* green flowers 2x; *Rudbeckia laciniata ampla* yellow 2x; *Solidago altissima* “*canadensis*” yellow 25x; *Solidago missouriensis* yellow 12x; *Solidago* yellow; mud 3x. Adults fly down-valley to seek flowers and mud (Scott 1973b).

*Satyrium tetra* (W. Edwards) visits whitish and pink flowers at least: *Aesculus californica* whitish 203x; *Asclepias speciosa* pink 2x; *Eriodictyon californicum* white to lavender 2x; *Melilotus alba* white; Lamiaceae.

*Satyrium sylvinus* (Boisduval) visits all colors of flowers (pink and white and yellow and purple/blue) except perhaps pure red, and mud: *Aesculus californica* whitish 2x; *Allium* sp. probably ~pink; *Apocynum androsaemifolium* pinkish-white 2x; *Asclepias* pink; *Asclepias speciosa* pink 25x incl. female captured by flower; aster blue; Asteraceae shrub; *Brassica nigra* yellow; *Carduus nutans* rose-purple; *Centaurea diffusa* lavender; *Cirsium arvense* purple 5x; *Clematis ligusticifolia* white 3x; *Melilotus alba* white; *Melilotus officinalis* yellow; Rosaceae shrub white; *Rudbeckia hirta* yellow; white uns *Rudbeckia laciniata ampla* yellow 4x; tiny white flowers; mud.

*Satyrium californica* (W. Edwards) visits whitish and yellow flowers, sometimes pink and purple, and mud: *Achillea millefolium* “*lanulosa*” white; *Aesculus californica* whitish 21x; *Apocynum androsaemifolium* pinkish-white 7x; *Asclepias* pink; *Asclepias speciosa* pink many; *Ceanothus fendleri* white 8x; *Cirsium arvense* purple 5x; *Eriogonum flavum* yellow; *Eriogonum jamesii* cream; *Eriogonum lobbii* var. *robustius* cream; *Eriogonum subalpinum* [pinkish]-cream 48x; *Euphorbia esula* yellow-green tiny flowers 3x; *Holodiscus discolor* whitish 11x; *Hymenopappus filifolius* yellow; Lamiaceae; *Marrubium vulgare* cream; *Melilotus alba* white; *Mentzelia* ~yellow; Lamiaceae many; *Potentilla fruticosa* yellow; *Rhus glabra* greenish 5 min.; Rosaceae shrub white; *Rudbeckia laciniata ampla* yellow 6x; *Sedum lanceolatum* yellow; *Solidago altissima* “*canadensis*” yellow 14x; *Solidago* yellow 2x; *Tetradymia canescens* yellow sunflower 13x; mud 7x.

*Satyrium acadica* (W. Edwards) visits pink, white, and less often purple-violet flowers: *Apocynum androsaemifolium* pinkish-white; *Apocynum cannabinum* whitish; *Asclepias speciosa* pink 27x; *Asclepias syriaca* pink 2x; *Cirsium arvense* purple 3x; *Medicago sativa* violet; *Melilotus alba* white 11x; *Polygonum amphibium coccineum* pink; *Tamarix chinensis*=*ramosissima* rosy-white.

*Satyrium titus* (Fabricius) visits yellow and white flowers, and less often purple, pink, blue, and orange, and sometimes mud: *Apocynum androsaemifolium* pinkish-white 4x; *Asclepias speciosa* pink 11x; *Asclepias tuberosa* orange; *Aster laevis* var. *geyeri* blue; *Aster porteri* white; Asteraceae yellow; Asteraceae shrub yellow; *Ceanothus fendleri* white 6x; *Chrysothamnus nauseosus* yellow 2x; *Cirsium arvense* purple 3x; *Clematis ligusticifolia* white 3x; *Cleome (Peritoma) serrulata* pinkish 2x; *Cryptantha jamesii* white 2x; *Eriogonum flavum* yellow-cream 16x; *Eriogonum umbellatum* yellow 9x; *Geranium caespitosum* pink 2x; *Heterotheca villosa* yellow 3x; Lamiaceae some; *Lupinus argenteus* blue; *Melilotus alba* white; *Monarda fistulosa* rose-purple 2x; *Opuntia imbricata* purplish; *Prunus americana* white; *Rhus glabra* green flowers 2x; *Rudbeckia hirta* yellow; *Senecio spartioides* yellow; *Solidago altissima* “*canadensis*” yellow 42x; *Solidago ~missouriensis* yellow 12x; *Solidago (Oligoneuron) rigida* yellow; *Symphoricarpos albus* pink; mud 2x.

*Satyrium favonius autolyucus* (W. Edwards) =*violae* (Stallings and Turner): white flowers 22x; *Apocynum androsaemifolium* pinkish-white; *Trifolium* 2x.

*Satyrium favonius ilavia* (Beutenmüller): abundant on white flowering plant.

*Phaeostrymon alcestis* (W. Edwards): *Apocynum androsaemifolium* pinkish-white; *Salix ?amygdaloides* catkins.

*Callophrys dumetorum* “*affinis*” *homoperplexa* W. Barnes and Benjamin generally visits yellow and white flowers: *Aletes acaulis* yellow 2x; *Antennaria parvifolia* whitish; *Apocynum androsaemifolium* pinkish-white 3x; *Astragalus flexuosus* purple 2x; *Barbarea orthoceras* yellow 3x; *Berberis (Mahonia) repens* yellow; *Ceanothus fendleri* white 9x; *Comandra umbellata* white 2x; *Cryptantha jamesii* white; *Eriogonum flavum* yellow; *Eriogonum umbellatum* yellow 5x; *Harbouria trachypleura* yellow 6x; *Heterotheca villosa* yellow; *Jamesia americana* white; *Lesquerella montana* yellow 2x; *Phacelia heterophylla* white; *Potentilla fissa* yellow; *Prunus americana* white 4x; *Ribes cereum* pinkish-white; *Rudbeckia hirta* yellow; *Senecio canus* yellow 2x; *Senecio fendleri* yellow 4x; *Senecio* yellow; *Thlaspi arvense* white landed 2x but I didn’t see proboscis; mud 9x.

*Callophrys dumetorum affinis* (W. Edwards): *Eriogonum subalpinum* [pinkish]-cream 2x.

*Callophrys sheridanii* (W. Edwards) prefers yellow/white flowers. Ssp. *sheridanii*: *Berberis (Mahonia) repens* yellow; *Cerastium strictum* “*arvense*” white 4x; *Claytonia rosea* pinkish-white 5x; *Cymopterus acaulis* white 2x; *Eriogonum umbellatum* yellow 2x; *Lesquerella montana* yellow; *Lomatium orientale* white; *Mertensia lanceolata* blue; *Thlaspi arvense* white 2x; *Thlaspi (Noccaea) fendleri* “*montanum*” white 4x. Ssp. *paradoxa*: *Lesquerella* yellow. Ssp. *pseudodumetorum*: *Salix* catkins ~whitish some; mud. Ssp. *lemberti*: *Arctostaphylos uva-ursi* whitish; *Ranunculus* ~yellow 2x.

*Callophrys gryneus* (Hübner) ssp. most often visit yellow/white flowers, and also visit pink etc. Ssp. *gryneus*: *Asclepias syriaca* pink. Ssp. *chalcosiva* Clench: *Purshia tridentata* yellow; mud. Ssp. *nelsoni* (Boisduval): *Achillea millefolium* “*lanulosa*” white ~18x; *Cryptantha* whitish; Gentian flower courting; *Mimulus ?guttatus* yellow with red spots; *Potentilla* yellow many; *Rubus* “blackberry” white; *Senecio* yellow. Ssp. *siva* (W. Edwards): *Achillea millefolium* “*lanulosa*” white 2x; *Aletes acaulis* yellow; *Apocynum androsaemifolium* pinkish-white 16x; *Asclepias asperula occidentalis* purple; *Asclepias speciosa* pink 3x; *Astragalus drummondii* white 3x; *Baccharis* whitish; *Ceanothus fendleri* white 26x incl. Janet Chu; *Chrysothamnus nauseosus* yellow 14x; “*Cirsium vulgare*” probably *Carduus nutans* rose-purple; *Cirsium arvense* purple 4x; *Cleome (Peritoma) serrulata* pinkish; *Comandra umbellata* whitish; *Conium maculatum* white 4x; *Cryptantha jamesii* white 12x; *Cryptantha virgata* white tall; *Eriogonum flavum* yellow 2x; *Eriogonum ovalifolium* var. *ovalifolium* pinkish or white; *Eriogonum umbellatum* yellow 10x incl. Janet Chu; *Erysimum asperum* yellow; *Euphorbia esula* yellow-green 4x; *Geranium caespitosum* pink; *Harbouria trachypleura* yellow 3x; *Heterotheca villosa* yellow 4x; *Hymenopappus filifolius* yellow 3x; *Jamesia americana* white 8x; large shrub in stream with erect brown “catkins” Ariz.; *Melilotus alba* white; *Melilotus officinalis* yellow commonly (Scott 1973a); *Opuntia polyacantha* yellow;

*Phacelia heterophylla* white 2x; *Phlox hoodii canescens* white with yellow centers; *Physocarpus monogynus* white; *Prunus virginiana* white 3x; *Rhus aromatica trilobata* yellowish old flowers; *Rudbeckia hirta* yellow; *Salix* flowers ~whitish 2x; *Schoenocrambe linifolia* yellow; *Sedum lanceolatum* yellow 2x; *Senecio canus* yellow 2x; *Senecio fendleri* yellow 9x; *Solidago altissima* “canadensis” yellow 4x; *Solidago* ~missouriensis yellow; *Solidago* yellow; *Trifolium hybridum* pinkish-white; *Veronica* ~*catenata* pale blue or white; white flowering plant; white flowering shrub; mud 7x.

*Callophrys johnsoni* (Skinner): *Ceanothus* sp. whitish; *Rhus aromatica trilobata* yellowish several; *Cercis occidentalis* pink; mud. Adults fly down-valley to seek flowers and mud (Scott 1973b).

*Callophrys spinetorum* (Hewitson) mostly visits whitish and yellow flowers: *Antennaria* ?*parvifolia* whitish Janet Chu; *Arctostaphylos uva-ursi* whitish 2x incl. Janet Chu; *Asclepias* pink; dull whitish-cream flower; *Eriogonum subalpinum* [pinkish]-cream 3x; *Fragaria* ~*vesca* white; *Melilotus alba* white; on flower; *Potentilla concinna* yellow; *Prunus americana* white 2x; *Pseudocymopterus montanus* yellow Janet Chu; *Sedum lanceolatum* yellow 2x; *Taraxacum officinale* yellow; yellow flower; catkin *Salix* ?*monticola* ~whitish; mud 16x incl. female.

*Callophrys mcfarlandi* P. Ehrlich and Clench: *Nolina greenii* “*texana*” white to cream many.

*Callophrys mossii schryveri* (Cross): *Cerastium strictum* “*arvense*” white; *Lesquerella montana* yellow; *Prunus americana* white 2x; *Taraxacum officinale* yellow.

*Callophrys mossii windi* (Clench): *Arctostaphylos* (manzanita) pink/white; *Cercis occidentalis* pink; mud.

*Callophrys augustinus iroides* (Boisduval): *Amelanchier* white NM; *Aletes acaulis* yellow. Adults fly down-valley to seek flowers and mud (Scott 1973b).

*Callophrys augustinus augustinus* (Westwood) usually visits white/yellow flowers: *Arctostaphylos uva-ursi* (the hostplant) whitish 21x; *Asclepias* pink; *Berberis* (*Mahonia*) *repens* yellow; *Calyptridium umbellatum* white; *Cerastium strictum* “*arvense*” white; *Cercis occidentalis* pink; *Prunus virginiana* white; *Rhamnus californica* yellowish many; *Rhus aromatica trilobata* yellowish 2x; *Senecio canus* yellow; *Thlaspi arvense* white; mud 5x.

*Callophrys polios* (Cook and F. Watson) prefers the white flowers of its caterpillar hostplant: *Arctostaphylos uva-ursi* whitish 18x; *Barbarea orthoceras* yellow 2x; *Penstemon secundiflorus* purple rear of flower (male aimed toward peduncle); mud 2x incl. female.

*Callophrys eryphon* (Boisduval) mostly visits white/yellow flowers: *Arctostaphylos uva-ursi* whitish 5x; *Asclepias subverticillata* whitish; *Barbarea orthoceras* yellow 35x; *Berberis* (*Mahonia*) *repens* yellow 3x; *Calyptridium umbellatum* white; *Conium maculatum* white; *Cryptantha jamesii* white 2x; *Eriogonum lobbii* var. *robustius* cream; *Euphorbia esula* yellow-green 2x; *Harbouria trachypleura* yellow 3x (one briefly); *Hymenopappus filifolius* yellow; *Hymenoxys* (*Tetranuris*) *acaulis* yellow; *Prunus americana* white 5x (including Janet Chu); *Prunus virginiana* white 2x; *Rhus aromatica trilobata* yellowish 4x; *Rosa* ~pink; *Rubus deliciosus* white; *Salix monticola* catkin ~whitish 12x; *Salix scouleriana* catkin ~whitish several; *Sedum lanceolatum* yellow; *Senecio canus* yellow; *Senecio* yellow; *Taraxacum officinale* yellow; *Thlaspi* (*Noccaea*) *fendleri* “*montanum*” white; *Townsendia grandiflora* bluish-white; mud 7x.

*Strymon melinus* Hübner visits all colors of flowers, even red, and sometimes visits mud: *Abronia fragrans* whitish; *Achillea millefolium* cultivated variety white; *Achillea millefolium* “*lanulosa*” white; *Aesculus californica* whitish; *Agastache rupestris* red; *Allium textile* white to light-rose; *Apocynum androsaemifolium* pinkish-white 6x; *Arctium minus* rose-purple; *Asclepias pumila* white; *Asclepias syriaca* pink; *Asclepias tuberosa* orange; (proboscis too short for *Asclepias speciosa* pink); *Aster ericoides* white 6x; *Aster fendleri* blue-violet; *Aster laevis* var. *geyeri* blue 5x incl. Janet Chu; *Aster lanceolatus hesperius* bluish-white; *Aster porteri* white 4x; Asteraceae yellow; Asteraceae shrub yellow 3x; *Astragalus bisulcatus* purple; *Astragalus flexuosus* purple 3x; *Astragalus laxmannii* “*adsurgens*” usually whitish 3x; *Astragalus shortianus* purple; ~*Baccharis sarothroides* whitish; *Baccharis* whitish; *Berberis* (*Mahonia*) *repens* yellow; *Berteroa incana* white; *Bidens cernua* yellowish 4x; *Buddleja davidii* purple 2x; *Carduus nutans* rose-purple; *Ceanothus fendleri* white 4x; *Centaurea diffusa* white; ?*Chaenactis douglasii* white-flowered Asteraceae; *Chrysanthemum Xsuperbum* white (1x, + several times but flew after sipping for a few sec.); *Chrysothamnus nauseosus* yellow 39x; *Cirsium arvense* purple 18x; *Clematis ligusticifolia* white; *Conyza canadensis* whitish; *Croton texensis* whitish 3x; *Dalea candida*

white; *Dalea purpurea* pink-purple 2x incl. Anne U. White and Janet Chu; *Echinacea purpurea* purple 3x; *Erigeron pumilus* bluish-white; *Erigeron speciosus* blue; *Eriogonum alatum* yellowish (ovipositing?); *Eriogonum corymbosum* var. *velutinum* whitish; *Eriogonum effusum* white 17x; *Eriogonum flavum* yellow 9x + var. *chloranthum* cream 1x; *Eriogonum jamesii* cream; *Eriogonum latifolium* whitish 6x; *Eriogonum lonchophyllum* whitish 2x; *Eriogonum umbellatum* yellow 9x; ~*Eupatorium purpureum* pink-purple big 1 m “*Liatrix*” with wide leaves; *Euphorbia* green sp. and palpated its flowers some for 2 min. then flew; *Euphorbia marginata* green and white; *Geranium caespitosum* pink; *Glycyrrhiza lepidota* yellowish-white; *Gutierrezia sarothrae* yellow 4x; *Helianthus nuttallii* yellow; *Hesperis matronalis* pink (+another 2 sec.); *Heterotheca canescens* yellow; *Heterotheca villosa* yellow 7x; *Lesquerella montana* yellow; *Liatrix punctata* purplish 10x; *Linaria canadensis* var. *texana* blue; *Linaria vulgaris* yellow with orange palate 15x by feeding from holes made by bumblebees? in spur (most flowers have such holes and one had 5 holes, a bumblebee fed out of same holes); *Marrubium vulgare* cream 2x; *Medicago sativa* violet 45x; *Melilotus alba* white 5x; *Melilotus officinalis* yellow 5x; *Mentha arvensis* pink low Lamiaceae; *Oxytropis lambertii* reddish-purple; *Phacelia heterophylla* ~pinkish; *Phlox hoodii canescens* white with yellow centers; *Plantago lanceolata* white 2x; *Polygonum amphibium coccineum* pink 5x; *Prunus americana* white; *Psoralea tenuiflora* 6x blue-purple; *Rhus aromatica trilobata* yellowish; *Rudbeckia hirta* yellow; *Senecio canus* yellow 2x; *Solidago altissima* “*canadensis*” yellow; *Solidago missouriensis* yellow; *Solidago nana* yellow sprawling; *Solidago (Euthamia) occidentalis* yellow 2x; *Solidago rigida* yellow 2x; *Solidago simplex* var. *nana=decumbens* yellow; *Solidago* yellow; *Sphaeralcea coccinea* orange; *Taraxacum officinale* yellow; *Thelesperma megapotamicum* yellowish; *Trifolium fragiferum* pink; *Trifolium repens* whitish 8x; *Trifolium*; *Verbascum thapsus* yellow 2x; *Verbena hastata* purple 2x; *Verbena* “Purple Top” purplish-blue; *Verbena stricta* purplish-blue; *Verbena* purplish-blue Janet Chu; *Verbesina encelioides* golden-orange; *Viguiera (Heliomeris) multiflora* yellow; big yellow sunflower; *Zinnia elegans* ?pink 2x; catkin *Salix*; mud 4x.

*Strymon cestri* (Reakirt): ~*Senecio spartioides* yellow.

*Strymon bazochii* (Godart): *Lantana camara* yellow-red common.

*Ministrymon leda* (W. Edwards) visits whitish, often yellow, sometimes pink flowers: *Apocynum androsaemifolium* pinkish-white; Asteraceae shrub yellow; ~*Baccharis sarothroides* whitish 7x; *Baccharis* whitish 2x; *Clematis*? ~white; *Croton texensis* whitish; large shrub in stream with erect brown “catkins” Ariz.; *Polygonum ?pensylvanicum* pink many; *Senna hirsuta* var. *leptocarpa* yellow; tiny white-yellow-flowered tiny-leaf “*Cercocarpus*”; white-flowered shrub similar to *Amelanchier*.

*Erora laeta quaderna* (Hewitson): *Ceanothus fendleri* white; mud (Scott 1973b). Adults fly down-valley to seek flowers and mud (Scott 1973b).

#### LYCAENIDAE, LYCAENINAE, POLYOMMATINI

*Leptotes marina* (Reakirt) visits whitish, yellow, orange, pinkish, purple-violet flowers, and frequents mud: *Apocynum androsaemifolium* pinkish-white; Asteraceae yellow shrub; *Baccharis* whitish; *Chrysothamnus nauseosus* yellow; *Cirsium arvense* purple; *Eriogonum umbellatum* yellow; *Geranium caespitosum* pink; *Medicago sativa* violet 16x; *Melilotus alba* white 4x; orange winged flower; *Phaseolus heterophyllus* flower with two orange hoods and yellow center with vine stem and tri-part leaves; *Polygonum ?pensylvanicum* pink; *Trifolium repens* whitish; white flowering plant; yellow-flowered low bush; mud 68x.

*Brephidium exilis* (Boisduval): *Aster fendleri* blue-violet; *Baccharis salicifolia* whitish; *Chrysothamnus nauseosus* yellow 2x; *Medicago sativa* violet; *Melilotus alba* white.

*Cupido comyntas* (Godart) visits yellow, white, bluish/purple, or pink flowers: *Asclepias incarnata* pink 2x; *Cirsium arvense* var. *incanum* purple; *Coreopsis verticillata* yellow; *Erigeron philadelphicus* white; *Lotus corniculatus* yellow 2x but proboscis maybe not inserted as flowers are long; *Medicago lupulina* yellow 4x; *Medicago sativa* violet 5x; *Melilotus alba* white 2x; *Oxalis stricta* yellow 7x; *Trifolium fragiferum* pink; *Trifolium hybridum* pinkish-white 4x; *Trifolium pratense* red-purple 2x; *Trifolium repens* whitish 23x; *Vicia villosa* violet and white to rose; blood of chicken many fed on blood on ground; mud 13x.

*Cupido amyntula valeriae* (Clench) visits white, sometime yellow or purplish or pinkish flowers: *Allium cernuum* pink 2x; *Apocynum androsaemifolium* pinkish-white; *Aster porteri* white; *Astragalus drummondii* white; *Astragalus flexuosus* purple-blue 12x; *Centaurea diffusa* white; *Cerastium strictum* "arvense" white 2x; ~*Draba* yellow; *Eriogonum effusum* white; *Eriogonum lobbii* var. *robustius* cream; *Lathyrus leucanthus* white 3x; *Potentilla ?pulcherrima* tiny yellow flower 1 cm wide; *Rhus aromatica trilobata* yellowish; *Sedum lanceolatum* yellow 2x; *Taraxacum officinale* yellow; *Thlaspi (Noccaea) fendleri* "montanum" white; *Trifolium pratense* red-purple; *Vicia americana* purple; urine; manure horse; mud 105x.

*Celastrina neglecta* (W. Edwards) usually visits white flowers, sometimes yellow or purplish ones: *Anemone canadensis* white; *Anethum graveolens* yellow Lakewood, Jeff. Co. CO (evidently *neglecta*); *Aster simplex* whitish; *Cornus sericea*=*stolonifera* white 5x; *Cryptotaenia canadensis* white; *Melilotus officinalis* yellow 2x; *Rhus glabra* whitish or greenish-yellow bushes flowers a long time 3x; *Sambucus canadensis* white; *Trifolium pratense* red-purple; *Trifolium repens* whitish 65x; *Verbena hastata* purplish-blue; mud common.

*Celastrina neglecta echo* (W. Edwards): *Aesculus californica* whitish.

*Celastrina neglecta cinerea* (W. Edwards) prefers white flowers: *Ceanothus fendleri* white; *Holodiscus discolor* whitish; *Solidago* yellow; white flowering plant; mud 19x.

*Celastrina lucia sidara* (Clench) feeds only on yellow and white flowers (biology was discussed by Scott and Wright 1998): *Aletes acaulis* yellow 2x; *Antennaria parvifolia* whitish 2x; *Arctostaphylos uva-ursi* whitish 10x; *Barbarea orthoceras* yellow 14x; *Berberis (Mahonia) repens* yellow Janet Chu; *Ceanothus fendleri* white; *Cerastium strictum* "arvense" white 3x; *Clematis ligusticifolia* white; *Harbouria trachypleura* yellow; *Jamesia americana* white 24x; *Lesquerella montana* yellow; "mustard" Janet Chu; *Physocarpus monogynus* white 3x; *Potentilla fissa* yellow; *Prunus virginiana* white 17x; *Salix monticola* catkin ~whitish 7x; *Senecio canus* yellow; *Senecio fendleri* yellow; *Thlaspi (Noccaea) fendleri* "montanum" white 3x; feeding on sugar? on leaves of ~*Conium maculatum* white umbel; wet rotting wood 2x; manure horse 2x; mud 182x (includes f. *lucimargina* 6x).

*Celastrina lucia lumarco* Scott: *Ribes inerme* pinkish.

*Celastrina humulus* Scott and Wright (hop-ecotype) seldom feeds on flowers, but prefers white or yellow flowers, sometimes pink: *Apocynum cannabinum* whitish 4x; *Barbarea orthoceras* yellow 3x; *Ceanothus fendleri* white 4x incl. Janet Chu; *Cerastium strictum* "arvense" white landed on and flew; *Geranium caespitosum* pink; *Jamesia americana* white cream 6x; *Phacelia heterophylla* ~pinkish; *Solidago altissima* "canadensis" yellow; honeydew from cream-colored small Cicadellidae on ups of leaf bases of two *Lactuca serriola* plants; mud 13x incl. visit by female. It ignored *Achillea millefolium* "lanulosa" white and ignored *Physocarpus monogynus* white, and landed on *Anemone canadensis* white but flew.

*Celastrina humulus* Scott and Wright (lupine-ecotype) seldom visits flowers: *Barbarea orthoceras* yellow 4x; *Ceanothus fendleri* white; *Claytonia rosea* pinkish-white; *Euphorbia esula* yellow-green 2x; *Geranium caespitosum* pink 7x and white 6x; *Linum lewisii* blue landed below petals to ?feed once for ~10 sec.; *Prunus virginiana* white; (one landed on *Clematis hirsutissima* blue but left); mud 14x; dung of ?dog.

*Hemiargus isola* (Reakirt) has a very small proboscis, so can visit only small flowers. It visits yellow and white and purplish-violet and sometimes pink and reddish flowers (it frequents small *Trifolium*), and often visits mud: *Achillea filipendulina* "Gold Plate" yellow; *Aster ericoides* white (6x + var. *ericoides* 4x + var. *falcatus* 1x); *Aster laevis* var. *geyeri* blue; *Aster porteri* white 4x; *Astragalus drummondii* white 2x; *Astragalus flexuosus* purple 2x; *Astragalus gracilis* + var. *parviflorus* purple; *Berteroa incana* white; *Chrysothamnus nauseosus* yellow 6x; *Cirsium arvense* purple 2x; *Eriogonum corymbosum* var. *velutinum* whitish; *Eriogonum umbellatum* yellow 2x; *Glycyrrhiza lepidota* yellowish-white 3x; *Gutierrezia sarothrae*? yellow; *Helianthus petiolaris* yellow 1 sec.; *Helianthus pumilus* yellow; *Heterotheca canescens* yellow; *Heterotheca villosa* yellow 2x; *Humulus lupulus* female flower; *Hymenopappus filifolius* yellow; *Hymenoxys (Tetraneuris) acaulis* yellow; *Lavandula angustifolia* light-purple 3x; *Lesquerella montana* yellow; *Liatris punctata* purplish; *Limonium latifolium* violet-blue 6x; *Lupinus argenteus* blue; *Medicago lupulina* yellow; *Medicago sativa* violet 23x; *Melilotus alba* white 6x;



*Melilotus officinalis* yellow 2x; *Mertensia lanceolata* blue flower that had lost its petals (intact flowers have petals too long for the short proboscis); *Nepeta Xfaassenii* violet 4x; *Perovskia atriplicifolia* blue (Michael S. Fisher); *Polygonum ?pensylvanicum* pink; *Psoralea tenuiflora* blue-purple 2x; *Psoralea?* thin blue legume; *Rhus aromatica trilobata* yellowish; *Rorippa sinuata* yellow; *Sedum lanceolatum* yellow 5x; *Solidago missouriensis* yellow 2x; *Sphaeralcea coccinea* orange; *Tagetes patula* orange; *Thlaspi arvense* white 10x; *Trifolium fragiferum* pink 23x popular; *Trifolium pratense* red-purple 2x; *Trifolium repens* whitish 45x; yellow-flowered low bush; mud 26x.

*Hemiargus ceraunus gyas* (W. Edwards): *Melilotus alba* white; *Polygonum ?pensylvanicum* pink some; mud.

*Philotiella speciosa* (H. Edwards): Asteraceae small yellow.

*Euphilotes* species visit mostly just the flowers of the local hostplant.

*Euphilotes bernardino martini* (Mattoni): *Eriogonum fasciculatum* var. *polifolium* whitish many.

*Euphilotes battoides battoides* (Behr): mud.

*Euphilotes battoides comstocki* (Shields): *Eriogonum umbellatum* var. *furcosum* yellow.

*Euphilotes battoides intermedia* (W. Barnes and McDunnough): *Eriogonum ~nudum* ~yellowish ½ m tall many; *Eriogonum umbellatum* yellow 2x; mud.

*Euphilotes battoides (ellisii) basinensis* Austin: *Eriogonum heermannii* var. *humilius* white 2x.

*Euphilotes battoides (ellisii) ellisii* Shields: *Eriogonum corymbosum* whitish many.

*Euphilotes battoides (ellisii) anasazi* Scott: *Eriogonum corymbosum* var. *velutinum* whitish many.

*Euphilotes glaucon glaucon* (W. Edwards): *Eriogonum umbellatum* yellow; *Eriogonum* like *E. shockleyi* 1” cream balls with gray spoonlike leaves.

*Euphilotes glaucon hadrocheilus* Pratt and J. Emmel: *Eriogonum umbellatum* yellow.

*Euphilotes glaucon centralis* (W. Barnes and McDunnough): *Eriogonum jamesii* cream 24x; *Aster* ?whitish; manure; mud 19x.

*Euphilotes enoptes enoptes* (Boisduval): *Eriogonum nudum* yellowish 12x; *Eriogonum incanum* yellow; *Eriogonum* tiny white flowers.

*Euphilotes enoptes bayensis* (Langston): *Eriogonum latifolium* whitish abundant.

*Euphilotes enoptes dammersi* (J. Comstock and Henne): mud.

*Euphilotes ancilla* (W. Barnes and McDunnough) visits almost only yellow flowers esp. of its hostplant, and frequents mud: Ssp. *ancilla*: *Chrysothamnus nauseosus* yellow 4x; *Eriogonum subalpinum* cream 5x. Ssp. *barnesi* Opler and Fisher: *Eriogonum flavum* yellow-cream 2x; *Eriogonum subalpinum* [pinkish]-cream 5x; *Eriogonum umbellatum* yellow 100x; *Euphorbia esula* yellow-green; *Heterotheca villosa* yellow 3x; *Medicago lupulina* yellow Janet Chu; mud 106x; Ssp. *gilvatunica* Austin: *Eriogonum lobbii* var. *robustus* cream.

*Euphilotes ancilla stanfordorum* Opler and Warren: *Eriogonum ovalifolium* var. *ovalifolium* pinkish or white 6x.

*Euphilotes rita coloradensis* (Mattoni): *Eriogonum effusum* white 30x; mud 5x.

*Euphilotes rita rita* (W. Barnes and McDunnough): *Eriogonum wrightii* white 3x.

*Euphilotes rita emmeli* (Shields): *Eriogonum* (bluish-gray with no or small leaves, bushy 1.5’ tall) white; *Eriogonum leptocladon* (var. *leptocladon* yellow many, var. *ramosissimum* white several).

*Euphilotes rita pallescens* (Tilden and Downey): *Eriogonum kearneyi* var. *kearneyi* whitish.

*Euphilotes spaldingi pinjuna* Scott: *Eriogonum jamesii* cream; *Eriogonum racemosum* cream; mud many.

*Glaucopsyche piasus daunia* (W. Edwards) visits white and yellow flowers, sometimes pink or purple, and often visits mud: *Astragalus drummondii* white; *Astragalus flexuosus* purple 3x; *Astragalus laxmannii* “*adsurgens*” usually whitish; *Barbarea orthoceras* yellow 5x; Brassicaceae white; *Ceanothus fendleri* white; *Chrysothamnus nauseosus* yellow 3x; *Conium maculatum* white 5 sec.; *Cryptantha virgata* white 2x; *Erigeron pumilus* white; *Eriogonum umbellatum* yellow 2x; *Geranium caespitosum* pink; *Glycyrrhiza lepidota* yellowish-white; *Jamesia americana* white; *Phacelia heterophylla* white 3x; *Sedum lanceolatum* yellow; *Senecio integerrimus* yellow; mud 24x.

*Glaucopsyche lygdamus oro* (Scudder) visits most colors except perhaps red: *Allium cepa* lilac or white 17x; *Astragalus alpinus* (purple 1x, white with small purple areas 1x); *Astragalus agrestis* purple 2x; *Astragalus drummondii* white; *Astragalus flexuosus* purple 10x; *Barbarea orthoceras* yellow 9x; *Berberis*

(*Mahonia repens*) yellow; *Cerastium strictum* “*arvense*” white; *Erigeron pumilus* 5x (usually bluish-white, some white); *Eriogonum umbellatum* yellow; *Erysimum asperum* yellow; *Hymenopappus filifolius* yellow; *Hymenoxys (Tetraneuris) acaulis* yellow; *Harbouria trachypleura* yellow; *Iris missouriensis* pale-blue failed to probe petal; *Lepidium campestre* white; *Lesquerella montana* yellow 3x; *Linum lewisii* blue; *Lonicera involucrata* yellow Janet Chu; *Medicago sativa* violet 5x; *Melilotus alba* white; *Melilotus officinalis* yellow; *Mertensia lanceolata* blue 2x; *Oxytropis lambertii* reddish-purple 5x; *Phacelia heterophylla* ~pinkish; *Physaria ~vitulifera* yellow 2x; *Senecio fendleri* yellow; *Thermopsis divaricarpa* yellow 8x (5 of these noted to put proboscis between corolla and sepals); *Thlaspi arvense* white 17x; *Thlaspi (Noccaea) fendleri* “*montanum*” white 2x; tiny white and yellow mustard blossoms Janet Chu; *Vicia americana* purple; dung of ?dog; white bird dung; mud 35x.

*Plebejus atrapraetextus longinus* (Nabokov): mud 6x.

*Plebejus melissa melissa* (W. Edwards) visits whitish, yellow, and blue/purple colors but seldom pink or reddish, and often visits mud: *Achillea millefolium* “*lanulosa*” white; *Allium textile* white; *Aster ascendens* blue 3x; *Aster ericoides* white 22x + var. *ericoides* 1x + var. *falcatus* 5x; *Aster laevis* var. *geyeri* blue; *Aster lanceolatus hesperius* bluish-white 3x; *Aster porteri* white 5x; *Astragalus agrestis* purple 2x; *Astragalus bisulcatus* purple 3x; *Astragalus drummondii* white 3x; *Astragalus flexuosus* purple 8x; *Astragalus laxmannii* “*adsurgens*” usually whitish; *Astragalus missouriensis* rose-purple; *Barbarea orthoceras* yellow; *Berteroa incana* white 2x; *Ceanothus fendleri* white; *Centaurea diffusa* (white 8x, lavender 1x); *Centaurea maculosa* lavender; *Chrysothamnus nauseosus* yellow 28x; *Cirsium arvense* var. *incanum* purple 3x; *Croton texensis* whitish 2x; *Dalea candida* white; *Delphinium ajacis* violet; *Erigeron pumilus* bluish-white 8x; *Eriogonum brevicaulis* yellow; *Eriogonum effusum* white 5x; *Eriogonum flavum* yellow; *Eriogonum subalpinum* [pinkish]-cream; *Eriogonum umbellatum* yellow 5x; *Erysimum asperum* yellow; *Grindelia squarrosa* yellow 2x; *Gutierrezia sarothrae* yellow 5x; *Heterotheca villosa* yellow 14x; *Hymenopappus filifolius* yellow; *Hymenoxys (Tetraneuris) acaulis* yellow 2x; *Kuhnia eupatoroides* white; *Lesquerella montana* yellow 2x; *Liatris punctata* purplish 3x; *Linum lewisii* blue; *Lygodesmia juncea* pink; *Machaeranthera pinnatifida*=*Haplopappus spinulosus* yellow; *Medicago lupulina* yellow 2x; *Medicago sativa* violet 25x; *Melilotus alba* white 5x; *Melilotus* white or yellow common; *Melilotus officinalis* yellow 5x; *Oxytropis lambertii* purple 2x (one placed proboscis into base of flower); *Psoralea tenuiflora* blue-purple 28x; *Rorippa sinuata* yellow; *Sedum lanceolatum* yellow; *Senecio fendleri* yellow 2x; *Senecio plattensis* yellow; *Senecio tridenticulatus* yellow; *Solidago missouriensis* yellow 2x; *Trifolium fragiferum* pink 6x; *Verbena hastata* purplish-blue; *Verbena stricta* purplish-blue; *Viguiera (Heliomeris) multiflora* yellow 2x; urine; mud 81x.

*Plebejus melissa pseudosamuelis* (Nabokov): *Astragalus alpinus* purple; *Erigeron ursinus* blue-purplish; *Potentilla fruticosa* yellow.

*Plebejus saepiolus* (Boisduval) visits yellow, whitish, and blue/purple flowers (seldom reddish), and mud: *Achillea millefolium* “*lanulosa*” white; *Anaphalis margaritacea* whitish; *Antennaria parvifolia* whitish 2x (one probing dry seedy head); *Arabis stricta* white; *Arnica cordifolia* yellow; *Arnica mollis* yellow; *Aster foliaceus* var. *apricus* purple; *Astragalus agrestis* purple 18x; *Astragalus alpinus* purple 2x; *Astragalus flexuosus* purple 2x; *Astragalus kentrophyta implexus* blue; *Barbarea orthoceras* yellow; *Ceanothus fendleri* white; *Cirsium scariosum* cream 2x; *Erigeron elatior* pink-purple 2x; *Erigeron pumilus* bluish-white 5x; *Erigeron speciosus* blue; *Erigeron ursinus* blue-purplish 13x; *Eriogonum subalpinum* [pinkish]-cream 2x; *Fragaria virginiana glauca* white 2x; *Geum (Acomastylis) rossii turbinatum* yellow; *Heterotheca pumila* yellow 2x; *Jamesia americana* white; *Limnorchis* “*Habenaria*” *dilatata* white 2 sec.; *Polygonum bistortoides* whitish 2x; *Potentilla pulcherrima* yellow (1x + ½ sec. twice); *Sedum rhodanthum* pink; *Senecio atratus* yellow; *Senecio canus* yellow; *Senecio crassulus* yellow 6x; *Senecio dimorphophyllus* yellow; *Senecio integerrimus* yellow; *Senecio triangularis* yellow; *Solidago simplex* var. *nana*=*decumbens* yellow; *Taraxacum officinale* yellow; *Trifolium hybridum* pinkish-white 11x; *Trifolium pratense* red-purple 2x; *Trifolium repens* whitish 7x; *Veronica nutans* blue; mud 14x.

*Plebejus icarioides* (Boisduval) (mostly ssp. *lycea* [W. Edwards]) visits whitish, yellow, and sometimes bluish/purple, rarely reddish, flowers, and often visits mud: *Achillea millefolium* “*lanulosa*” white; *Aesculus californica* whitish; *Apocynum androsaemifolium* pinkish-white; *Astragalus flexuosus* purple

4x; *Astragalus laxmannii* “*adsurgens*” 1x and white var. 1x; *Astragalus miser* pinkish-white; *Astragalus* blue 3x; *Ceanothus fendleri* white 4x; *Erigeron pumilus* usually white; *Eriogonum effusum* white; *Eriogonum lobbii* var. *robustius* cream; *Eriogonum subalpinum* [pinkish]-cream 45x; *Eriogonum umbellatum* yellow 9x; *Harbouria trachypleura* yellow; *Helianthus ~petiolaris* yellow; *Helianthus pumilus* yellow; *Heterotheca villosa* yellow 2x incl. Janet Chu; *Lupinus plattensis* blue; *Lupinus* blue 2x; *Melilotus alba* white 2x; *Melilotus officinalis* yellow; *Mentha arvensis* pink; [*Mentha spicata* or *Nepeta cataria*] white Lamiaceae; *Mertensia lanceolata* blue; *Oxytropis lambertii* reddish-purple; *Phacelia heterophylla* white 2x; *Plantago lanceolata* white; *Potentilla* yellow; *Prunus virginiana* white; *Salix exigua* female catkin; *Sedum lanceolatum* yellow 5x; *Senecio fendleri* yellow 6x; *Senecio plattensis* yellow; *Solidago?* yellow; *Trifolium pratense* red-purple; sweat on net handle; leafhopper honeydew female sucked it from tops of *Monarda fistulosa* and top of *Heterotheca villosa* plants; mud 112x.

*Plebejus shasta* (W. Edwards) usually visits yellow flowers, sometimes cream/white, sometimes blue/violet: Ssp. *pitkinensis* Ferris: *Arnica mollis* yellow; Asteraceae yellow usually; *Erigeron pinnatisectus* violet 4x; *Erigeron ursinus?* light-blue “aster”; *Eriogonum flavum* var. *chloranthum* cream; *Haplopappus (Tonestus) pygmaeus* yellow 2x; “Saxifrage” white; *Sedum lanceolatum* yellow 2x; *Solidago simplex* var. *nana=decumbens* yellow 5x. Ssp. *minnehaha* (Scudder): *Eriogonum flavum* yellow 3x; *Eriogonum umbellatum* yellow; *Heterotheca villosa* yellow ~5x.

*Plebejus acmon* and *P. alupini* (Boisduval) have *Eriogonum* (sometimes legumes) as caterpillar hostplants, yet adults feed on many flowers, in contrast to *Euphilotes* which usually feed only on *Eriogonum* as adults.

*Plebejus acmon* (Westwood) visits all flower colors except pure red, most often whitish: *Asclepias speciosa* pink; Asteraceae shrub yellow 6x; *Astragalus* blue; *Baccharis salicifolia* whitish 30x; *Brassica nigra* yellow 1x; Brassicaceae ?yellow or white; *Cirsium arvense* purple 1x; *Cirsium canescens* whitish; *Eriodictyon* white to lavender; *Eriogonum latifolium* whitish 14x; *Eriogonum lobbii* var. *robustius* cream many; Iridaceae white; *Polygonum pensylvanicum* pink.

*Plebejus alupini texanus* (Goodpasture) visits yellow and white flowers, sometimes blue-purple, and mud: *Aster ericoides* var. *falcatus* white; *Aster lanceolatus hesperius* bluish-white; *Aster porteri* white; *Astragalus flexuosus* purple; *Astragalus sericoleucus* (on flower?) blue-purple; *Chrysothamnus nauseosus* yellow; *Erigeron pumilus* usually white; *Eriogonum annuum* whitish 2x; *Eriogonum brevicaulis* yellow; *Eriogonum corymbosum* var. *velutinum* whitish; *Eriogonum effusum* white 59x; *Eriogonum jamesii* cream; *Eriogonum lonchophyllum* whitish 2x; *Eriogonum umbellatum* yellow; *Eriogonum wrightii* white 32x; *Glycyrrhiza lepidota* yellowish-white sucking; *Gutierrezia sarothrae* yellow 2x; *Heterotheca canescens* yellow 5x; *Heterotheca villosa* yellow 3x; *Melilotus officinalis* yellow; *Psoralea tenuiflora* blue 3x; purple legume several; *Senecio fendleri* yellow 4x; *Taraxacum officinale* yellow “landing on dandelion”; *Thelesperma filifolium* yellow; white flowering plant; manure; mud 40x.

*Plebejus alupini lutzii* dos Passos visits yellow and whitish flowers, and mud: *Achillea millefolium* “*lanulosa*” whitish; *Berteroa incana* white 2x; (near-lutzii) *Ceanothus fendleri* white 11x; *Cerastium strictum* “*arvense*” white; *Chrysothamnus nauseosus* yellow 10x; *Eriogonum flavum* yellow; *Eriogonum subalpinum* [pinkish]-cream 15x; *Eriogonum umbellatum* yellow 11x; *Solidago simplex* var. *nana=decumbens* yellow; mud 4x.

*Plebejus alupini cotundra* Scott and M. Fisher: *Erigeron pinnatisectus* blue/purple; *Eriogonum flavum* var. *chloranthum* cream.

*Plebejus alupini alupini* (Boisduval): *Eriogonum marifolium* yellow; *Eriogonum ~nudum* yellowish ½ m many; *Eriogonum umbellatum* yellow 2x. *Plebejus* “*lupini*” was grossly misnamed because its larvae eat *Eriogonum* and its adults have never been seen to visit *Lupinus* (I have no records), illustrating a defect in International Commission of Zoological Nomenclature articles that require such misleading names to be used in perpetuity with no possibility of correction, so Scott (2008) invoked the *lapsus contrarius* principle to rename it *P. alupini*.

*Plebejus chlorina monticola* (Clemence): *Eriogonum umbellatum* var. *furcosum* yellow.

*Plebejus glandon rustica* (W. Edwards) visits yellow and whitish (sometimes bluish/purplish and rarely reddish) flowers, and mud: *Achillea millefolium* “*lanulosa*” white 8x; *Agoseris glauca* yellow;

*Antennaria parvifolia* white 4x + 1 sec.; *Arnica cordifolia* yellow 3x; *Arnica mollis* yellow 2x; *Aster foliaceus* var. *apricus* blue-violet sometimes purple 10x; *Astragalus laxmannii* “*adsurgens*” usually whitish; *Barbarea orthoceras* yellow; *Cerastium strictum* “*arvense*” white? tiny leaves; *Chrysanthemum leucanthemum* white; *Erigeron compositus* white filiform leaves 2x; *Erigeron coulteri* whitish 2x; *Erigeron elatior* pink-purple 26x; *Erigeron pinnatisectus* blue/purple 2x; *Erigeron pumilus* white 1x; *Erigeron simplex* blue 2x; *Erigeron speciosus* blue 2x; *Erigeron ursinus* blue 93x; *Erigeron* ~blue 2x; *Eriogonum subalpinum* [pinkish]-cream 4x; *Eriogonum umbellatum* yellow 10x; *Fragaria virginiana glauca* white 1x + 1 sec.; *Geranium caespitosum* pink 3x; *Geum (Acomastylis) rossii turbinatum* yellow; *Haplopappus (Oreochrysum) parryi* yellow 3x; *Heterotheca pumila* yellow 12x; *Heterotheca villosa* yellow; *Hymenoxys grandiflora* yellow; *Machaeranthera pattersoni* purple/violet; *Melilotus officinalis* yellow 2x; *Oxalis dillenii* yellow; *Oxytropis lambertii* reddish-purple; *Penstemon virens* blue; *Polygonum bistortoides* whitish 3x; *Potentilla diversifolia* yellow 2x; *Potentilla fissa* yellow 2x; *Potentilla fruticosa* yellow 5x; *Potentilla hippiana* yellow; *Potentilla pulcherrima* yellow 7x; *Prunus virginiana* white; *Rudbeckia hirta* yellow 3x; *Saxifraga (Micranthes) oregana* white 2x; *Sedum lanceolatum* yellow 12x; *Senecio atratus* yellow 11x; *Senecio crassulus* yellow; *Senecio fendleri* yellow 2x; *Senecio fremontii* var. *blitoides* yellow; *Senecio triangularis* yellow 2x; *Solidago multiradiata* yellow 6x; *Solidago simplex* var. *nana=decumbens* yellow 20x; sunflower yellow; *Taraxacum officinale* yellow 3x; *Tetradymia canescens* yellow; *Haplopappus (Tonestus) pygmaeus* yellow; *Tragopogon dubius major* lemon-yellow; mud 26x.

## **Part II. Flowering Plants Visited and not Visited by Butterflies, the Butterfly Species that Visit Them (or Visit Other Food Sources), and their Known Pollinators**

In this section, the flower-feeding/food records are sorted by flower species and food types, not by butterfly species. This arrangement shows which butterfly species are attracted to that flower/food. Each paragraph in the records section below is a flower species (or food source such as sap or mud), with an alphabetical list of the butterflies visiting that flower/food and the number of their visits/records. Or the paragraph (in parentheses) explains that the flower is shunned by butterflies. Pollinators of the flowers are listed from information in published studies (the good studies are cited). Frequent visitors that might pollinate are listed if no good pollination studies are available. The flowers are arranged by phylogeny of plant families. After the identified flower species, is a list of flowers of unknown species and plant family. Other foods (mud, sap, fruit, honeydew, dung, etc.) are not sorted by plant family (even though sap and fruit comes from plants thus could be sorted by the sap-exuding or fruiting plant). Those other foods are listed after the section on sorted flowers, and the butterflies that visited them are listed.

Before listing the records, I now discuss them and provide relevant literature, in order to reach some conclusions.

The ultimate goal of a paper like this, is to determine which flowers are popular and visited often by butterflies, which flowers are pollinated by them, and why the butterflies visit them. There are two sides to such popularity. The following list of flowers visited, along with the butterfly visitors, helps determine which flowers have qualities that attract butterflies. I also list the plants that are commonly found in Colorado that butterfly adults never visit or seldom visit, to determine which plants are shunned or are unpopular and thus have qualities that repel or do not attract butterflies. One must ask several questions about butterflies and flowers. What attracts the butterflies to the flowers or repels them?, is it the visible colors of the flowers, their pattern of ultraviolet reflection, their size or shape or height in the habitat, their clustering into a big floral display or just small individual flowers, the odors emitted by the flowers, or (in rare cases such as *Heliconius* that feed on pollen) the pollen produced by the flower? Are the popular butterfly flowers being pollinated by butterflies?

In an attempt to help answer these questions, I also list the known pollinators of the flowers (as determined from published papers)—both the flowers popular with butterflies and the flowers shunned by

them—in order to help understand why the butterflies visit or ignore them. This information is the only modern compilation of pollinators of Colorado plants.

A full understanding of the reasons for a flower's attractiveness for butterflies would involve quantifying the size and shape and clustering and height and colors and ultraviolet pattern of the flower, measuring the minimum length of a capillary tube (proboscis) that could tap the nectar, analyzing the nectar contents and concentration, using head-space gas chromatography techniques to determine the floral odors produced by the flower that might attract or repel butterflies, and would involve an analysis of the wind or animals that cross-pollinate or self-pollinate the flower.

A brief discussion is needed here about the factors affecting the number of records of visits that I recorded for a particular flower species. These factors seem important: 1) the abundance of the flower; 2) the basic attractiveness of the flower to most butterflies in general, determined by the factors just noted, mainly its colors and ultraviolet pattern and shape and size and scent; 3) whether the flower is too young or too old on the day of observation to have an attractive display and aroma; 4) the basic attraction of that butterfly species to that type of flower; 5) the height of the flower in relation to the preferred flight height of the butterfly (large *Papilio* that fly 3-5 m above ground seldom visit tiny low flowers, for instance, and *Pholisora catullus* skippers that fly just above the ground will seldom visit flowers on bushes or trees); 6) the abundance of the butterfly in the flower's microhabitat on that day; 7) the amount of overlap of the flowering period of the flower and the flight period of the butterfly. That list of influential factors is long and complex. Of course all these influential factors were not measured here, and overall they are too complicated to be accurately measured except in a few high-intensity studies of one particular butterfly and one particular flower at one locality. This paper attempts to estimate the popularity of a flower to a butterfly by the inferences that can often be made when a large number of observations of visits to flowers are accumulated.

Using my knowledge of the factors listed above, I was sometimes able to make a better conclusion about the popularity of a species of flower than a mere inspection of the number of visits would suggest. Some rare flowers are popular where they occur, even though I do not list many visits for those. Likewise, some very common flowers are not popular, even though there are many visits listed for them. So in this paper I also add comments that estimate the popularity of a flower species by my rough understanding of these factors based on experience, as a supplement to a simple inspection of the number of visits listed below.

There are hundreds of flowers listed in the floras that are so uncommon or rare in Colorado that I did not encounter and identify them enough to make observations about them, so those plants cannot be discussed here. Some of those plants are expected to be popular, so perhaps elsewhere in the range of those plants where they are more common, someone will be able to determine whether butterflies often visit them.

This paper is a start on determining why some flowers are attractive and some are not. A complete survey of the ultraviolet reflection of Colorado flowers will be needed to understand the flowers' popularity more fully. And good studies of their floral scents will be needed to understand differences in floral attraction.

Various "Butterfly gardening" books are not mentioned here, because most of those books are replete with errors; up to half of the flowers that they cite as popular with butterflies are actually not popular or are even shunned. The authors of those books are usually people who have very little knowledge of butterflies and have extremely poor ability to identify butterflies and wild plants. Most websites are also replete with such errors, including the websites of nurseries which mistakenly list numerous flowers as attractive to butterflies merely to boost their sales.

Before listing the detailed records, all those factors influencing the attractiveness of flowers are discussed, allowing some conclusions to be made from the records. The most popular flowers in Colorado. There are many popular flowers, as noted below. But the most popular may be *Asclepias tuberosa*, which has astonishing powers of attraction, and can attract butterfly species not seen elsewhere at the site that day (I planted seeds of it in the back yard, but unfortunately it is very difficult to grow). All *Asclepias* are very popular, as are *Apocynum* and thistles (*Cirsium*, *Carduus*,

etc.), *Verbena*, *Monarda*, and *Buddleja*. *Eriogonum* are fairly popular. *Sedum lanceolatum* is popular. Other popular common flowers are *Erysimum*, *Jamesia*, some legumes including *Medicago sativa*, *Lythrum*, *Cnidoscopus*, *Ceanothus*, *Aesculus*, many Lamiaceae, most *Penstemon*, *Lobelia siphilitica*, and most Asteraceae (*Aster*, some *Baccharis*, *Carduus*, *Chrysothamnus*, *Cirsium*, *Echinacea*, *Erigeron*, *Gaillardia*, *Grindelia*, *Liatris*, *Machaeranthera*, *Pericome*, *Rudbeckia*, *Senecio*, *Solidago*, *Zinnia*, etc.). Other popular flowers are listed below. Asteraceae is the most popular plant family, when abundance of the plants and the popularity of each plant are both considered. Most of these flowers are clustered which forms a kind of “landing platform” that butterflies supposedly often visit, though many lack this.

(Of course the popular flowers are different in other regions. In eastern U.S. some additional very popular flowers are *Cephalanthus occidentalis*, *Verbesina virginica*, *Clethra alnifolia*, *Pontederia cordata*, *Eupatorium*, *Vernonia*, *Lantana*, *Pycnanthemum*. In California and the southwest deserts some *Baccharis*, *Lippia*, *Aesculus californica*, *Cnidoscopus*, etc. are also popular.)

Unpopular flowers. To understand why butterflies prefer certain flowers, it is necessary to also determine which flowers butterflies do NOT visit. The list below adds common Colorado flowers that are seldom or never visited. These shunned flowers clearly show that most of the pretty flowering plants in nature are rarely visited by butterflies. Butterflies may come near those flowers but do not visit them. For instance a *Papilio multicaudata* will dip down over a garden *Petunia* flower within ~20 cm but will not land. What conclusions can we draw from this? A flower pretty to a human but not desirable to a butterfly, means that the butterfly is detecting and selecting features of the flower that humans cannot detect or appreciate (or vice-versa, as humans enjoy numerous flowers that butterflies shun). Now we must ask, what qualities of flowers do butterflies like that humans cannot detect, or humans can detect that butterflies cannot?

Color vision of butterflies is one possibility. Traditionally, it has been thought that insects do not see red very well. Bees for instance have trichromatic color vision with peak sensitivities in the ultraviolet UV344, blue B436, and yellow G544 [UV=ultraviolet, V=violet, B=blue, G=green, Y=yellow, R=red etc.], so they can see all colors from ultraviolet to orange (Proctor et al. (1996), although bumblebees see a little more into the red than honeybees (whereas humans see all colors from violet to red, wavelengths 400-750nm) (wasps have similar vision to bees, but sawflies evidently cannot see ultraviolet). Lack of good vision for red in butterflies seems to explain many of the cases noted below in which red flowers are not visited by butterflies as much as humans would expect. But many butterflies are attracted to red flowers, and the longer length of many red flowers offers another explanation: red flowers are often too long for the proboscis of most butterflies and are visited by hummingbirds instead. And there is another important explanation: there are fewer red flowers in Colorado. Flipping through the color photos of every pretty wildflower in the Rocky Mountains and adjacent plains (Rickett 1973), one realizes that the most common color is yellow, and there are very many white flowers, and many blue flowers, and many purple, but the redder flowers tend to be pink instead, and there just aren't very many truly red flowers, and there aren't many orange ones either. So this lack of red flowers may be a large part of the reason for the deficit in visits to red flowers that I observed in most butterflies. (Similarly, one wonders whether Lycaenidae butterflies visit yellow and white flowers more often than other colors in part because their proboscis is short and there seem to be more yellow and white flowers with short corollas or open corollas than with long corollas.) Interestingly, bees—like butterflies--mostly bypass red flowers and visit blue, yellow and white flowers, especially when white flowers have ultraviolet (Dodson and Dunmire 2007); but bees cannot see red well, whereas butterflies can. Some butterflies are attracted to red, for instance the white males of *Neophasia terlooii* are attracted to red cups because red is the color of their females. And an *Asterocampa clyton* probed my red truck, and a *Lethe eurydice* probed a red ribbon. And *Heliconius erato* are known to be attracted to the red patch on their wings (Swihart 1972). My results show that Hesperidae butterflies are often attracted to red flowers (I saw 43 species visit reddish flowers, though the majority were visits to reddish-purple yet many were to pure red) and are the majority of visitors to red *Hedysarum boreale*, and *Poanes hobomok* seems to prefer red-pink flowers. Actually Hesperidae often fly much faster than other butterflies (*Hesperia miriamae* and *Paratrytone snowi* and *Megathymus ursus* and some *Agathymus* fly so fast that they can be seen only when they slow down,

placing them among the fastest insects in the world), leading to the conclusion that their vision in general may be superior to that of Papilionoidea butterflies. Vision has been studied in only one Hesperidae evidently, by Swihart (1969) who concluded that they have superposition eyes like moths and have only two optical pigments (of wide wavelength range), but if true the superposition eye may allow their brain to organize a fine image of the visual field that may permit their faster more precise flight.

Until recently it was thought that butterflies were at most trichromatic with three visual pigments (opsins) like bees that did not allow very good vision for pure red. However, new research shows that butterflies can see all the colors from very-near-ultraviolet to true red (300 to 700nm). Blackiston et al. (2011) studied *Danaus plexippus* and reviewed butterfly vision. *Danaus plexippus* has a time-compensated sun-compass navigation system and uses specialized ultraviolet-sensitive and polarization-sensitive receptors in the dorsal rim of the compound eye, just like the honeybee. They found that *Danaus* has the three expected opsin pigments with peak sensitivity at UV340, B435, and Y545nm wavelengths, and the butterflies make use of dark-orange pigments distributed heterogeneously in the eye (in the pigment cells at the rhabdom) to enhance long-wavelength discrimination to let them see red colors (the dark-orange filtering pigments in some ommatidia result in orange and yellow eyeshine when the eye is struck with bright light, because the light reflects off the basal tracheoles and back out through the ommatidium to recapture more photons, like a cat's eye [Stavenga and Arikawa 2006]). Blackiston et al. (2011) also concluded that *Danaus* has an additional (fourth) long-wavelength color receptor, based on the butterflies' trainability to long-wavelength colors (they can learn to distinguish between two colors made by narrow-band filters transmitting 589 and 620nm wavelength for instance). *Vanessa cardui* has similar receptors at UV360, B470, G530 (Briscoe et al. 2003), like the presumed ancestor of Papilionoidea butterflies. *Vanessa atalanta* cannot see redder colors (590-640 nm) (but it visits red flowers, see Part I), while *Heliconius erato* has three similar peaks in reception and in addition has long-wavelength orange and red receptors at O590, R620, and R640 nm because of filtering pigments at the rhabdom that produce its orange and red eyeshine (*Vanessa atalanta* has only orange eyeshine) (Zaccardi et al. 2006). And Stavenga and Arikawa (2006) found that *Pieris rapae* butterflies have color vision from 300-700nm with ultraviolet, violet, blue, green, pale-red, and red receptors, because pale-red and deep-red screening pigments at the rhabdom modify the peak sensitivity of the opsin pigments to create the redder receptors. And Ogawa et al. (2013) found that *Colias erate* butterflies have four color receptors (ultraviolet, blue, green, red), but males have 11 and females have 8 different receptor classes when the effects of pigments etc. are included, and the blue and red receptor classes differ between males and females, and the butterflies can even see a little out to 725nm (almost to the infrared at 750nm). The pierid butterfly *Phoebis sennae* clearly sees red, as the records in Part I prove. And Kinoshita et al. (1999) found that *Papilio xuthus* butterflies are tetrachromatic (including red) with five opsins expressed in the eye, and they have eight varieties of photoreceptors when the filter pigments are considered along with the opsin pigments. *Papilio aegaeus* has visual receptors peaking at UV360, V390, B440, G540, and R610 (Kelber, 1999), and *Battus philenor* can be trained to distinguish red from yellow or blue colors (Weiss and Papaj 2003). And *Lycaena heteronea* and *L. rubidus* (Lycaenidae) have tetrachromatic eyes with the four optical pigments peaking at UV360, B437, G500, and Y568nm, the latter useful for detecting reddish hostplants (with the same peak wavelength as human red cone detectors) and longer than the G530 wavelength pigment of most insects; some detectors differ between those two species and between sexes to function better in mating and oviposition.

Flower preferences of *Phoebis sennae* (Pieridae, Coliadinae), a tropical butterfly that prefers long tubular red flowers. The pollination books (Proctor 1996, Willmer 2011) seem to overemphasize that butterflies prefer red tubular flowers, I think because existing literature publications studied many large tropical species, so their preferences have come to dominate popular opinions. During my research I did find one of those species that prefers red long-tube flowers, so I researched it fully to serve as a comparison to the flower preferences of Colorado butterflies. That butterfly is *Phoebis sennae*, which ranges throughout Latin America from Argentina to Mexico, and in southern U.S. it migrates north each year then migrates back to Florida and Mexico in the fall. I have a few records for the species, and some records are from published literature, but most records I got from internet photos of *P. sennae* butterflies on flowers, by

laboriously identifying the flowers with books, internet photos of identified flowers (google “genus species photo”), and trips to nurseries (see the records above in Part I). *Phoebis sennae* has a very long proboscis, and it does visit a large variety of flowers, of all colors, but it seems to prefer red and orange, and the flowers it visits mostly have long tubular corollas. It often sticks its whole body and the base of its wings into a flower to suck nectar from the far end of flowers that can reach 5 cm in length. Evidently tropical butterflies, especially large ones, have different flower preferences than temperate climate butterflies (and the literature also suggests that subalpine-alpine flowers are pollinated much more often by flies, as noted below).

Considering all this research, the conclusion is that butterfly vision covers a spectrum that is among the widest known in the animal kingdom (Briscoe and Chittka 2001), as they can see all the colors humans can, plus ultraviolet.

Ultraviolet reflection of flowers. So, we should investigate the ultraviolet reflection of flowers.

Apparently all butterflies see ultraviolet (as do bees and other insects and birds), which humans cannot see, and many flowers are known to have ultraviolet patterns that are used by insects at least to find some flowers and help locate the nectar and pollen. The ultraviolet reflection is generally caused by specialized epidermal structures on the flower surface, while numerous kinds of flavonoids in the flower absorb ultraviolet evidently to protect the flower from damage caused by too much sunlight. In particular, many flowers are known to have the center of the flower non-reflective (absorbing) of ultraviolet, while the outer part of the petals reflects ultraviolet (an ultraviolet bullseye). Examples are many Asteraceae including *Rudbeckia hirta* yellow, *R. laciniata* yellow, *Helianthus petiolaris* yellow, *Viguiera multiflora* yellow (see photos in Fig. 40 of Scott 1986a), while other flowers do not reflect ultraviolet (*Aster laevis* var. *geyeri* blue, *Geranium caespitosum* pink, *Heterotheca foliosa=fulcrata* yellow, *Aster porteri* white, *Heterotheca villosa* “*horrida*” yellow on those Fig. 40 photos). Bauer (1983) found an ultraviolet pattern in *Delphinium bicolor*, but none in *Castilleja pulchella*, *Lupinus monticola*, *Mertensia ciliata*, *Oxytropis campestris*, *Penstemon procerus*, and *Trifolium dasyphyllum*. Of these flowers, *Rudbeckia*, *Viguiera*, *Aster*, and *Heterotheca* are popular with butterflies, and among Bauer’s flowers only *Oxytropis campestris* and *Penstemon procerus* might be fairly popular, while *Geranium* is only moderately popular (except some tiny skippers love it) and *Osteospermum* is not common enough in Denver for me to determine its popularity. *Brassica rapa* is fairly popular and has an ultraviolet bullseye (Omura et al. 1999a). The popularity of the flowers does not seem to correlate very well with ultraviolet pattern in this sample, which is too small to be conclusive. Luckily the internet has hundreds more images of flowers that compare regular photos to uv-reflecting photos (Rorslett 2006; Primack 1982; etc.). Only about a quarter or fewer of all flower species have ultraviolet patterns different from the visual ones. Guldberg and Atsatt (1975) photographed flowers of 300 species of 61 families and found that yellow and violet flowers seem to have the highest probability of reflecting ultraviolet, while greenish and white flowers seldom reflect; pollination guides on flowers generally do not reflect uv; larger flowers are more likely to reflect uv (probably to help pollinators locate the flower center). Chittka et al. (1994) studied the flower reflection spectra of 573 species and found uv reflection to be less common and less intense than reflections of other colors. Among all those photos on the internet, by far the most common ultraviolet pattern—when it exists—shows the inner part of the flower absorbing ultraviolet, and the outer part of the flower reflecting ultraviolet. This uv “bullseye” pattern does not vary much between flowers, although the width of the uv-absorbing center varies somewhat (20-60% of the diameter of the flower, maybe averaging ~40%), while the most extreme flowers have the dark center of the bullseye much larger such as *Magnolia* and *Sonchus* and *Arnica angustifolia* and *Caltha palustris* and some *Rudbeckia hirta* that have just the petal tips uv-reflecting. So the insect may home in on the dark center of the ultraviolet-reflecting bullseye on those flowers, to help it find the middle of the flower where the nectar occurs (untrained bees probe the uv-absorbing end of the petal to seek nectar). Omura et al. (1999a) suggested the uv bullseye in *Brassica rapa* flowers is a nectar guide for *Pieris rapae* butterflies. *Cornus florida* and *Hibiscus trionum* and the sundew *Drosera longifolia* have the opposite pattern (uv reflects only in the center), and *Nuphar lutea* *X* *pumila* has uv reflection only in a ring between center and outer non-reflecting parts, but that reversed uv pattern is rare and butterflies evidently shun those flowers. One would think



that the appearance of an ultraviolet ring with a dark center would enable flower visitors to easily locate those flowers, but many of those flowers are unpopular with butterflies. When I compare the popularity of the flowers to whether or not they have an ultraviolet-reflecting pattern, I am not able to find any correlation. Many popular and unpopular flowers have the bullseye ultraviolet pattern, but many popular flowers have no ultraviolet pattern at all because the flower is completely non-reflective. And some closely-related flowers have different uv reflection but similar popularity: for instance the regular *Potentilla* species have the uv bullseye pattern while *Potentilla* (*Dasiphora* = *Pentaphylloides*) *fruticosa* is completely non-reflective, but both kinds are equally (moderately) popular with butterflies; and *Viola tricolor* has the bullseye pattern while *Viola arvensis* *X* *tricolor* has the upper petals absorbing and the lower parts reflective yet both flowers are probably unpopular. Kevan et al. (2001) note that bees perform poorly in identifying pure ultraviolet patterns when lighting changes (dim light etc.), which explains why there are few if any totally-uv-reflecting flowers in nature (only 3% of sunlight at sea level is uv, but the proportion rises in twilight due to greater scattering through a longer atmospheric trip that favors the passage of shorter-wavelength photons—however nocturnal sphingid moths refuse to visit flowers with uv reflection [White et al. 1994]). Most white flowers do not reflect ultraviolet, and would look blue and green to a bee and blue and yellow and reddish to a butterfly thus are still attractive to them. Kevan et al. (2001) note that uv reflection is no more important than the normal colors of reflection from flowers in a bee's choice of flowers. And non-ultraviolet color changes in flowers are definitely known to affect the popularity of flowers: at least 214 genera of plants have flowers that change colors with age, as *Lantana camara* does when popular nectar-rich yellow flowers are pollinated and then change into nectar-poor red ones that are not visited (Barrows 1976). So perhaps the ultraviolet reflection patterns in flowers are mostly just an aid in helping bees and other insects to place their mouthparts on the uv-absorbing center of those flowers in nature, and they can use other colors and scent to locate the flowers (bees are the most important pollinators of flowers, so the evolution of flowers is surely driven mostly by bees, and most bees and most Hymenoptera have trichromatic vision with ultraviolet, blue, and green receptors [Chittka et al. 1994], and they evidently don't see red very well, so most butterflies can see red better than bees). This conclusion is supported by reports that irregular (zygomorphic) flowers are more likely to have ultraviolet reflection patterns than regular (radially symmetrical) flowers; pollinators could use the help of uv bullseyes in locating the sweet spot on irregular flowers. So, ultraviolet reflection is evidently not the key to understanding the popularity or repulsion of flowers to butterflies.

If ultraviolet is not the key to understanding why flowers are popular or unpopular to butterflies, and the colors humans can see aren't key either, then there is only one last possibility: the nectar and odor of the flowers.

Flower nectar. Flowers need sugary nectar to keep most pollinators (including pollinating butterflies sometimes) visiting. Some animals such as sunbirds and honeyeaters and new world bats and short-tongued bees and flies imbibe nectars that have double or more the amounts of glucose and fructose compared to sucrose, but most animals including long-tongued bees and butterflies visit flowers with more (or mostly) sucrose, and those flowers tend to have longer distances to the nectaries (Baker and Baker 1991, Proctor et al. 1996). Longer corollas usually have more sugary nectar (May 1988). *Battus philenor* (Erhardt 1991) and *Vanessa indica* (Omura and Honda 2003) preferred sucrose to fructose to glucose. This ratio seems unimportant for butterflies though, because glucose and fructose are more abundant in Asteraceae flowers than sucrose yet those are generally very popular for butterflies. And sucrose is dominant in Fabaceae yet those flowers are not as popular as Asteraceae. And female *Lysandra bellargus* preferred glucose while males preferred sucrose (Rusterholz and Erhardt 2000). And the butterfly-pollinated *Gladiolus* species have nectar that is either sucrose-rich or hexose [=glucose and fructose]-rich (Goldblatt and Manning 2002). And the preferences of *Ornithoptera priamus* differ by sex (Erhardt, 1992). Willmer (2011) summarizes nectar preferences in butterflies and other flower visitors and concludes that the sucrose/(glucose + fructose) ratio is very variable and does not matter much (butterflies don't seem to care, table 8.2), though some visitors may prefer more concentrated nectar whatever the ratio.

The nectar of flowers attractive to butterflies (and birds and bats) is generally reported to be dilute enough (15-25%) to not plug the narrow proboscis. However Pivnick and McNeil (1985) reported that *Thymelicus lineola* preferred thick nectar and their sucrose intake was highest at about 40%, and they prefer flowers of *Trifolium pratense*, *Medicago sativa* and *Vicia cracca* which have 40-65% nectar. They used an engineering equation of laminar flow through pipes while assuming the Lepidoptera proboscis exerts constant sucking pressure, to calculate that the optimum nectar concentration is 35% (Boggs 1988, Hainsworth et al. 1991, May 1985, 1988, 1992; Willmer 2011 table 8.4 lists 35-45%). Kim et al. (2011) refined the engineering analysis and calculated that the optimal sugar concentration is 30-40% for animals that use active suction (Lepidoptera) and capillary suction (hummingbirds and sunbirds), but 50-60% for viscous dipping (used by most bees and ants). Those methods of feeding seem to be responsible for most differences in sugar concentration that have been reported (such as Willmer 2011 fig. 8.12). So butterflies can sip most of the nectar available in flowers, as the records seem to suggest (has anyone ever seen a butterfly reject a flower because the nectar is too thick?--butterflies whip out their proboscis on thick immobile sap on tree trunks and suck it up, evidently because they exude a little saliva to thin it).

Gardener and Gillman (2002) studied the amino acid profiles in nectar of 65 diverse plant species, and found a wide range of mixtures, with most plant species having their own amino acid "taste" values. Nectar of butterfly flowers was reported to contain small amounts of some or all of the biologically important amino acids, averaging more amino acid concentration than the nectar of flowers preferred by bees and other pollinators (except for flowers that mimic dung or carrion to attract flies, which have large amounts of amino acids) (Baker and Baker 1983, and Willmer 2011 table 8.3 in which average amino acid concentration of butterfly flowers is 50-300% more than flowers visited by other insects, except for carrion and dung flies). However methodological considerations suggest that most visitors care little about amino acid concentration (Willmer 2011), although some butterflies may truly prefer more. If pollen falls into the nectar, amino acids diffuse into the nectar over time (Ehrhardt and Baker 1990). *Heliconius* collect pollen on their proboscis tip with tiny spikes, roll it up, spit protease-containing saliva into the ball, and absorb amino acids and proteins from the pollen, enabling them to live six months (Gilbert 1972); females do this more often than males. Because of the proteases in *Heliconius melpomene* saliva, the more pollen they gather with their proboscis the more eggs they produce (Eberhard et al. 2007). And *Araschnia levana* females laid more eggs when fed amino acids, except if their larval food was enriched with nitrogen so they didn't need more nitrogen (Mevi-Schütz and Erhardt 2005). Female *Coenonympha pamphilus* preferred nectar with more amino acids, while males had no preference, and butterflies raised on low-nitrogen leaves desired more amino acids (Mevi-Schütz et al. 2003) to compensate for larval deprivation. Long-lived (but not short-lived) tropical Borneo butterflies did live longer when fed amino acids (Beck 2007). *Pieris rapae* females (and honeybees) but not males prefer nectar that contains amino acids (Alm et al. 1990), as they visit those flowers more often and suck more nectar. However *Ornithoptera priamus* visited amino-acid-containing nectar no more than sugar solution (Erhardt 1992). And *Battus philenor* males preferred plain sugar over sugar and amino acids, while females showed no preference (Erhardt 1991). *Lysandra bellargus* females but not males preferred flowers with more amino acids in spring, while males preferred higher-sucrose nectar and more sugar than females who preferred more glucose (Rusterholz and Erhardt 2000). Although female (but not male) *Inachis io* preferred nectar mixed with amino acids (Erhardt and Rusterholz 1998), they evidently cannot detect amino acids well and greatly prefer sugar. *Euphydryas editha* requires sugar in nectar for an optimum production of eggs but amino acids increase egg production very little and an excess is harmful (Murphy et al. 1983). *Colias* visit flowers with significant [but not high] amounts of nitrogen-rich amino acids and a high proportion of monosaccharide sugars in their nectar (Watt et al. 1974). The consensus seems to be that most butterflies care little about the amino acid concentration of nectar, and only some females and some long-lived species really desire more amino acids. Some female butterflies desire amino acids to grow their eggs, especially if their larval food was deficient in nitrogen due to bad soil, while males desire sodium more.

These components of nectar such as sugars and amino acids evidently are not volatile, so they do not contribute to floral scents, and thus do not influence the butterflies' choice of flowers before they land; a butterfly must evidently lower his proboscis into the nectar to determine if the nectar is good.

Floral scents. It seems likely that most undesirable flowers lack a floral scent that is attractive to butterflies. But butterfly flowers generally have a weak—not a powerful—scent. Proctor et al. (1996) state that flowers adapted to pollination by butterflies usually have sweet and sometimes heavy scents, and they cite five flowers from England that have powerful scents (*Lonicera periclymenum*, *Hyacinthus orientalis*, *Syringa vulgaris*, *Erysimum cheiri*, and *Dianthus caryophyllus*). *Syringa vulgaris* does have a powerful scent, but it is not very popular with butterflies in Colorado, where the cultivated *Lonicera* and *Dianthus* are not popular either, although Colorado *Erysimum* are popular (it does not have a strong scent). Cultivated *Salvia sclarea* and *Iris germanica* have a very powerful scent, but are not visited by butterflies. Unfortunately humans have a poor sense of smell, as most of the 1000 genes that rodents and bears and wolves use to power their tremendous olfactory capabilities (bears can smell food many kilometers away) have been lost in the evolution of humans, as apes have only 700 and humans only 400 of those olfactory genes. Perhaps that is the reason that I have not noticed a medium or strong scent in most of the flowers that are popular with butterflies. It is now thought that butterfly flowers smell mildly sweet, but not as sweet as those visited by sphingid moths which are very sweet (Dobson 2006; Willmer 2011). Butterflies evidently have a much better sense of smell than humans (like bees, which can detect odors at 1% the concentration noticeable by humans). Butterflies can perceive most floral scent chemicals, except the highly-volatile monoterpenes (pinene, carene, 1,8-cineole, sabinene, p-cymene, limonene) (Andersson 2003b). Butterflies are probably just as good at detecting odors as bumblebees, and Marden (1984) found that bumblebees detect the odor of flowers while flying to decide whether to land. Butterflies are known to be good chemists, as their antennae and labial palpi and leg tips detect scents, including the pheromones wafted by males and females to facilitate courtship and mating, and the scents of caterpillar hostplants. Some butterflies love sap for instance, as noted below in the records, and they find it by smell as the sap is generally very inconspicuous on a tree (typically the butterfly approaches the sap by smell, and lands above the sap and walks down to it, to avoid getting stuck and fossilized in amber). Also, males and females choose conspecific individuals for mating primarily based on detecting the odors of pheromones in both sexes, because the courtship movements of butterflies are generally the same within genera or tribes so are not specific enough to provide enough information for reproductive isolation (Scott 1973e) (most western North American species of *Argynnis* for instance are so similar in appearance that only experts can distinguish them by wing pattern, and their courtship dances are identical, and they produce offspring butterflies when males and females are forcibly paired in the lab [Steve Spomer research], yet they seldom interbreed in nature, obviously because pheromones produced by both sexes produce reproductive isolation).

Most flowers evidently have a scent that attracts visitors in order to promote pollination. More than 1,700 compounds have been isolated so far, from 990 taxa of 90 plant families (Knudsen and Gershenson [2006], Dudareva and Pichersky [2006]). Flower scents are small volatile organic compounds, including aliphatic compounds (fatty acid derivatives, including hydrocarbons such as pentadecane, esters such as ethyl acetate, alcohols such as hexanol, and ketones such as jasmine), benzenoids (and phenylpropanoids) with a benzene ring (such as vanillin, methyl salicylate, eugenol, methyl cinnamate, benzaldehyde, and phenylacetaldehyde), terpenoids (including monoterpenes such as linalool, limonene, alpha-pinene, verbenone, geraniol and citronellol, sesquiterpenes such as alpha-farnesene, caryophyllene, and ionone; and irregular terpenes such as oxoisophorone), plus some compounds containing nitrogen (such as indole and skatole) and sulfur (such as dimethyl disulfide), etc. Dudareva and Pichersky (2000, 2006) reviewed floral scents and noted that they are almost always a complex mixture of small (30-300 amu) volatile molecules of the above compounds, that are generally emitted by the flower petals, and no two closely-related plant species emit the same volatiles; evidently all plants contain the gene for making linalool (which is also used by corn and soybeans as a defense against herbivores).

There are now some good studies that show that some compounds are frequently used by flowers to attract butterflies: their scents have abundant benzenoids (including phenylacetaldehyde and 2-

phenylethanol, often benzaldehyde, benzyl alcohol), certain terpenoids (especially linalool, often oxoisophorone, trans-beta-ocimene, cis-3-hexenyl acetate); some have fatty-acid derivatives (such as cis-3-hexenyl acetate), seldom with nitrogen compounds in small amounts (Dobson, 2006). Andersson et al. (2002) studied the scent compounds of 22 butterfly flowers in Europe and America (including butterfly-pollinated *Buddleja davidii*, *Centranthus ruber*, *Phlox paniculata*, and *Warszewiczia coccinea*), and identified 217 compounds (8 to 65 per plant); they reported that the following compounds are probably a signal to attract pollinating butterflies to flowers: the benzenoids phenylacetaldehyde and 2-phenylethanol, the monoterpenes linalool and linalool oxide (furanoid I and II), and the irregular terpene oxoisophorone. *Buddleja davidii* emits oxoisophorone (the most common, and related oxoisophoroneoxide and dihydrooxoisophorone), phenylacetaldehyde, and linalool (and 2-phenylethanol) to attract butterflies (Andersson et al. 2002), while *Cirsium arvense* emits the same basic mixture with phenylacetaldehyde the most common (Andersson 2003b). Theis (2006) found 10 chemicals in the flowers of *Cirsium arvense* (Asteraceae) that attract insect pollinators (benzaldehyde and phenylacetaldehyde dominate, with 2-phenylethanol, methyl salicylate, p-anisaldehyde, benzyl alcohol, linalool, furanoid linalool oxides [E and Z], and dimethyl salicylate also present) and found that the two dominant ones attracted both the pollinators and insects that ate the flowers (the pollinators are mostly bees, and some flies, and even the butterflies *Vanessa atalanta* and *Pieris rapae*). Oxoisophorone is also the most common in *Centranthus*. Andersson (2003b) further found that the compounds phenylacetaldehyde, linalool, and oxoisophorone are exclusively of floral scent origin (found in *Cirsium* and *Buddleja* etc.) and elicit the greatest antennal response in three nymphalid and pierid butterflies (compared to 39 synthetic compounds, Andersson 2003a,b), so are likely to be important compounds for attracting butterflies to flowers in nature. *Pieris rapae* is attracted to floral scents of *Brassica rapa* flowers (phenylacetaldehyde especially, and benzaldehyde, benzyl alcohol, and 2-phenylethanol, phenyl acetonitrile), which are used for close-range flower location and recognition in Japan (Omura et al. 1999a); *P. rapae* is repelled by gamma-decalactone in *Osmanthus fragrans* flowers (Omura et al. 2000a) (and is also repelled by indole). Three of those compounds are the same as the five in *Ligustrum japonicum* that attract *Pieris rapae* (phenylacetaldehyde, 2-phenylethanol, 6-methyl-5-hepten-2-one, benzaldehyde, and methyl phenylacetate—these compounds are more attractive together than separately) (Honda et al. 1998); benzyl acetate also attracts *P. rapae* (Raguso 2004). These compounds attractive to *Pieris rapae* are similar to those Andersson (2002) considered important, and similar mixtures attract honeybees and are emitted by rust fungi that attract diverse flies and bees (Raguso 2004), which suggests that many butterflies are attracted to floral scents that are very common among flowers, and butterflies are mostly generalists regarding their choice of flowers (which is evidently why the common butterfly species have such large lists of flowers visited in my records). More butterfly flowers with benzenoids: *Prunus yedoensis* flowers attract *Luehdorfia japonica* butterflies with phenylacetaldehyde, and a little less by benzaldehyde, benzyl alcohol, and 2-phenylethanol (Omura et al. 1999b). Butterfly-pollinated European orchids *Gymnadenia [Nigritella] nigra*, *Gymnadenia densiflora*, and *Anacamptis pyramidalis* also have high benzenoid emissions (Andersson 2006; *G. nigra* emits mostly benzyl alcohol and phenylethanol, plus some terpenes and aldehydes including vanillin, Tava et al. 2012, Kaiser 1993). *G. [“conopsea”] densiflora* emits the benzenoids benzylacetate [especially], mixed with benzyl benzoate, eugenol, methyl eugenol, and benzyl alcohol, but the nocturnal scent has less benzyl alcohol and methyl eugenol, suggesting those two might be more important for butterfly attraction) (Huber et al. 2005); the moth-pollinated *G. conopsea conopsea* has high fatty-acid-dominated and indole emission typical of moth flowers (Andersson 2006; indole repels *Pieris rapae* butterflies, Omura et al. 1999a). *A. pyramidalis* has a simple blend of phenylacetaldehyde, 2-phenylethanol, linalool, verbenone, alpha-pinene, and oxoisophorone which varies greatly between individuals yet attracts butterflies anyway (Andersson 2006), so butterflies evidently do not rely on a single compound for attraction. Omura and Honda (2005) found that benzaldehyde, acetophenone, and (E and Z)-nerolidol, isolated from *Taraxacum officinale* and *Cirsium japonicum* flowers, caused *Vanessa indica* to extend its proboscis to feed. The Japanese butterfly-pollinated *Cimicifuga simplex* type II emits the benzenoid isoeugenol plus methylanthranilate that each attract fritillary butterflies but together are more attractive (Pellmyr 1986); these compounds are

absent in bumblebee-pollinated types I and III. Andersson suggests that benzenoids are more predominant in temperate zone European and American flowers, while the terpenoid linalool and derivatives are more predominant in warmer American areas. For instance the originally-tropical-American *Lantana camara* is dominated by terpenoids such as trans-beta-ocimene, cis-3-hexenyl acetate and low in benzenoids (the main benzenoid is benzaldehyde) (Dobson 2006, Andersson and Dobson 2003b). And the tropical *Heliconius melpomene* much prefers the terpenoid compounds in *Lantana camara* flowers to the fatty acid derivatives in *Philadelphus coronarius* (Andersson and Dobson 2003a, b). But some temperate zone flowers emit more terpenoids. The originally-Chinese *Buddleja davidii* emits more terpenoids as noted above. And the European butterfly-pollinated *Dianthus carthusianorum* scent is dominated by terpenoids such as trans-beta-ocimene and some cis-e-hexenyl acetate, and is low in benzenoids such as benzaldehyde (Dobson 2006) (the sphingid-pollinated *D. gratianopolitanus* attracts the moth with methylbenzoate and less methyl salicylate). Originally-Texas *Phlox drummondii* flowers produce linalool and beta-caryophyllene, while eastern U.S. *Phlox paniculata* produces mainly trans-beta-ocimene, followed by phenylacetaldehyde and 2-phenylethanol (Andersson et al. 2002).

These floral scents are evidently much smaller compounds than the large compounds such as alkaloids etc. that are “tasted” by butterfly females drumming their forelegs onto potential hostplants to determine suitability for egg-laying, so their small molecular weights may provide some hope that floral scents can be more easily studied with head-space gas chromatograph technology to soon enable us to understand why butterflies find certain flowers popular and reject most flowers.

Flowers visited and pollinated by moths also have complex mixtures and great variation in floral scents. They are predominantly terpenoids (including some monoterpenes) or benzenoids (often including aldehydes) (Dobson 2006). The floral scents attractive to “settling moths” (moths than land on the flower, including Noctuidae, Geometridae, Pyralidae, Tortricidae, etc.) tend to be intermediate to the scents chosen by the hovering Sphingidae moths; typical benzenoids tend to have more phenylacetaldehyde and benzaldehyde and esters, terpenoids include linalool and beta-ocimene and lilac compounds, and they sometimes have fatty-acid-derived esters and nitrogen compounds. Hovering sphingid-attracting scents tend to be dominated by terpenoids (especially oxygenated ones, and linalool), benzenoid esters especially methyl benzoate, and more-abundant nitrogenous compounds (even indole). Moth flowers tend to be pale, long (with narrow tubes or spurs), and strongly-scented to attract nocturnal moths.

Bee-pollinated plants also produce numerous floral volatiles, but their scents tend to be dominated by terpenoids and generally have low amounts of benzenoids and fatty acid derivatives (Dobson 2006) (butterfly flowers tend to have more benzenoids and less terpenoids than bee flowers).

Every plant emits a different composition of floral scents (Knudsen et al. 1993). Borg-Karlson et al. (1993) studied floral scents of six genera of Apiaceae (including *Aegopodium podagraria*, *Heracleum*, and *Pastinaca sativa*) and found that the various mixes of terpenes and nitrogen compounds and esters and linalool etc. differed in every species. Levin et al. (2001) studied floral scents of Nyctaginaceae (*Mirabilis*, *Acleisanthes*, *Selinocarpus*, pollinated by sphingid moths), and found that every plant had a unique blend of mono- and sesquiterpenoids, aromatics (both benzenoids and phenylpropanoids), aliphatic compounds, lactones, and nitrogen-bearing compounds. So the popular compounds above may enable a butterfly to determine that the flower probably has nectar, then the butterfly can learn the scent composition of rewarding flowers and prefer those. At short range, some butterflies still use the colors etc. on the flowers as much or more than their scents to choose them (Hirota et al. 2012; Omura and Honda 2005), and *Heliconius melpomene* uses color to approach flowers but needs floral scents to feed and forage (Andersson and Dobson 2003a,b). But butterflies in general use both color and floral scents to choose flowers (Andersson 2006).

Inflorescence shape and height. Flowers shaped with a “landing platform” are traditionally claimed to be important for butterflies, but this does not seem to be very important when we consider the shapes of the popular flowers in the list above, as many popular flowers/ inflorescences have irregular shapes (such as legumes, *Delphinium*, *Liatris*, *Asclepias*, *Buddleja*, *Lobelia*, etc.), and butterflies have claws on the tips of their legs that grasp irregular flowers very well, so an odd flower shape is no impediment to a landing

butterfly (note the way *Papilio multicaudata* harvests nectar from *Delphinium ajacis* flowers described below). Irregular flowers are actually safer for a butterfly to land on, because landing on a flat area (wet sand for instance) would cause wing tip damage as the wing tips knock against sharp things (sand grains on wet sand, or the flowers at the edge of an *Achillea* inflorescence) when the butterfly flies away. The really flat inflorescences on Apiaceae are not very attractive to butterflies (although the flat *Eupatorium* in Asteraceae are attractive), and the flat-inflorescence *Achillea* is not the most popular Asteraceae flower. Very long flowers are not visited by most butterflies because the corolla is too long for the proboscis, and this is evidently why Hesperinae (which have longer proboscis) visit some flowers with longer corollas (such as *Opuntia*, *Convolvulus sepium*, *Hedysarum*, and *Penstemon* as noted below) more often than other butterflies visit them, and is why small butterflies such as most Lycaenidae only visit small flowers that fit their small proboscis. Nectar spurs are not typical of butterfly flowers either, as often claimed; few flowers have such nectar spurs in Colorado; *Aquilegia* has long spurs but is not popular, though *Delphinium geyeri* is popular with long-proboscis *Papilio*. And butterflies generally visit the flowers that are about at the height that they fly, because of the coincidence of that level being the height that they fly for mate-location (for males, especially fleeking =“patrolling to seek females” males rather than raiting =“perching to await females” males; see Scott 2010 for these definitions) or oviposition (for females), although butterflies that fly very high, such as *Neophasia* that fly around *Pinus* trees to seek females, tend to come down near the ground to find flowers.

Butterflies use minimal standards to select their flowers. Now we have to consider all this information regarding the colors of flowers and their ultraviolet reflection and their nectars and floral scents and their size and heights above ground, and apply a little logic. If floral scents are the key to understanding butterfly attraction to flowers, but nearly every flower species has a different mix of floral scents, how could a butterfly deal with the numerous flower species in its environment, every one different in scent? This paper shows that most butterflies visit very many flower species, as the list of flowers visited grows longer and longer and even longer the more you watch them. So the scents that attract most butterflies must be of numerous kinds or must be rather general—encompassing entire classes of volatile compounds—to allow them to visit so many flowers. There is evidence above that butterflies have a good sense of smell and are attracted to multiple floral scent compounds, which lets them visit many different kinds of flowers. The same logic applies to colors, ultraviolet reflections, and shapes/sizes and heights. Butterflies visit so many flowers, of so many fragrances, of so many colors, of so many types of ultraviolet reflections, of so many different heights and sizes and amounts of clustering, that it would take a giant brain to analyze all that if they dealt with every aspect of every flower. The butterfly brain is simply not powerful enough to analyze every one of the thousands of chemical combinations or the thousands of combinations of color and uv and size and shape that exist in flowers, so there has to be just one basic conclusion about what butterflies are thinking: When a flying butterfly is thirsty and something appears in its view or olfactory neighborhood that is remotely adequate (that isn't brown or green and has any kind of hopeful color and scent or at least isn't repulsive), it will approach near and look and smell again and then stop and see if it provides accessible nectar with an adequate taste. Then it will learn and rapidly reduce its handling time on rewarding flowers, and farther on it will be more likely to choose that type of flower (demonstrated in the butterflies *Thymelicus flavus*, *Battus philenor*, *Pieris rapae*, *Pieris napi*, *Euphydryas editha*, and *Lycaena virgaureae*, which all learn to exploit good flowers and visit them more often [Kandori and Ohsaki 1996, McNeely and Singer 2001, Goulson et al. 1997, Goulson and Cory 1993, Lewis 1986, 1989, Weiss and Papaj 2003, and references in Andersson 2006 p. 208]), while naive untrained young butterflies have a genetic preference for some floral scents that are prevalent in butterfly flowers (Andersson 2003a, Andersson and Dobson 2003a). Different localities and different seasons have different flowers, so the species visited will differ with locality and time, so a viewer like me who studies hundreds of localities at all seasons will eventually record a list of flowers visited that is long with numerous types of flowers. Maybe the main conclusion of this paper is that butterflies are not very restrictive in their choice of flowers; most of them visit very many different flower species and flower colors and shapes and sizes if those are available and if they satisfy minimal standards of color and scent and nectar availability and quality and size and height.

Yet from the records presented below it is obvious that most flowers fail those minimal standards, as most flower species in nature—even beautiful ones—are shunned by butterflies.

So, what are the minimal standards butterflies use to choose flowers? I do not know why butterflies are attracted to most of their flowers. Surely they require some of the floral scents discussed above, and usually require reasonably bright colors, and after landing they require adequate nectar. It would seem that weak/mild floral odor is attractive to most butterflies, and a colorful or bright white appearance (even without uv reflection) is attractive. The big unknown in understanding this seems to be floral scents, about which we know the least.

The shunned flowers evidently have unpopular scents (such as the unpopular fatty-acid-derivative and sesquiterpene scents of *Philadelphus coronarius* and *Achillea millefolium* [Andersson 2003a], and the “aminoid” odor of amino acid derivatives such as valine methyl ester, isoleucine-related imines, and 1-pyrroline in the white-umbel plants *Daucus*, *Heracleum*, *Sambucus*, *Sorbus*, *Viburnum*, and *Cornus* [Raguso 2006] that evidently make them unpopular for butterflies) and rely on other insects for pollination, usually bees, sometimes wasps, flies (Bombyliidae, Syrphidae, etc.), beetles, Sphingidae moths, hummingbirds (which especially visit red flowers), or bats (pollinating *Agave* or Saguaro cacti in the American desert etc., and especially in the tropics), rarely thrips or ants etc. Many plants have beautiful flowers yet are seldom visited by butterflies and are pollinated by bees etc. Some flowers such as *Oenothera* bloom at night and are pollinated by moths. But some flowering plants have flowers that are truly adapted to attract insects such as butterflies.

Pollination of flowers by butterflies. Pollinators helped create the diversity of life still surviving on earth today. About 80% of flowering plants are pollinated by animals, as flowering plants and their pollinators coevolved together in the late Cretaceous and Tertiary. Without pollinators, there would be many fewer plants on earth because they would have to be common enough so that wind could blow pollen between them (or they would have to self-pollinate). An efficient animal pollinator allows the plant to become rarer because the pollinator can carry the pollen the longer distance between individuals of rarer plants. So as pollination efficiency increased, rarer plants could survive, specialization of both plants and pollinators could continue, and the average plant became rarer as the number of species increased. This has culminated in the Orchidaceae with a huge number (20,000 species) of rare orchids that are efficiently pollinated by bizarre complex pollination systems. 40,000 or more species of bees worldwide evolved to pollinate plants, and some flies and wasps and other insects and birds and bats etc. also evolved as pollinators. Without pollinators, many plants would become extinct, and the fewer number of plant species would mean that the number of plant-feeding insects such as Lepidoptera would be greatly reduced. Now, why did the plants become rare and need pollinators? Willmer (2011 fig. 4.9) shows four current arguments about the evolution of floral-pollinator specialization, none of which seem entirely correct. I think this is a search-process game. We can divide the players here into three: the plants, the munchers, and the pollinators. The “munchers” are various animals that consume plants and can drive them into extinction, so as the plants become rare from the munchers they are saved from extinction only if there is a pollinator that can pollinate them at that low density (numerous plants without such pollinators surely went extinct due to lack of pollinators or due to too much selfing-induced inbreeding), and then the munchers and pollinators and plants can coexist, at a low-enough density that the munchers cannot easily find and exterminate the plants and destroy the system. Of course, to be realistic we could throw in all the parasitoids and predators and parasites and herbivores and fungi and bacteria and viruses etc. that make the density of all three players low as well, but they don't disturb the basic logic, because the value of low density for all the players in this game is the lesser susceptibility to being killed due to the greater difficulty of being found by munchers. The diversity of plant (and animal) species and the diversity of their repellent chemicals and muncher-avoidance devices and immune systems, all serve to make the density of creatures that are killable by the munchers low enough to make it difficult for the munchers to find them. That low density then requires effective pollinators and effective mate-location systems that succeed at low density for all these players in the search-process game. Selfing is rare because it contributes less to the diversity of plants' anti-muncher repertoire.

In this section, it helps to know that many plants, especially trees, weeds, and grasses/sedges, have tiny ugly flowers which are wind-pollinated. Of course the least popular flowers for butterflies are wind-pollinated flowers, because they lack nectar and their pollen is unusable by butterflies. In temperate zone Colorado, wind-pollinated plants include most trees, many weeds, grasses/sedges/rushes, and the primitive plants mosses/liverworts/ferns/horsetails. Trees are mostly wind-pollinated in cold temperate climates because most insects fly lower to the ground and the wind speed is faster higher up, because temperate zone trees are generally common so the distance between conspecific trees is small enough for wind to bring pollen, and because trees generally have too many flowers for insect populations to pollinate them efficiently (there are too many flowers per insect, and the insect is likely to visit another flower on the same tree rather than travel to another tree) (grasses/sedges and weeds also have too many flowers). Thus trees such as Cupressaceae, Pinaceae, *Celtis*, *Morus*, *Ulmus*, *Fagus*, *Quercus*, *Populus*, *Salix*, *Juglans*, *Alnus*, *Betula*, *Acer*, *Fraxinus*, *Ginkgo*, etc. are wind-pollinated (all of those are found in Colorado in nature or in towns, except *Fagus*). (Many trees native to the deciduous forest in eastern U.S. are not wind-pollinated, such as *Catalpa* trees with large white flowers [which are not visited by butterflies], *Castanea*, *Tilia* (partially wind-pollinated), etc. And tropical rain forest trees tend to be rare [with hundreds of species in a small area] so animal pollinators are useful to bring pollen from the flowers of one to a distant other.) That wind-pollination reduces floral display is shown in *Eupatorium*: wind-pollinated *Eupatorium* flowers tend to have smaller floral heads, larger stigmas that are more exposed to the wind, and weaker inflorescence branches, while insect-pollinated *Eupatorium* flowers tend to have reduced stigma size and exposure and stiffly upright inflorescences and showy heads (Sullivan 1975).

Pollination involves more than just transfer of pollen from stamen to stigma. Many plants are obligate outcrossers and their flowers may be receptive only at certain times of day. Many plants produce pollen on different days than the stigma is receptive, in order to avoid self-pollination, so pollen transfer on a single day between synchronized flowers will not pollinate. Some plants have flowers that set seed without pollen transfer. An effective pollinator is one that transfers pollen in the correct manner according to the plants's breeding system. So to prove actual pollination, experimental studies of seed set of the flower may be needed. Thus it is important to note that mere visits to a flower do not prove that the butterfly is pollinating it.

Butterflies are often claimed to be pollinators of flowers. However, the butterfly proboscis tends to be very smooth and pollen appears not to stick to it very well (except *Heliconius* are known to gather pollen of *Anguria* flowers etc. with their proboscis which has scales sticking out near the tip to capture the pollen, then they roll up the pollen in their curled proboscis and exude saliva onto the drop to dissolve amino acids and proteins from the pollen that they then suck up [Gilbert 1972]). The butterfly proboscis is operated like a crane, lifted up by the more rigid basal part and then only the tip inserted into the flower, so the opportunity for the proboscis to contact pollen or stigma is limited. And butterfly legs are rather smooth, though they may be covered with scales and setae that might catch pollen. The butterfly body is covered with more scales that can catch pollen, but the long stiltlike legs generally keep the butterfly's body above the pollen-bearing anthers and stigmas of the flower. To pollinate a flower, the butterfly must visit one flower and get pollen stuck onto its proboscis or legs or body or wings, and then visit another plant of that species and deposit the pollen on the stigma, where the pollen must successfully fertilize the plant.

This chain of events requires a lot of time and effort to prove. To prove pollination by a butterfly species, detailed studies are needed to determine where it lands on the flower and whether pollen is transferred to which parts of the butterfly, etc. It is desirable also to determine why a butterfly is attracted to a particular flower and not others, whether the attraction is based on colors visible to humans or ultraviolet or scent or whatever, to see if the butterfly is attracted enough to that species of flower to visit many of them to transfer pollen. In the best studies, a palynologist examines the butterfly to search for the microscopic grains of pollen and uses powerful microscopes to identify the pollen to plant species (great care is needed in catching and preserving that butterfly in order to avoid contamination from pollen present in the net capturing the butterfly or present in preservation boxes or on tweezers etc.). The process is easier for pollen-gathering bees, because the mass of pollen that the bee gathers in its pollen



basket (corbiculae on the hind leg of the honeybee) or other hairlike pollen-storage devices (called scopae) and brings back to its nest for the larva to eat can be examined to determine which flowers produced its pollen grains (for instance Muller 1996 studied 1,800 pollen loads, and Sedivy et al. 2008 studied many loads). The current paper provides evidence that butterflies pollinate only a few plant species, because it lists only visits to flowers, although any visit by a butterfly to a flower could possibly pick up a few grains of pollen or deposit it to pollinate the flower. This paper merely suggests—from the frequency of visits of a butterfly to the flowers of a plant species--the likelihood that pollination might be occurring.

Thus bees, with their obvious construction and olfaction and behavior that enable them to efficiently gather pollen, are far better pollinators than butterflies. Bees are obviously great pollinators of flowers as they deliberately collect pollen and take it back to the nest. Bees are covered with branched hairs to grab more pollen. Honeybees have specially-adapted legs to allow them to gather pollen with all six legs and they have a scraping brush on the tip of the tibia and a flange on the base of the tarsus of the hind leg that scrapes the pollen off the other hind leg and stuffs it onto a long spine in a large pollen basket (corbicula) formed of long hairs (setae) on the hindleg tibia, which secures the pollen as they fly. Honeybees moisten dry wind-pollinated pollen with saliva to make it stick together during transport. Honeybees also have great olfactory senses: they can smell flower scents at 1/100 the concentration that humans can detect, and they have two pheromones they deposit on a good food source to attract other bees to it (one pheromone disperses quickly while the other lasts overnight), and they have navigation behavior using visible and ultraviolet and polarized light and time-compass orientation, and they have different dances for close and far trips (the round dance for nearby trips, the waggle dance for farther trips, and the tremble dance to keep bees in the hive for housekeeping duty to receive and process nectar--they perform those dances in the hive using movements and buzzing sounds and four different scents to communicate the location of good foods to other bees) that all make them great pollinators. Honeybees even have scout bees to help locate good food. Other bees also pack and store pollen in those hairlike “scopae” (on hind legs in bumblebees, on legs and sometimes on sides of thorax and abdomen in Andrenidae, in various places on the hind legs in many bees such as Halictidae and Melittidae and Anthophoridae, on hind legs and underside and front of abdomen in *Lasioglossum*, on thick hair on underside of abdomen in Megachilidae, while *Hylaeus* bees carry pollen in their crop mixed with nectar). Bees attack flowers like brutes, sweeping them to gather pollen, and forcing open recalcitrant flowers such as legume (pea) flowers that weak butterflies could never hope to open. Bumblebees are incredibly strong compared to butterflies. Bumblebees and some other bees can even grab the flower and vibrate their thorax (“buzz pollination”) to actually shake pollen out of the flower that other bees can’t get (out of a hole in the anthers of tomatoes and eggplants for instance). But sometimes even the herculean bumblebees get lazy and chew a hole in the flower base to steal the nectar; bumblebees are the usual culprits in making these holes that they chew in *Linaria*, *Aquilegia*, *Lupinus*, garden *Narcissus*, etc. Bees vary in the number of flower species that they visit: those that visit only the flowers of one species or genus or family of plants are called specialist (oligolectic) bees (if the bee visits just one plant it is called monolectic), while those non-specialists that visit numerous flowers of many plant taxa are called polylectic. Specialist bees generally collect the pollen and store it in their nest and use it to grow their larvae, which are adapted to feed on that plant’s pollen and often die eating other flowers’ pollen (Praz et al. 2008) (they typically have just one yearly generation coinciding with those flowers). Evidently many or most plants place toxic chemicals in their pollen to kill the larvae of promiscuous bees that visit many kinds of flowers and would steal their pollen without doing much pollination, and this process causes bees to evolve specialization on few flowers, the ones their larvae can thrive eating. In fact it is now thought that the original bee was a specialist pollinator. However, a specialist bee will be forced to evolve into a promiscuous polylectic bee if its flowers become unreliable, which seems to be why most specialist (oligolectic) bees get pollen from generalist flowers that are adequately common, such as *Salix* catkins and *Helianthus* and *Aster* and *Solidago* flowers. There are 4,000 species of bees in North America (1,000 of them *Andrena*), so there are plenty of bees to pollinate the flowers. Butterfly collectors usually pay little attention to bees and flies, so they should carry a cyanide jar and net into the field and collect bees etc. that visit flowers, so the

bees and pollen loads can be identified to bee species and flower species (pollen can be identified using powerful microscopy at least to plant genus usually, though similar species may have identical pollen).

In comparison, butterflies are built like nectar robbers and not pollen transporters, so are not expected to be efficient pollinators. Butterfly bodies are poorly adapted for pollination. The butterfly proboscis is a long straw that serves to neatly suck nectar from a distance away from the mess of the flower so the butterfly will not become bothered and weighted down with pollen, and the stiltlike legs keep the body away from the floral mess, and whatever pollen sticks to the proboscis or legs is partly shaken off as the proboscis rolls up and the legs retract for flight, and much of the pollen that was on the proboscis gets brushed off and stuck in the proboscis chamber between the labial palpi (Venables and Barrows 1985), and the air rushing past during flight knocks off more pollen.

For example, Lazri and Barrows (1984) observed the butterfly *Pieris rapae* visit 38 flower species in Washington D.C. (nearly all exotic plants) and found that each butterfly carried an average of 1 to 9 pollen grains of seven flower species on their proboscis and from 0 to 2 grains of four flower species on their legs, and transported much more of *Raphanus sativus* (especially) and *Lythrum* flowers than the others; but they concluded that the butterflies function primarily as nectar thieves. Wiklund et al. (1979) found that the proboscis of Swedish *Leptidea sinapis* butterflies made little contact with *Viola canina*, *V. riviniana*, and *Lathyrus montanus* flowers as it sucked nectar and there were only an average of three pollen grains on each adult, so they are mostly nectar thieves and poor pollinators (*Viola* was shunned when *Lathyrus* became common, but *Lathyrus* is probably not preferred by *Leptidea* either). Venables and Barrows (1985) studied pollination of mostly garden flowers by two hesperiid butterflies, and found that *Atalopedes campestris* visited 23 flower species and had an average of 68 pollen grains per butterfly, and *Epargyreus clarus* visited 27 flowers and had an average of 45 pollen grains; these grains were mostly on the head in the proboscis cavity and on the body, fewer on legs and abdomen tip; they concluded that few pollinations occurred and these HesperIIDae are mostly nectar thieves, because their most popular flowers were Asteraceae and they visited mostly protandrous disc flowers when the pollen was available and not later when stigmas were receptive, and they estimated that the pollen loads were small enough that it would take an average of four trips to transfer one pollen grain. They noted that spiny pollen does not stick to the butterfly proboscis as well as spineless pollen. Bees pollinate *Lotus* flowers, while butterflies steal the nectar (Proctor et al. 1996, table 4.3). Courtney et al. (1982) wrote that *Anthocharis cardamines* and other Pieridae and *Aglais urticae* butterflies carried pollen for days on head and body so could pollinate, but later critics doubted that there was much pollen transfer. I prove in this paper that most butterflies visit numerous flower species, so when they do this locally few pollen grains will stick to conspecific flowers. Hawkswoud (1985) found 11 butterfly species visiting *Acacia bidwillii* in Australia, and found pollen on 26 of 58 butterflies (most on underside of abdomen), but considered that the short visit times and small numbers of pollen carried made the butterflies unimportant pollinators compared to other insects. Butterfly/moth flowers last an average of six days before wilting, longer than any other flowers except Australian bird flowers (Willmer 2011 Table 21.2), which suggests that they need to stay fresh longer because they are being pollinated rather slowly by the butterflies.

However, butterflies may be better pollinators than we think, because electrostatic pollen transfer is evidently important in nature: plants tend to be negatively charged in warm still air, especially at narrow protrusions, and flying insects accumulate a positive charge as they fly, so when a butterfly lands on a flower the pollen can leap across and adhere due to electrostatic attraction (Vaknin et al. 2000). This phenomenon evidently does occur (especially for tiny pollen “buzz-pollinated” out of anthers by bees) but was thought to need more study (Willmer 2011 pp. 171, 175). However Clarke et al. (2013) apparently confirmed the phenomenon and even demonstrated that bumblebees can learn the electric fields of flowers to help discriminate between flower species during foraging. Could electrostatic attraction transfer pollen between butterfly and flower to partially overcome the morphological deficiencies that limit butterfly pollination?

Overall, it would seem that butterflies are not very good pollinators in Colorado. And Shapiro (2007) notes that in California “butterflies—at least in our area—are rarely if ever critically important as pollinators.”

But my records presented below suggest that some butterflies may pollinate flowers. *Hesperia leonardus* in central North America visits *Liatris punctata* [purple] flowers almost exclusively, and surely pollinates them often as the pollen and stigma extend outward to contact the body sometimes. *Notamblyscirtes simius* crawls among the stamens of *Opuntia* and surely pollinates the flowers. *Papilio multicaudata* were found covered with *Hemerocallis fulva* [orange flowers] pollen and surely pollinate this yard plant, and other authors including Hirota et al. (2012) confirm that *Papilio* spp. do pollinate it. Some butterflies visiting Asteraceae do end up with pollen among the scales on the lower part of their thorax, which suggests they do pollinate those flowers sometimes. Examples of butterflies observed covered with Asteraceae [mostly-yellow flowers] pollen are *Parnassius phoebus smintheus* (seen repeatedly covered with *Senecio fendleri* pollen), *Oeneis calais ivalda*, *Erebia callias* (*Hymenoxys grandiflora* pollen), *Polygonia gracilis zephyrus* (*Senecio canus* and *Taraxacum officinale* pollen), *Argynnis* (*Speyeria*) *callippe* (*Senecio fendleri* pollen), *Euphydryas anicia* (6 adults covered with *Gaillardia aristata* pollen), *Euphydryas editha*, *Lycaena heteronea* (*Chrysothamnus nauseosus* pollen), *Lycaena arota* (*Hymenoxys richardsoni* pollen). (Likewise, a photo of *Lycaena phlaeas* on protandrous *Verbesina virginica* [white] in Bright and Ogard [2010, p. 122] shows pollen shed from protruding anthers on legs and body, ready to fall off onto another stigma-ready flower.) I found many butterflies with *Asclepias* pollinia stuck on their legs, which suggests they could pollinate pink *Asclepias*. However, Morse (1982) found that Lepidoptera are not important pollen carriers of *Asclepias syriaca*, because bumblebees are several times more common than all other visitors combined and they carry a heavy pollen load. And Waddington (1976) found that 25% of Lepidoptera visitors had *Apocynum* pollen on their proboscis tip, but actual pollinations by Lepidoptera were “infrequent”. *Euphydryas editha* adults carry pollen but are poor pollinators, although they may pollinate some flowers especially *Lasthenia*, *Layia*, and *Linanthus* (Murphy 1984). *Piruna pirus* visits *Geranium caespitosum* frequently and perhaps can pollinate it occasionally, but they are too small to often contact the stigmas and there is no proof of pollen transfer. Of course experimental studies of seed set in flowers is needed to actually confirm pollination by butterflies and pollination by insects or other mechanisms.

But some flowers are reported to be butterfly pollinated based on better evidence. Butterflies are the primary pollinators of *Caesalpinia pulcherrima* flowers which have a yellow “target” on a reddish background and have protruding stigmas to catch the pollen (Cruden and Hermann-Parker, 1979); papilionid butterflies are the most important pollinators, as they approach the flowers from above and in front and transfer pollen due to fluttering of their wings while feeding, and the pollen is carried on the wings, held together by viscid threads which clump the pollen on the wings. *Dianthus* species are reported to be pollinated by butterflies (Erhardt, 1990). *Dianthus carthusianorum* (pink) is pollinated in Switzerland mostly by the Satyrinae butterflies *Satyrus ferula* and *Melanargia galathea* that contact the extended stamens and stigma, the former because it transferred 10 pollen grains to a stigma on average and visited the flowers frequently, while the latter transferred 13 grains but visited less frequently (the butterflies *Papilio machaon*, *Thymelicus sylvestris*, and the sphingid moth *Macroglossum stellatarum* visited seldom) (Bloch et al. 2006, Bloch and Erhardt 2008); the proboscis of the two pollinators and the hesperiid *Ochlodes venatus* fits the *Dianthus*, so they prefer *Dianthus carthusianorum* and seldom visit the longer-corolla *Dianthus sylvestris*. Jennersten (1984) found that butterfly pollination is important in *Dianthus deltoides* [pink] and *Viscaria vulgaris* [pink] (and they might pollinate *Knautia arvensis* [violety-pink] when butterflies are common because the sexual organs protrude in *Knautia*) based on pollen found on the bodies, but they concluded that butterflies are of minor importance in pollination of the majority of northern European plants, and lycaenids such as *Plebejus amanda* visit Fabaceae regularly but are nectar robbers as they rarely transport pollen. Suzuki et al. (1987) showed that *Papilio helenus* and *P. protenor* butterflies are the main pollinators of *Clerodendron trichotomum* (white) in Japan (sphingid moths are less important), as they fed on nectar with a >24 mm proboscis the length of the flower tube, and the styles and stigmas contacted the thorax so most butterflies became loaded with pollen (1,776 and 2,817 grains average on the two species), and the flowers are protandrous and asynchronous so pollination was efficient (the *Papilio* also visited *Zanthoxylum ailanthoides*, but evidently did not pollinate it well). *Phlox pilosa* [pink] and *P. glaberrima* [pink] have a weak fragrance and are visited and

pollinated by butterflies (*Colias*, *Pieris*, *Danaus*, *Polites* in nature) (Levin and Berube 1972, Levin and Kerster 1967); in greenhouses *Colias eurytheme* picked up 1942 and 1,053 pollen grains of the two *Phlox* (which have about 15,000 per floret), but coiling the proboscis shed 15%-52% of the pollen, then one visit delivered 320 and 100 grains to another flower; but in the field they deduced that less than 1% of pollen from a flower would be transferred by *Colias* to another plant; yet butterflies must be occasional pollinators. *Phlox paniculata* [pink-purple etc.] and *P. drummondii* [red, pink, purple etc.] are pollinated by butterflies and moths (Grant and Grant 1965; Levin 1985). *Aesculus californica* [white or pale-pink] is reportedly pollinated by butterflies (Moldenke 1976), and I observed numerous butterfly visits to it. Butterflies produce more gene dispersal of pollen between *Senecio* [yellow] flowers than do bumblebees (Schmitt, 1980). Three of the 165 *Gladiolus* species in South Africa are pollinated by the Satyrinae butterfly *Aeropetes tulbaghia* (Goldblatt and Manning 2002), and six are pollinated by nocturnal moths, while most are pollinated by bees, birds, flies, or beetles. Butterfly-pollinated *Gladiolus* flowers are mostly bright crimson to scarlet, open by day, usually have prominent white patches on lower tepals, and are large with long tube and produce quantities of relatively dilute nectar (either sucrose-rich or hexose-rich) (Goldblatt and Manning 2002) (moth-pollinated *Gladiolus* are equally large with long tube, but open at night and are pale or mottled dull purple to brown, and are richly scented, with concentrated sucrose-rich nectar). (The current paper finds that most temperate zone Colorado area butterflies do not prefer red flowers, but most of those butterflies are probably ineffective pollinators.) Reddi and Bai (1984) found that the Indian *Cadaba fruticosa* [greenish-white] is pollinated by butterflies (*Colotis eucharis*, *C. danae*, and *Anaphaeis aurota*) whose abdomen and wings contact the stamens and gynaecium. Herrera (1987) found that a dozen species of bees (*Anthidium*, *Bombus*, and *Megachile*) were more effective pollinators of *Lavandula latifolia* [blue-violet or lilac] in Spain than flies (6 species) and a sphecid wasp and ten species of butterflies, as the bees made pollen transfers in 2 of every 3 trips on average, while most butterflies pollinated only once in 20 trips; however the Nymphalidae butterflies (Satyrinae, *Argynnis paphia*, *Pandoriana pandora*, and *Fabriciana adippe*) pollinated once in about every 3 or 4 trips, and they produced more cross-pollination than the bees. The lowland sunny type II of *Cimicifuga simplex* [white] in Japan is pollinated by fritillary butterflies (*Argynnis paphia*, *Argyronome ruslana*, and *Damora sagana*, that are common and carry pollen on legs and thoraxes) and some syrphid flies, while 14 families of Lepidoptera and 7 of Diptera and *Vespa* wasps and a few beetles and halictid bees merely visit but do not pollinate; a highland type I and a lowland shady type III are both pollinated by bumblebees (Pellmyr 1986). Andersson (2006) reported butterflies are major pollinators of *Silene acaulis* [pink] in arctic Sweden (I saw visits to it on Colorado tundra) as it has stamens and stigmas that stick out and she found pollen on the underside of butterfly bodies (although bumblebees and flies also pollinate it across the arctic). Butterflies are the main pollinators of *Lantana camara* [yellow {turning orange} or orange] (7 references in Andersson 2006, Dronamraju 1960, Thakur and Mattu 2010). In Costa Rica large butterflies predominate as pollinators of *Lantana camara* which has yellow flowers that turn orange and red as they lose nectar and senesce, while small butterflies pollinate the smaller lavender-with-yellow-ring *Lantana trifolia* that loses the ring (Schemske 1976). Additionally, numerous published studies cited below with the records report that various flowers are pollinated by butterflies, and some of those studies have good evidence of actual pollen transfer.

Some butterflies even pollinate orchids. In Panama, three species of *Epidendrum* orchids including *E. ibaguense* lack nectar and resemble *Lantana* and *Asclepias* to fool *Danaus plexippus* butterflies into pollinating them (Boyden 1980; Bierzychudek 1981); each places pollinia in a different place on the butterflies. The European orchids *Gymnadenia (Nigritella) nigra* [dark-red] and *G. "conopsea" densiflora* [pink] and *Anacamptis pyramidalis* [pink] are discussed by Proctor et al. (1996) and Andersson (2006) (and Fritz and Nilsson 1994 for *Anacamptis*) as pollinated by *Argynnis* and other butterflies (and zygaenid and nocturnal noctuid moths for *Anacamptis*); Proctor et al. (1996) provide a photo of a *Melitaea cinxia* butterfly with a pair of *Anacamptis pyramidalis* pollinia glued to its proboscis. *Gymnadenia densiflora* is actually a separate species from *G. conopsea* (Stark et al. 2011, Marhod et al. 2005, Jersakova et al. 2010) and is pollinated by butterflies in Sweden and pollinaria were found on their proboscis (L. Nilsson, in Andersson 2006); it is evidently pollinated by butterflies in central Europe

(fritillaries, and internet photos include *Erebia ligea* [with pollinaria] and *Ochlodes venatus* on the pink flowers), plus (Jersakova and Kindlmann 2004, Jersakova et al. 2010) Sphingidae (diurnal *Deilephila porcellus*, *Macroglossum stellatarum*) and settling Noctuidae (*Autographa gamma*, *A. bractea*, *Cucullia umbratica*); moths pollinate other *Gymnadenia* including *G. conopsea conopsea*). In North America Cingel (2001) and Catling and Catling (1989, 1991) discuss pollination of *Platanthera* orchids {often placed in *Limnorchis* or *Habenaria*}, and Hilty (2013) lists more visitation records: The bright-orange *Platanthera ciliaris* is pollinated in daytime by large butterflies (mainly *Papilio troilus* in the Carolinas, Pennsylvania, and Michigan, also *Battus philenor*, *Papilio palamedes*, and rarely *Phoebis sennae*) by gluing the viscidium of the pollinarium onto the butterfly's head (Smith and Snow 1976; Robertson and Wyatt 1990; Cingel 2001); *Platanthera ciliaris* was visited by the butterflies *Papilio troilus*, *P. glaucus*, *Danaus plexippus*, *Satyrium liparops*, and the sphingid moth *Hyles lineata* in Illinois (Hilty 2013; *Satyrium* is probably too small to pollinate). *Platanthera cristata* yellow to orange is pollinated by butterflies and the bumblebees *Bombus pensylvanica*. Most *Platanthera* glue the pollinaria onto the head, but several other spp. (*P. leucophaea*, *P. psycodes*, and *P. huronensis*) glue their two-part "hemipollinaria" on the proboscis while the insect rests on the lip, then it rotates down in front of the head in position to brush against the next stigma to transfer pollen. *Platanthera huronensis* whitish-green is pollinated in Colorado by butterflies (*Erebia epipsodea*, *Vanessa virginiensis*) and bumblebees (*Bombus appositus*, *B. flavifrons*, *B. occidentalis*) and other bees (*Psithyrus suckleyi*, *P. insularis*) all in daytime, and by three noctuid moths just after dusk (*Tichodestria dodii*, *Aletia oxygala*, *Cucullia intermedia*); all of those insects had pollinia attached to the proboscis, while Syrphidae only visited and did not pollinate (Catling and Catling 1989); it can self pollinate. *Platanthera dilatata* white is pollinated by butterflies (*Papilio glaucus canadensis*, *P. zelicaon*, *Vanessa cardui*, and by noctuids (including *Discestra oregonica* and *Autographa californica*) that had pollinaria, plus several other noctuids that probably pollinate. *Platanthera psycodes* lilac pink to deep rose-purple is pollinated in daytime by smaller butterflies (A. Moldenke; visits include *Papilio polyxenes* and *Polites mystic*, plus nocturnal moths and sphingids including *Hemaris*). *Platanthera blephariglottis* white to cream is pollinated mostly by nocturnal moths attracted by scent (Sphingidae 4 spp., and a noctuid) and often in daytime by bumblebees (*Bombus vagans* and *B. fervidus*), and sometimes by honeybees and butterflies (*Papilio troilus*, *Danaus plexippus* [those two had pollinaria], *Argynnis (Speyeria) atlantis*, *Epargyreus clarus*, *Colias philodice*, *Pieris rapae*, *Polites mystic*, *P. peckius*, and *Euphyes vestris*); the pollinaria was glued onto head or eyes of the butterflies. *Platanthera grandiflora* pale lilac to roseate or white is evidently pollinated by both moths (sphingids and the noctuid *Artographa ampla*) and butterflies (*Papilio troilus*, *P. glaucus*, *P. polyxenes*); pollinaria glued to eyes. *Platanthera peramoena* rose-purple to purple-violet is primarily pollinated by the sphingid moth *Hemaris thysbe* and probably by *Hemaris diffinis* and large butterflies (visitors were 4 Sphingidae spp. and the butterflies *Papilio glaucus*, *P. troilus*, *Danaus plexippus*, *Argynnis (Speyeria) cybele*, *Epargyreus clarus*); the sphingid *Hyles lineata* is a nectar thief. *Platanthera integrilabia* white to cream is pollinated by nocturnal sphingids 10 sp., occasionally by diurnal butterflies (*Papilio glaucus*, *P. troilus*, *Epargyreus clarus*); pollinaria glued to eyes. *Platanthera stricta* greenish is pollinated by 14 empidid flies, several bumblebees, and several moths. (The whitish species *Platanthera leucophaea*, *P. praeclara*, *P. orbiculata* are pollinated by sphingid moths, greenish *P. hyperborea* by noctuid moths, greenish-white *P. obtusata* by many *Aedes* mosquitoes and several moths, greenish *P. flava* by mosquitoes and a pyralid and seldom by butterflies, and *P. chorisiana* by an oedemerid beetle.)

In general those flowers that are definitely pollinated by butterflies have bright or white colors, a narrow floral tube to increase the probability that the head or proboscis will contact pollen, and the stamens and stigma extend outward to contact the butterfly's body, like the flowers of *Diascia* spp., *Centranthus ruber* [red], *Lantana camara*, and *Buddleja davidii* [purple], which are reported to be butterfly pollinated (Proctor et al. 1996; Andersson 2006). Previous authors (Proctor et al. 1996 etc.) overemphasized that butterfly-pollinated flowers are mostly reddish. Willmer (2011) emphasized it less, as her table 11.1 lists red, orange, yellow, mauve [=violet to purple], although p. 118 says "butterflies in general like white, yellow, orange, pink, and red". Based on the above butterfly-pollinated flowers, they are frequently pink or yellow, often white, sometimes red, and least often are orange, purple, violet or

blue. Colorado butterflies visit blue/violet and purple flowers often (and of course yellow and white often), with a shortage of visits to red and orange, so the colors of any flowers pollinated by Colorado butterflies may differ somewhat. (It is notable that *Ipomopsis aggregata* is frequently studied as pollinated by long-tongued bumblebees and hummingbirds; it has red flowers over most of its range, but in central Colorado [where most of my records were gathered] it often has white flowers.) But Willmer notes that red flowers are more common in the tropics, while blue flowers are more common in high-altitude habitats such as this study (most of my records in Colorado are ~1300-4300 m=4000-13000 feet and I live at 5400 feet). German butterflies have color choices similar to large bees (Willmer 2011 fig. 5.12), which may be similar in Colorado. Previous authors overemphasized that they have sweet scents (often not powerful) with much nectar reached only through a slender tube or spur; more recent studies suggest that butterfly flowers are weakly scented (to humans) or fairly strongly scented, and few have spurs. Willmer notes that butterfly flowers tend to have a small, long floral tube, and often occur en masse; this is true mostly because Asteraceae are very popular and fit that description.

So, what is the verdict; do butterflies pollinate flowers? The good studies cited above and those cited below prove that some butterflies are the main pollinators of some flowers. But most flowers claimed to be “butterfly pollinated” (nearly all the flowers claimed in those awful “butterfly gardening” books or on the websites of nurseries) are expected to be pollinated primarily by other insects, usually bumblebees or other bees (usually by uncharismatic flies if you are in cold arctic/alpine places), as noted below in the studies cited of the pollinators of the plants. Evidently anything that travels between flowers of different individuals of a plant species will sometimes pollinate that species (if the flower reproductive system permits it), so butterflies fit in that category. Butterflies in general seem to be common occasional pollinators of flowers, and in a few cases they are main pollinators, but are usually just nectar thieves.

The ultimate question regarding pollination by butterflies is this: how many plant species would become extinct if butterflies became extinct? Comparing the popular flowers listed below with their pollinators as determined by literature reports summarized below, the answer appears to be—none or almost none. The plants most popular with butterflies also have alternative pollinators. *Buddleja davidii* and *Lantana camara* also have honeybees and thrips etc. The flowers most popular with butterflies, such as Asteraceae, generally have numerous additional pollinators. So, basically, butterflies are mostly nectar thieves, and they pollinate flowers only occasionally.

The records of visitation to flowers presented herein may assist future studies of pollination.

I searched the literature to determine which animals pollinated the plants listed below--both the plants popular with butterflies and the plants shunned--and found many good studies that demonstrate pollination by various insects and animals or wind or self-pollination etc. that are cited below, plus other studies with less evidence which are mentioned (readers can google “[plant species] pollination” to find the lower quality sources of this information or perhaps find something better). The good plant classification book of Judd et al. (2008) contains general information regarding pollination of the flowers of most plant families, and the relevant information is cited below. Most statements of pollination on the internet are just superficial observations of visits to flowers, which are of no greater use than this paper to determine the likelihood of pollination. (A bright spot on the internet is the vast records of flower visitation in Illinois based on C. Robertson [1929], presented at <http://illinoiswildflowers.info> and edited by Hilty [2013] [Tooker et al. 2002 lists those Illinois butterfly records]) There are now more than a million photos on the internet of butterflies on flowers, and most of those butterflies are identified properly but almost none of the flowers are identified even to family, and most of the key identification traits of the flowers are missing on macro photos of butterfly-on-flower, so only a minority can be identified to plant species although most can be partially identified; to identify most of those would require many experts familiar with exact details of the appearance of native and cultivated flowers. Laborious comparison of those photos with photos of identified flowers (from books, and google “[flower genus] [flower species] photo”) does produce useful results, with gratifyingly-accelerating results as the viewer learns the details of known flowers.

The numerous published studies on plant pollination do help to explain why some flowers are not popular with butterflies. Tiny flowers, especially tiny ugly ones, are generally wind-pollinated. Tiny

pretty flowers such as those of *Medicago lupulina*, *Portulaca oleracea*, *Polygonum viviparum*, *Capsella bursa-pastoris*, *Lepidium campestre*, many *Cardaria*, *Polygonum viviparum*, and small *Gayophytum* are very often self-pollinated (although many tiny pretty flowers such as *Eriogonum* and *Limonium latifolium* are insect pollinated). Many beautiful flowers that are unattractive to butterflies are pollinated by bees. Bumblebees evidently are the best pollinators, as they gather nectar and pollen and are strong enough to get into almost any flower, and they can “buzz pollinate” (vibrate their thorax and legs) to shake the pollen out of crannies on the flower. Bumblebees often pollinate up to 50% of all the flowers in an area. Other bees are excellent pollinators. Flies are evidently major pollinators in alpine/arctic habitats where bees are few (Kevan, 1971; Pont 1993; Philipp et al. 1990). Flowers that open toward evening are mostly pollinated by moths, but can be pollinated by bees the next morning. Specialized flowers such as orchids have just one or a few pollinating animals that are highly adapted to each orchid species, but there are few orchids in Colorado and they are rare and there evidently aren't many of those extreme cases of coevolution of flower and pollinator in Colorado.

Sap and Fruit Feeding. Some butterflies prefer sap to flower nectar. These butterflies belong to taxonomic groups that are basically the same worldwide. Sap feeding is most frequent in some groups of Nymphalidae, notably Satyrinae (in western North America sap feeding is frequent only in *Cercyonis pegala*, and is occasional in *Cyllopsis* and some others, whereas there are many examples worldwide, and many in eastern U.S. including *Lethe*, *Cyllopsis gemma*, *Hermeuptychia*, *Megisto cymela*), in most tropical Morphinae (including Morphini and Brassolini), all Charaxinae (*Anaea* etc.), many Nymphalinae (Limenitidini [*Limenitis*, *Adelpha*], tropical Coeini and Biblidini, Apaturini [*Asterocampa* etc.], many Nymphalini [*Nymphalis*, *Polygonia*, *Vanessa atalanta*, less by other *Vanessa*, occasionally *Aglais*]). In other families only the small group of Theclini-Theclina (*Hypaurotis*) in Lycaenidae/Lycaeninae frequents sap. Among other butterflies, I observed sap-feeding only occasionally: in Hesperidae (*Polites origenes*), Papilionidae (*Parnassius phoebus smintheus*), Nymphalinae/Heliconiini (*Argynnis cybele*, *A. aphrodite*, *A. hesperis*), Lycaenidae/Lycaeninae (*Lycaena heteronea*, *Satyrium behrii*, *S. calanus*). Visits to sap seem to be very rare in Pieridae and the blues (lycaenid tribe Polyommataini). Some of these sap feeders are long-lived as they hibernate as adults (*Anaea*, *Polygonia*, *Nymphalis*); however *Aglais milberti* adults aestivate in the mountains a long time and hibernate, yet they mostly feed on flowers.

Sap feeders are also the butterflies that most often feed on rotten fruit, so the chemicals attracting the butterflies must be similar.

Sap feeders generally approach the sap by odor (the sap is usually difficult to find visually), and they land just above the sap and walk down to it so they rest head downward as they feed. The obvious reason for this is the sap is sticky and gets thicker as it dribbles downward and evaporates, so if they climbed up to it they might get stuck and die and become fossilized in amber. I observed this downward posture often, and there are many photos on the internet of butterflies head downward sucking sap (for *Lethe anhedon* [Satyrinae], *Nymphalis antiopa*, *Vanessa atalanta*, *Polygonia interrogationis* and *P. comma* etc.). Sap-feeding butterflies can have a short proboscis, and some do, such as *Morpho* and *Hypaurotis* (but most such as *Asterocampa* and *Polygonia* have a normal longer proboscis), evidently because a short proboscis is less likely to become plugged by the thick sap, although certainly butterflies thin it with saliva before sucking it in, because it flows very slowly when stuck on the side of a tree. *Morpho peleides* evidently has a specialized short proboscis to feed on rotten fruit (it apparently never visits flowers and cannot feed on *Lantana* in greenhouses), because its proboscis is wide with a row of oblique transverse fissures on the posterior side of the distal part (which rests in the rotting fruit, posterior side up) that let the proboscis roll up and supposedly lead into the feeding tube (plus a row of large mid-posterior sensillae), that let it suck up fluid at a faster rate than the flower-feeding *Vanessa cardui* (Knopp and Krenn 2003). Sap-fruit feeders have a proboscis that is adapted to suck liquids from moist surfaces (Krenn 2010).

*Nymphalis antiopa* has been seen to imbibe sap from tree trunks, then raise the abdomen greatly and squirt clear fluid out into space (internet photos); evidently the butterfly found a spot where the sap was dilute so it passed much sap through the digestive tract to extract nitrogen, then voided the rest, as aphids do with their cornicles.

The chemicals in sap and fruit that attract butterflies seem to be different from those of floral nectar. Tree sap has sugars, and rotting fruit and some sap has those sugars plus fermentation chemicals. Omura and Honda (2003) studied the attractiveness (proboscis extension and feeding) of various sugars and amino acids in tree sap and rotting fruit, and of ethanol and acetic acid (which are most common in rotting fruit), to *Nymphalis xanthomelas*, *Kaniska canace*, and *Vanessa indica*, and found that they like sucrose more than fructose, and prefer glucose the least, but the most popular mix includes sucrose plus ethanol and acetic acid (both produced by bacterial fermentation of sugar); the butterflies were not attracted to the 15 amino acids that occur in sap and fruit. Tolerance of the fermentation products ethanol and acetic acid (even attractiveness when mixed with sugar) is evidently a required characteristic of sap feeding butterflies: Omura et al. (2008) found that the flower/sap/rotten fruit feeder *Vanessa indica* was not inhibited much by acetic acid from feeding, and 5-20% ethanol actually stimulated its feeding, whereas the strictly-flower-visiting *Argyreus hyperbius* was inhibited by ethanol and especially by acetic acid. (Also, *Arum palaestinum* emits an odor of rotting fruit to attract pollinating *Drosophila*, a scent almost entirely of ethyl acetate, with lesser amounts of ethanol and acetic acid [Kite et al. 1998]). Omura et al. (2000b) studied the odoriferous chemicals in *Quercus* sap that attract *Vanessa indica* and *Kaniska canace*, and found that *Vanessa* lowered its proboscis for five aliphatic acids (acetic, propionic, butyric, isobutyric, and isovaleric) and for 2-methylpropan-1-ol and 3-hydroxybutan-2-one, while *Kaniska* lowered its proboscis for those seven and also for ethanol, 3-methylbutan-1-ol and 1-hydroxypropan-2-one. Sourakov et al. (2012) studied the attraction of the fermenting-banana-feeding *Morpho* and *Caligo* to chemicals in rotting fruit, and found that they are attracted (based on electroantennogram response) to 14 aliphatic esters (the commonest being 3-methylbutylacetate); sense organs on forelegs, middle legs, proboscis, and antennae respond to 10 of them, and interestingly the labial palpi respond to seven including four that the other organs did not respond to. They thought that fruit-feeding butterflies are not attracted to unripe fruit because they need to smell volatile compounds from both the fruit and from its fermentation; my googling the smell of those 14 chemicals reveals that essentially all of them (plus a hundred more variants) are all sold as fragrances in the chemical industry and their odors are described as sweet with banana (usually) or apple or pineapple odors, so those chemicals are natural products of fruit ripening even prior to obvious fermenting (ethanol and acetic acid are the final endpoints of fermentation, creating the wine and vinegar-pickles that humans love). They found that the strict fruit-feeding *Morpho* and *Caligo* were attracted only by odor and not by color, while flower-feeding butterflies used color as well as scent to choose test foods.

Amino acids in sap and fruit (or flowers) are not very attractive to butterflies. They did not extend the lifespan of *Bicyclus anynana* butterflies (Molleman et al. 2008), while fruit sugars etc. did extend its lifespan, which can reach 100 days. And the various fruit-feeding butterflies in Uganda that prefer different fruits, do not choose those preferred fruits based on their nutrient content or their visual attractiveness (Molleman et al. 2005).

I have few records of adults feeding on honeydew (from Homoptera), but honeydew has sugars like sap and most of the butterflies feeding on it also visit fruit at least occasionally, so the attractive chemicals are evidently similar to those of sap.

There are a few records of butterflies visiting decaying fungi (my records of *Vanessa* and *Nymphalis*, a record in E. U.S. of *Cercyonis pegala* on puffball), which may have attractive chemicals similar to those of sap.

**Dung and Carrion Feeders.** Dung and carrion are occasionally fed upon by butterflies, and some butterflies frequently visit them. Many butterflies in tropical America feed on dung. The butterflies that feed on them are mostly different than those that like sap and rotting fruit. Butterflies that seldom visit rotting fruit, such as Hesperidae, Papilionidae, Pieridae, Ithomiini, Melitaeini, Heliconiini, and all groups of Lycaenidae, feed on dung, though not as frequently as the taxa that visit sap/fruit (various groups of Nymphalidae etc.). Many dung feeders are listed below, Payne and King (1969) list visitors to pig carrion, and the internet has photos of many dozen more species.

Carrion feeding butterflies in Borneo are very diverse (many kinds of butterflies visit carrion) compared to the few fruit feeders, and there is little similarity between the lists of carrion and fruit



feeding species (Hamer et al 2006); they suggested that butterflies may get nitrogen from the carrion. I have few records of carrion feeding, but many more photos are available on the internet, and my perusal of those suggests that carrion feeders are also more diverse than fruit feeders (Hesperiidae and Papilionidae and Melitaeini and Lycaenidae [*Feniseca*, Theclini and Polyommataini] also visit carrion), although again they visit carrion less often than butterflies that like sap/fruit (various Nymphalidae groups).

Because the butterflies eating these foods are much more diverse than fruit feeders, it is expected that the chemicals involved in attraction must be very different. Boggs and Dau (2004) found that *Pieris "napi" marginalis* butterflies tested on mud and dung preferred the samples that merely provided the most sodium; however that is a flower-feeding butterfly that visits mud and seldom or never feeds on dung in nature. Amino acids are not volatile enough to be attractive, and cannot be detected well, but ammonium ions may be attractive components of dung: *Inachis io* preferred ammonium ions in the lab but showed no response to urea (Erhardt and Rusterholz 1998), and related nymphalids were not attracted to amino acids (Omura and Honda 2003). (The nitrogen in ammonium chloride is used by *Papilio polytes* to produce sperm and reproductive fluids and muscle, and transferred to females during mating, then is incorporated into eggs [Honda et al. 2012]). It appears that little work has been done on determining the compounds of dung and carrion that are attractive to butterflies.

However, there is good evidence from flies and beetles. The stable fly *Stomoxys calcitrans* (Muscidae) is attracted to horse and cow dung, primarily by carboxylic acids (butanoic acid), alcohols (oct-1-en-3-ol), aldehydes (decanal), ketones (octan-3-one), phenols (p-cresol), indoles (skatole), terpenes (beta-caryophyllene) and sulfides (dimethyl trisulphide), and the higher CO<sub>2</sub> concentration near horse dung may cause it to be preferred (Jeanbourquin and Guerin 2007). The European dung beetle was studied by Dormont et al. (2010), who found 64 compounds emitted by cattle sheep horse and boar dung that attracted thousands of beetles, but only nine were emitted by all (p-cresol [abundant in all four kinds of dung], alpha-pinene, dihydrolimonene, limonene, terpinolene, indole, tridecane, alpha-copaene, skatole, and beta-caryophyllene). Cattle dung is the most popular (maybe because butyl propanoate, methyl hexanoate, and p-cymene were commonest in it?). They surmised that dung beetles are attracted to dung mostly by p-cresol, indole and skatole (the same compounds the dung-mimic flower *Arum maculatum* uses to attract flies, see below). And they note that indole and skatole (emitted by dung of humans dogs and pigs) is so potent that it can be detected by people and recognized as dung at only 1 ppm. Dung beetles reportedly prefer the dung of omnivorous animals, because it is smellier.

To determine the smallest mixture of compounds that is attractive to dung insects, the best clues may come from orchids and fungi and Araceae that mimic dung, because they have had millions of years to perfect their simple-and-efficient attraction recipe.

*Arum* species that have dung odors for pollination by dung-feeding flies and beetles have scents dominated by fatty-acid hydrocarbons, 2-heptanone, methyl(iso)butyrate, ethanol, p-cresol, indole, skatole, 2-nitro-p-cresol, and sesquiterpenoids (Kite et al. 1998). *Arum maculatum* attracts pollinating *Psychoda phalaenoides* flies whose larvae breed in cow dung, with a dung odor consisting of 95 compounds of which 2-heptanone, indole, and some p-cresol mostly produce the odor (other compounds are ammonia, ethylamine, diethylamine, putrescine, and skatole), while p-cresol is the key chemical of cow dung and is the floral scent that attracts the flies (Kite 1995).

Carrion beetles are also attracted to sulfur-containing gases (methanethiol, dimethyl sulphide, dimethyl disulphide, and dimethyl trisulphide). Carrion-burying beetles (*Nicrophorus*) are also attracted to sulfur-containing compounds (Kalinova et al. 2009): When they begin to decay, mouse carcasses emit sulfur-containing compounds (methanethiol, methyl thiolacetate, dimethyl sulphide, dimethyl disulphide, dimethyl trisulphide); the beetles' antennal olfactory sensillae respond to all those chemicals and live beetles are attracted to the latter three dimethyl sulphides. The orchid *Satyrium pumilum* is dull-maroon-brown and is visited by calliphorid, muscid, and sarcophagid flies that are attracted to oligosulfides (mostly dimethyl sulfide), 2-heptanone, p-cresol and indole (all are compounds that dominate the scent of carrion). Only *Sarcophaga* females pollinate the orchid because it emits small amounts of those attractants to mimic the small animals such as mice that *Sarcophaga* places its larvae on, while large

amounts of the same compounds attract numerous *Calliphora* flies that lay many eggs on large carcasses. Some Araceae flowers mimic decaying carrion: *Helicodicerus muscivorus* flowers smell like dead horse to lure carrion-fly pollinators, and emit mainly dimethyl mono- di- and trisulfides which also occur in rotting horses and attract the flies (Stensmyr et al. 2002). Araceae species that smell “gaseous” or like carrion (*Amorphophallus* and *Pseudodracontium*) produce a simple mixture of mainly oligosulfides (Kite and Hetterscheid 1997); flowers that attract carrion feeding insects have odors with dimethyl oligosulfides (such as dimethyl di- and trisulfides in *A. rivieri*). Some *Arum* spp. also produce oligosulfides that attract calliphorid flies (Kite et al. 1998).

Araceae that smell like fish (*Amorphophallus* sp.) have amines such as trimethylamine (Kite and Hetterscheid 1997).

In general, flowers that produce p-cresol, indole and 2-heptanone mimic dung to attract flies, while flowers that produce mostly oligosulfides mimic carrion to attract them. But the stinkhorn fungus *Clathrus archeri* is a black-striped red elongated mass that has fetid odors that attract flies that eat it and spread its spores on feet and excreta, and the stinkhorn and seven fly-pollinated angiosperm flowers (*Stapelia* spp., *Orbea* spp., *Huernia*, *Ferraria*, *Aristolochia cymbifera*) convergently produce the same chemicals to attract flies: they produce oligosulfides that dominate in carrion, as well as phenol, indole and p-cresol that dominate in dung (Johnson and Jürgens 2010). [Ironically, at low concentration indole and skatole smell flowery and are used in perfumes.] Jürgens et al (2006) studied 11 genera of Stapeliad flowers (Apocynaceae relatives) that attract fly pollinators and found they fit into several groups: flowers with high p-cresol content but low amounts of polysulfides mimic herbivore feces; while flowers emitting mainly polysulfides and low amount of p-cresol, or high amounts of heptanal and octanal, mimic carnivore/omnivore feces or carrion.

What is the conclusion? Clearly p-cresol and indole and skatole attract insects to dung, and oligosulfides attract them to carrion. Dimethyl sulfide is an oligosulfide, p-cresol is a phenol, and skatole is an indole. So, the ideal minimum mixture that collectors can formulate for attracting carrion and dung butterflies evidently should be mostly dimethyl sulfide, and less p-cresol and indole or skatole.

**Bird Dung Feeders.** Most of my observations of bird-dung feeding involve fluid-recycling skippers with a long proboscis (such as *Epargyreus*, *Piruna*, *Euphyes*, *Poanes*, and *Amblyscirtes*) that sometimes get nutrients from bird droppings by exuding clear fluid from the end of the abdomen onto the dropping, then extending the proboscis back under the body to the drop and sucking up part of the liquified dropping. This is an efficient way of liquefying the dried food enough to be sucked. In the neotropics, antbirds travel along with army ant swarms (*Eciton burchelli*) and eat insects stirred up by the ants, and some Ithomiini butterflies (*Mechanitis* and *Melinaea*, mostly females) congregate there and feed on the bird droppings (Ray and Andrews, 1980).

The compounds attracting butterflies to bird dung have not been studied. Bird dung differs somewhat from that of mammals. Birds secrete uric acid instead of urea, and place it in their dung, so the dung of many birds is white due to white uric acid crystals and does not look very nutritious. Yet butterflies do visit it sometimes, at least for sodium and nitrogen. Guano contains ammonium oxalate, nitrates (mostly urate), phosphates, some earth salts (sodium, potassium and potash, etc.), and phosphoric acid. Penguin rookeries emit acetic acid, acetaldehyde, acetone, ammonia, and formic acid. The bird-dung crab spiders in SE Asia *Phrynarachne* look like dung to attract flies to eat, and some even spin a white patch around them to further the camouflage, and *P. ceylonica* even emits a dung/urine scent (Takafumi et al. 1999), but those chemicals have not been determined either. Aldehydes in chicken dung attract *Culex* mosquitoes (Cooperband et al. 2008). Robacker et al. (2000) found that a synthetic mixture of ammonia, methylamine, dimethylamine, trimethylamine, 1-pyrroline, phenol, and 2-ethylhexanol was 96% as attractive as duck dung in attracting Mexican fruit flies.

**Urine and Perspiration Feeding.** I have few observations on urine, but those few observations and internet reports suggest that a wide range of butterflies occasionally feed on it, unlike sap and rotten-fruit feeders that are mostly taxa within Nymphalidae. Thus Hesperidae, Papilionidae, Pieridae, Lycaenidae, and Melitaeini (Nymphalidae) also visit urine, as well as the Satyrinae and Nymphalinae sap feeders. Urine is a complex mixture of ~95% water, and solutes including urea, creatinine, uric acid, trace enzymes,

carbohydrates, hormones, fatty acids, pigments, mucins, and inorganic ions (sodium, potassium, chlorine, magnesium, calcium, ammonium, sulfates, and phosphates). The sodium and ammonium in urine are definitely attractive to butterflies. Shen et al. (2009) studied the grasshopper *Ceracris kiangsu*, which eats filter paper soaked in urine (which becomes most attractive after 3-6 days of warmth). The grasshoppers are stimulated to eat by NaCl, NaH<sub>2</sub>PO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>, KCl, NH<sub>4</sub>Cl, NH<sub>4</sub>HCO<sub>3</sub>, and are repelled by CO(NH<sub>2</sub>)<sub>2</sub>; the most powerful feeding stimulant was sodium salt NaCl. But Stapeliad flowers that emit hexanoic acid mimic urine (Jürgens et al 2006). Evidently butterflies feed on urine mostly to get sodium, as most reports of butterflies feeding on it assume, with the additional benefit of gaining some nitrogen. Butterflies that sometimes feed on human sweat, such as *Asterocampa*, are evidently seeking sodium as well.

**Mud Feeding (“Puddling”).** All butterflies have a proboscis, long or short, and evidently all butterflies feed on water at least when they become dehydrated (including the carnivorous-larva butterfly *Feniseca tarquinius*). Butterflies—mostly males—are often found imbibing water at mud puddles or wet sand etc., often in groups evidently because most butterflies assume that if other butterflies are present, predators must be absent and nutrients must be good. The usual explanation (Arms et al. 1974) is that males are seeking sodium in the mud, which males (such as *Thymelicus lineola*, Pivnick and McNeil 1987) incorporate into their spermatophores that are transferred to females during mating, and the females use the sodium for their eggs. Thus Japanese *Papilio* butterflies detect Na<sup>+</sup> using contact chemosensillae in the proboscis that fire for NaCl but not for CaCl<sub>2</sub> or MgCl<sub>2</sub> (Inoue et al. 2012), and they prefer Na<sup>+</sup> over K<sup>+</sup>, Ca<sup>2+</sup>, and Mg<sup>2+</sup> even if the concentration of the latter three ions is higher than that of Na<sup>+</sup>. So Lepidopterists today generally think that only males visit mud and think they are always seeking sodium. The *Thymelicus* mud feeders were all males, as were nearly all the *Pieris rapae* mud visitors studied by Adler and Pearson (1982). However, I have often seen females of many species visiting mud (although most mud feeders are males), so it is obvious that butterflies also visit mud simply to rehydrate. In hot summers at Arizona waterholes, hundreds of butterflies come to the mud to rehydrate. Boggs and Jackson (1991) found that young male *Argynnis (Speyeria) mormonia* spent more time at mud than older males, while young females almost never visited mud, yet older females visited just as often as older males (35% were older females, 38% were older males); perhaps the young males were often seeking sodium, and maybe older females want sodium also for their growing eggs, and evidently both sexes sometimes get dehydrated.

*Apyrrothrix araxes* has a unique method of sipping water. It lands with wings spread flat on the water, floats in that position, simply unrolls its proboscis, then when finished imbibing it flaps its wings and instantly blasts upward into space.

## **The Flowering Plants and Other Foods, and the Butterflies that use them**

Plant classification has improved greatly recently. Plant morphology is less complex compared to animals and is very plastic, resulting in fewer useful characters to study, and there is frequent convergence in most plant traits; these difficulties cause great difficulty in determining phylogeny. The recent use of DNA bypasses some of those problems and has greatly improved the natural phylogenetic classification of plants. Below I arrange the plant families using the “consensus” Angiosperm phylogeny reported by Stevens (2012) (one of the authors of the Judd et al. [2008] book cited above), which was constructed using DNA and plant morphology etc. in an attempt to deduce phylogeny; the Stevens (2012) website has phylogenetic trees, a sequential printed classification, and a poster and chart of the phylogeny. (Older floras such as Harrington [1964] and Flora of the Great Plains [McGregor 1986] arranged the plants in attempted-phylogenetic sequence, but many recent floras such as Hickman et al. [1993] and Weber and Wittman [1996-2012] arrange the families alphabetically and do not try to keep up with recent DNA advances in plant phylogeny.) Plant genera and species are arranged alphabetically within each plant family in the records below. The local floras listed in Literature Cited were used for

identification purposes and also to attempt to use the most correct names for plants that have different names in almost every flora.

Paragraphs in parentheses below concern flower genera and species that have no records of butterfly visitation; those serve as comparison to often-visited flowers.

#### MOSESSES/LIVERWORTS/FERNS/HORSETAILS

Butterfly adults do not feed on these wind-pollinated plants in North America.

#### CUPRESSACEAE/PINACEAE

Butterfly adults do not feed on these wind-pollinated junipers and conifers. Primitive plants such as these and *Ginkgo* are mostly wind-pollinated, but Zamiaceae cycads are pollinated by beetles (Judd et al. 2008) and weevils and thrips (Terry et al. 2005).

#### EPHEDRACEAE

(*Ephedra* has no apparent “flowers”, and no records. Most species are wind pollinated, except for some such as *E. aphylla* and *E. campylopoda* that are sometimes pollinated by ants that get sugary nectar.)

#### NYMPHAEACEAE

(*Nuphar polysepala* has pretty yellow flowers and occurs on subalpine Colorado ponds but I have made no observations involving it. *Nuphar* is pollinated by flies, bees, and *Donacia* beetles [Chrysomelidae] that evidently specialize on *Nuphar* [Lippok et al. 2000]. Three bee species (*Hylaeus nelumbonis*, *Lasioglossum nelumbonis*, and *Lasioglossum nymphaeorum*) are specialists on *Nuphar* and the closely-related *Nymphaea* and *Nelumbo*.)

#### ALISMATACEAE

Alismataceae in general are pollinated by insects, often bees and flies (Judd et al. 2008).

*Alisma subcordatum* whitish is too uncommon to assess its popularity: *Ancyloxypha numitor*. Flowers of *Alisma* underwater self-pollinate, and those above water are pollinated by flies.

(*Sagittaria* are common and have beautiful white flowers, but I have seen no butterflies on them, though in E U.S. visits are recorded by *Ancyloxypha numitor* and *Lycaena helloides*. *Sagittaria guyanensis* is pollinated by a wide variety of insects in China.)

#### JUNCAGINACEAE

(*Triglochin* has small ugly flowers that are evidently wind-pollinated.)

#### POTAMOGETONACEAE

(*Potamogeton* has small inconspicuous flowers that are not visited by butterflies. Some *Potamogeton* have flowers above water that are wind-pollinated, and others such as *P. pectinatus* have pollen carried to the surface in air bubbles where they float and move by wind or waves etc.; seed set is only 4% submerged, but up to 40% emerged [Zhang et al. 2010].)

#### MELANTHIACEAE (formerly in Liliaceae)

(*Veratrum californicum* is common but has tiny greenish flowers that are reportedly pollinated by flies.)

(*Zigadenus* white is ignored by butterflies. *Zigadenus venenosus* is pollinated by bees, but is toxic to honeybees. *Zigadenus [Anticlea] elegans* is visited by muscid flies. *Zigadenus paniculatus* is visited most often by syrphid flies [*Eristalis hirtus*], by the solitary bee *Andrena astragali* [which is a *Zigadenus* specialist], and by stratiomyid flies [*Stratiomys barbata*, *S. nevadae*] which become covered with pollen [Tepedino 1981].)

#### LILIACEAE

In general these flowers are unpopular, but giant *Hemerocallis* and *Lilium* flowers are actually pollinated by large papilionid butterflies. Elsewhere, Liliaceae with bell-shaped flowers are often pollinated by bees, while *Lilium martagon* is pollinated by the sphingid moth *Macroglossum stellatarum* (Proctor et al. 1996).

*Calochortus* ?yellow-orange: *Colias occidentalis*. *Calochortus macrocarpus* pink is pollinated by bees including two specialist pollinators of *Calochortus* (the halictid *Dufourea calochorti* and the andrenid *Perdita calochorti*), and by anthophorid bees, while flies visit but often get trapped in hairs within the blooms (Gary Ott, internet). California *Calochortus* are visited by bees that collect pollen and by beetles that feed at glands on the petals. Other *Calochortus* are reportedly visited by various generalist insects including honeybees and beetles.

*Calochortus gunnisonii* white: *Oarisma garita*.

*Calochortus nuttallii* violet-white: *Hesperia uncas tomichi*.

(*Convallaria* white flowers in my yard are shunned by butterflies. *Convallaria majalis* is reportedly pollinated by bees, honeybees, flies, and selfing. *C. keiskei* is reportedly visited by beetles and flies.)

(*Erythronium grandiflorum* yellow has no records. It is pollinated by bumblebees, *Apis*, and *Andrena* bees [Thomson 1986; Thomson and Thomson 1989; Motten 1986].)

*Hemerocallis* ~*fulva* orange (with some red) is pollinated by *Papilio* at least frequently: *Papilio multicaudata* 7x + another only 3 sec. (a very popular flower this butterfly seems to pollinate, as a male had orange-yellow pollen behind ventral forewing costa ~2 cm from middle of body that looks like *Hemerocallis* pollen; another had orange pollen on ventral forewing yellow area just behind costa 1.5 cm from body; and a 3<sup>rd</sup> had pollen on ventral forewing just behind costa 1.5 cm from body; a 4<sup>th</sup> male on var. “Magnificence” was deep into flower [half visible]), *Papilio polyxenes*. *Papilio* obviously pollinates *H. fulva*, which is confirmed by Hirota et al. (2012), who observed numerous visits of *Papilio xuthus*, *P. memnon*, and *P. helenus* to the flowers in Japan (along with a few visits of the nymphalid *Argyreus hyperbius* and many visits of the hesperiid *Parnara guttata* and many visits of the bee *Xylocopa appendiculata* during field tests of attraction); *Hemerocallis citrina* is yellowish with a sweet fragrance and opens in the evening and is pollinated by nocturnal sphingids *Theretra olderlandiae* and *T. silhetensis*. Hummingbirds pollinate other *Hemerocallis*.

*Leucocrinum montanum* white: *Erebia epipsodea*. This is pollinated by a nocturnal moth.

(*Kniphofia caulescens* has beautiful orange-red flowers but I have seen no butterflies on the few local plants. *Kniphofia* are reportedly pollinated by hummingbirds and insects in North America, bees in Britain, and sunbirds and sugar birds in their native south Africa [Brown et al. 2010; they note that *Kniphofia* is pollinated by the butterfly *Aeropetes tulbaghia* at two locales, but primary pollinators are sunbirds and to a lesser extent bees].)

*Lilium pardalinum* orange: *Papilio glaucus rutulus* (New Sunset Western Garden book).

*Lilium philadelphicum* orange is rare in Colo.: *Papilio eurymedon*. I saw no other butterflies on several dozen flowers SW of Denver. It is pollinated by large papilionid butterflies (*Papilio eurymedon* [Shapiro 2007 notes *Lilium* are visited by *Papilio eurymedon* that become covered with pollen] and *P. glaucus rutulus* in western U.S., *P. glaucus glaucus* in E U.S. including New England), while hummingbirds occasionally visit but the flower morphology causes the Papilionidae forewings to contact the reproductive structures and causes bird beaks to avoid contact (Flora of North America 26:180, www.efloras.org). Several *Lilium* species are pollinated by hummingbirds (Grant 1994), and some are reportedly pollinated by butterflies.

lily with yellow flower: *Hesperia lindseyi*.

*Muscari botryoides* deep-blue is very common in my yard but has few records: *Vanessa cardui* 32x mostly during superabundant migrations. It is pollinated by “insects” such as bombyliid flies but in gardens generally spreads vegetatively.

(*Polygonatum* white flowers in my yard are shunned by butterflies. *Polygonatum odoratum* is pollinated largely by bumblebees *Bombus terrestris* and *B. hortorum* in Spain [Guitian et al. 2001]. *Polygonatum multiflorum* and *P. biflorum* are pollinated by bees and self-pollination. *P. bistorta* is “buzz-pollinated” by bumblebees. In Illinois *P. commutatum* attracts various long-tongued bees including bumblebees,

Anthophorinae bees, and Little Carpenter bees, while short-tongued halictid bees visit for pollen but are not effective pollinators, and hummingbirds visit sometimes [Hilty 2013].)

*Smilacina (Maianthemum) stellata* white lilies are mostly ignored by butterflies: *Pieris marginalis mcdunnoughii*. *Smilacina racemosa* is reportedly pollinated by small bees flies and beetles. *S. (Maianthemum) canadense* is pollinated by bumblebees at least.

## ORCHIDACEAE

These are usually pretty but are not visited by butterflies, as most orchids are highly specialized for pollination by various bees or flies or other animals. Orchids are rare in Colorado. *Corallorhiza maculata* purplish-spotted white is pollinated by small flies, bees, and beetles (Dodson and Dunmire 2007).

(*Calypso bulbosa* rose is rare in Colorado so I have no records. It is pollinated by bumblebees that are tricked as it has no nectar [Dodson and Dunmire 2007].)

*Limnorchis "Habenaria" dilatata* white: *Plebejus saepiolus* 2 sec.

(*Spiranthes diluvialis* white is locally common in Wheat Ridge Colo. but I saw no visits on it. Bumblebees are principal pollinators of most North American *Spiranthes*, with megachilid bees minor pollinators [Catling 1983]. Eight butterfly spp. were seen as visitors on eight *Spiranthes* spp. flowers in the Illinois wildflower survey [Hilty 2013], while bumblebees and other bees visited them all.)

## IRIDACEAE

These are not popular with butterflies. Iridaceae in general are pollinated mainly by insects, esp. beetles, bees, and flies (Judd et al. 2008). Iridaceae produce floral oils as a reward.

(*Crocus* [cultivated] have many bright colors but are shunned, and in Denver they bloom in late winter too early for nearly all butterflies. They are pollinated by bees [Proctor et al. 1996].)

(*Gladiolus* is rare in Denver, and I have seen no butterflies on them. Several South African species are pollinated by the Satyrinae butterfly *Aeropetes* [Goldblatt and Manning 2002].)

Iridaceae white: *Plebejus acmon*.

*Iris* is rarely visited, though there are recorded visits by *Carterocephalus "palaemon" skada* in California, and visits on *Iris versicolor* by *Poanes hobomok* and *Euphyes bimacula* in eastern U.S.

*Iris germanica* blue: *Papilio multicaudata* 1x (another 1 sec.), *Papilio zelicaon*. In Louisiana bumblebees are the most common visitors to *Iris* at some sites, hummingbirds most common at another site.

*Iris missouriensis* pale blue is fairly common but seldom visited: *Epargyreus clarus*, *Glaucopsyche lygdamus* (failed to probe petal, so got no nectar), *Papilio multicaudata* (South Dakota, Gary Marrone), *Polites draco* (crawled down and turned and put proboscis between petal bases). *Iris* is pollinated by bumblebees in western North America (Dodson and Dunmire 2007). Elsewhere, *Iris pseudacoris* is pollinated by *Bombus hortorum* bumblebees and long-tongued flies that crawl inside (Proctor et al. 1996).

(*Sisyrinchium* has pretty little flowers but is seldom visited.)

*Sisyrinchium bellum* blue-violet (Calif.): *Euchloe ausonides ausonides* 2x, *Junonia coenia* 2x. In Brazil *Sisyrinchium vaginatum* has pollen but no nectar and is pollinated by syrphid flies, and in some places by bees (Freitas and Sazima 2003).

*Sisyrinchium montanum* deep violet: *Colias philodice*.

## AMARYLLIDACEAE (includes Alliaceae)

The plants formerly placed in Alliaceae are pollinated in general by various insects, esp. bees and wasps (Judd et al. 2008). *Brodiaea* is popular.

*Allium* (formerly in Liliaceae) is not very popular, but there are some records. *Allium* (including onion) is reportedly pollinated by bees, solitary bees, and syrphid and calliphorid (*Lucilia* and *Calliphora*) flies.

*Allium cepa*: *Glaucopsyche lygdamus* 17x.

*Allium cernuum* pink or pinkish-white (the inflorescence is nodding and flowers face downward, yet there are three records anyway): *Cupido amyntula valeriae* 2x, *Erynnis horatius*.

*Allium geyeri* pink: *Erebia epipsodea*, *Paratrytone snowi*.

*Allium sibiricum* violet: *Aglais milberti*, *Vanessa cardui*.

*Allium textile* white: *Erynnis afranius*, *Lycaena arota*, *Oarisma garita* (another did not land after inspecting two white flowers), *Plebejus melissa*.

*Allium textile* white to light-rose: *Argynnis (Speyeria) callippe*, *Atrytonopsis hianna hianna* 4x, *Chlosyne gorgone* 10x, *Chlosyne leanira fulvia* 2x, *Colias philodice*, *Erynnis persius* 3x, *Euchloe olympia* 9x, *Euptoieta claudia* 2x, *Hesperia juba*, *Oeneis chryxus*, *Phyciodes pulchella camillus* 6x, *Polites (Yvretta) rhesus* 2x, *Pontia protodice*, *Pyrgus communis* 2x, *Strymon melinus*.

*Allium* sp. violet: *Erynnis telemachus*.

*Allium* sp. ?pale-pinkish: *Chlosyne palla palla*.

*Allium* sp. probably ~pink: *Satyrium sylvinus sylvinus*.

*Brodiaea pulchella* blue seems moderately popular in Calif.: *Battus philenor hirsuta* 2x, *Colias occidentalis*, *Euchloe ausonides ausonides* 7x, (*Junonia coenia* did not visit it). This is reported to be pollinated by bees and butterflies. *Brodiaea ida-maia* and *B. venusta* are pollinated by hummingbirds (Grant 1994).

*Brodiaea* blue: *Hesperia lindseyi*, *Ochlodes agricola*, *Papilio zelicaon* [on *Brodiaea*?].

(*Narcissus pseudonarcissus* yellow is common in gardens but is shunned by butterflies. It is pollinated by long-tongued bees and flies [bumblebees including *Bombus terrestris* and the bee *Anthophora plumipes* and the fly *Eristalis*] [Proctor et al. 1996].)

#### ASPARAGACEAE (includes Agavaceae which formerly contained *Yucca* and *Nolina*)

Asparagaceae in general are pollinated by bees and beetles (Judd et al. 2008). Most genera are not visited, although *Nolina* is popular.

(*Asparagus officinalis* has tiny greenish flowers that produce nectar and pollen but are ignored by butterflies. It is pollinated by bees, primarily honeybees that make good honey from it.)

*Nolina greenei* "texana" white to cream: *Callophrys mcfarlandi* many visits (the hostplant, whose flowers are almost the only ones visited by this butterfly). *Nolina* is visited by honeybees, so is probably pollinated by bees and flies.

(*Yucca* has large beautiful large pendant white flowers which are not visited. They are pollinated by mostly-nocturnal female *Tegeticula* [*Yucca* moths] that do not feed and gather pollen with modified mouthparts and place it onto another flower's stigma, then they lay eggs in the carpel and the larvae eat the growing seeds [Powell, 1992]; *Yucca* is rarely pollinated by honeybees and bumblebees, as the flowers sometimes have nectar.)

#### TYPHACEAE

Butterflies do not visit the three species of wind-pollinated *Typha* (cattails) in Colorado. The family is wind-pollinated (Judd et al. 2008).

#### JUNCACEAE, CYPERACEAE, POACEAE=GRAMINAE

Butterflies do not visit these wind-pollinated rushes/sedges/grasses. Juncaceae and Poaceae are pollinated by wind; Cyperaceae are usually pollinated by wind, sometimes by insects in other lands ([for some *Rhynchospora* and *Ascolepis*, and by insects for *Hypolytrum*; Judd et al. 2008).

#### COMMELINACEAE

Commelinaceae in general are pollinated by bees or wasps (Judd et al. 2008).

*Tradescantia occidentalis* blue is fairly common but is mostly shunned and has almost no visits: *Epargyreus clarus* only 1 sec. *Tradescantia* is reportedly pollinated by long-tongued bees (honeybees and bumblebees); syrphid flies visit without pollinating.

#### PONTEDERIACEAE

These are rare in Colorado so I have no observations. The family in general is pollinated by bees, flies, and butterflies (Judd et al. 2008). *Pontederia cordata* is common along the Atlantic coast of U.S., where it is popular with butterflies and marsh skippers seeking nectar, including the skipper *Problema bulenta*

which surely helps pollinate it. *P. cordata* is pollinated by generalist bees *Bombus impatiens* and *B. vagrans*, and a specialist anthophorid bee *Melissodea apicata* (Harder and Barrett 1992, 1993) that is adapted to *Pontederia*. Another bee *Dufourea novaeangliae* also specializes on *P. cordata*.

#### CANNACEAE

*Canna* is present in some Colorado gardens, but I have seen no butterflies visiting the large showy orange flowers. *Canna* varieties are mostly pollinated by hummingbirds (*Heliomaster furcifer* pollinates *Canna indica*, a parent of many cultivated *Canna* [Glinos and Curcucci 2011]). The flowers have nectar, and might be pollinated by bees, butterflies, moths, and birds (Judd et al. 2008).

#### PAPAVERACEAE (includes FUMARIACEAE)

Butterflies rarely visit these. Papaveraceae in general are pollinated by bees, wasps, and flies (Judd et al. 2008).

(*Argemone* is beautiful but not visited. *Argemone hispida* is pollinated by bumblebees [*Bombus*] that roll in the pollen, and other bees [*Andrena argemonis*, *Epeolus auriginea*, *E. enavata*, *E. menuacha*, *Podalirium occidentale*] and beetles [the curculionid *Peritaxia hispida* and nitidulid *Carpophilus pallipennis*], and flies probably also pollinate [Willemstein 1987]. *Argemone mexicana* usually selfs but is sometimes pollinated by small stingless bees. Bees pollinate *Argemone aurantiaca* and beetles facilitate self-pollination.)

(*Papaver* spp. including *P. orientale* are beautiful but not visited. They lack nectar and are reportedly buzz-pollinated by bumblebees, and pollinated by honeybees and other bees, flies, beetles, and selfing.

European *Papaver rhoeas* is pollinated by bumblebees and honeybees seeking pollen [McNaughton and Harper 1960].)

*Corydalis* (Fumariaceae) is not visited by butterflies in my experience, but is rarely visited by butterflies elsewhere. In Colorado the bumblebee *Bombus appositus* is the most common visitor and pollinator of *Corydalis caseana*, while *Bombus occidentalis* and *B. flavifrons* mostly chewed a hole in the flowers and robbed them of nectar, and hummingbirds visited occasionally, and even the butterfly *Papilio zelicaon* visited once (Maliof 2000). In central Europe the bee *Anthophora acervorum* is a common pollinator of *Corydalis cava* and the bumblebee *Bombus terrestris* both pollinates and robs the flowers (but robbers usually pollinate the flower anyway due to its peculiar morphology), while in Denmark *B. terrestris* is the only pollinator (Olesen 1996, 2013?). Bumblebees are regular visitors to *Corydalis caseana*. *Anthophora acervorum* bees and *Bombus terrestris* bumblebees are common pollinators of *Corydalis cava* in Europe. *Corydalis ambigua* is pollinated by bumblebees and honeybees. *Corydalis flavula* sometimes self-pollinates but honeybees mostly pollinate it in New England, and flies and the butterfly *Anthocharis midea* sometimes visit (Farnsworth 2001).

(*Dicentra* has no records. Bumblebees pollinate them [Macior 1978].)

*Eschscholzia californica* orange (Calif.): *Euchloe ausonides ausonides* 1x, *Junonia coenia* 1x. In California it is pollinated by bumblebees, halictid and andrenid bees, honeybees and other Apidae (*Perdita*), and occasionally by other insect visitors syrphid flies, beetles, minute pirate bugs, and butterflies which seldom pollinate.

#### BERBERIDACEAE

Berberidaceae in general is pollinated by insects, mainly bees; pollen-bearing flaps on *Berberis* stamens contact the insect's head (Judd et al. 2008).

*Berberis* (*Mahonia*) *repens* yellow is moderately popular: *Argynnis* (*Speyeria*) *callippe*, *Callophrys dumetorum homoperplexa*, *Callophrys augustinus*, *Callophrys eryphon* 3x, *Callophrys sheridanii*, *Celastrina lucia sidara* Janet Chu, *Erynnis persius*, *Erynnis telemachus* 3x, *Euchloe ausonides*, *Glaucopsyche lygdamus*, *Polygonia gracilis zephyrus*, *Polygonia satyrus*, *Strymon melinus*, *Vanessa cardui* 2x.

#### RANUNCULACEAE (includes Thalictraceae)



There are many beautiful flowers in this family (nearly all those listed below are pretty), but they are unpopular flowers for butterflies, except *Clematis* and *Delphinium* are popular and *Ranunculus* is sometimes visited. Judd et al. (2008) note the following concerning pollination: Most Ranunculaceae are pollinated by insects. Some *Thalictrum* and *Anemone* and *Clematis* do not produce nectar and are pollinated by various pollen-gathering insects [including honeybees and other bees on *Thalictrum*, which is sometimes wind-pollinated] [however *Clematis ligusticifolia* obviously has nectar as it is very popular with butterflies as noted below]. They state that *Ranunculus Delphinium* and *Aquilegia* have nectar-producing petals and are visited mainly by bees and hummingbirds. *Caltha* has nectar glands at base of carpels and is bee pollinated. The fly *Chiastochaeta* pollinates *Trollius europaeus* and its larvae feed on the seeds.

(*Aconitum columbianum* blue-purple has no records. It and other *Aconitum* are pollinated by bumblebees including *B. flavifrons* and less often *B. appositus* [Macior 1995, Bosch and Waser 1999; Marden 1984; Proctor et al. 1996, Inouye 1978].)

*Anemone canadensis* white: *Ancyloxypha numitor* 2x, *Celastrina humulus* hop-ecotype (landed on it and flew), *Celastrina neglecta*, *Euphyes vestris*, *Vanessa cardui* (the butterfly found dead with proboscis wrapped around peduncle).

*Anemone cylindrica* greenish-white: *Argynnis (Speyeria) hesperis*.

*Aquilegia coerulea* blue: *Colias eurytheme*. Bumblebees pollinate dark blue short-spurred flowers, while sphingid moths pollinate pale long-spurred ones such as *A. pubescens* (Dodson and Dunmire 2007).

Hummingbirds pollinate many *Aquilegia* (Grant 1994) including *A. formosa* (Hirota and Nitta 2012).

*Caltha "Psychrophila" leptosepala* white: *Boloria freija*, *Boloria titania* 2x, *Boloria eunomia* 2x, *Erebia epipsodea*.

*Clematis hirsutissima* blue: *Celastrina humulus* (lupine-ecotype) landed on flower but left. *Clematis* is pollinated by bumblebees honeybees flies moths and other insects; *Clematis stans* is pollinated by bumblebees *Bombus diversus* and *B. honshuensis* (Dohzono and Suzuki 2002).

*Clematis ligusticifolia* white is popular: *Argynnis (Speyeria) callippe* 3x, *Argynnis (Speyeria) hesperis*, *Asterocampa celtis jeffermont* 2x, *Atrytone arogos*, *Calephelis nemesis*, *Celastrina lucia sidara*, *Cercyonis oetus* 12x, *Cercyonis pegala* 8x, *Danaus gilippus*, *Dione vanillae*, *Erynnis afranius*, *Hesperia viridis* some, *Hesperia leonardus* ssp. occasionally (Scott and Stanford 1981), *Limenitis weidemeyerii*, *Lycaena arota* cream-white 14x, *Lycaena dione*, *Ministrymon leda* [*Clematis?* ~white], *Poladryas minuta arachne*, *Polites mystic*, *Polites origenes*, *Satyrium behrii* behrii, *Satyrium liparops* 3x, *Satyrium sylvinus* 3x, *Satyrium titus* 3x, *Strymon melinus*, *Vanessa atalanta*, *Zerene cesonia*. *Clematis ligusticifolia* is pollinated by muscoid flies (mainly), Culicidae mosquitoes, and halictid bees (Borkent and Harder 2007).

*Clematis Xjackmani* blue: *Papilio multicaudata* 2x (but both only 2 sec.), *Papilio cresphontes* (4 sec.). This garden *Clematis* may lack nectar as it is mostly shunned.

*Delphinium* is pollinated by bumblebees (Bauer 1983, Dodson and Dunmire 2007 etc.) and sometimes by other Hymenoptera and Diptera and butterflies; the cultivated *D. ajacis* may be pollinated sometimes by butterflies as noted below. Elsewhere, *Delphinium nudicaule* and *D. cardinale* are pollinated by hummingbirds (Grant 1994).

*Delphinium ajacis* violet is popular with some butterflies with long proboscis: *Euptoieta claudia*, *Papilio glaucus rutulus* 4x, *Papilio multicaudata* 85x (males land on a lower flower of inflorescence then helicopter up to the other ~4-5 flowers one by one by aiming body vertical and flapping forewings to rise up), *Papilio polyxenes* 2x, *Pieris rapae* (violet flower 2x [+ one only 1 sec.], pink flower 1x), *Plebejus melissa*, *Poanes taxiles* 23x (+1x on pink flower), *Polites themistocles* briefly, *Pontia protodice* 2x, *Vanessa cardui* 3x and 1/3 sec.

*Delphinium cardiopetalum* violet: *Poanes taxiles* 2x.

*Delphinium ~geyeri* blue: *Colias philodice*, *Erynnis telemachus*, *Papilio zelicaon* (whitish flower).

*Delphinium nuttallianum* deep blue-purple: *Papilio eurymedon* 5x. This is pollinated primarily by bumblebees, solitary bees, and hummingbirds in Colorado (Bosch and Waser 1999). *D.*

*nuttallianum=nelsonii* is pollinated by *Bombus* bumblebees, *Habropoda* and *Osmia* bees, and less often by *Apis* honeybees, *Xylocopa* bees, sphingid moths and hummingbirds (Waser 1988).

*Delphinium ramosum* blue: *Boloria eunomia*, *Colias alexandra*, *Papilio indra*, *Thorybes mexicana*. (*Nigella damascena* has pretty blue flowers but I have seen no butterflies on it in local gardens. It is pollinated by honeybees. *Nigella bucharica* is pollinated by bees. *Nigella sativa* is pollinated by flies the commonest visitors [*Phytomyza atricantis*, *Melanagromyza phaseoli*, *Liriomyza congesta*], bees [honeybees were less common but they increase seed production, and a few *Megachile submucida*], a few *Polistes gallicus* wasps, plus a few Hemiptera [*Oxyannus halinipennis*] and beetles *Coccinella undecimpunctata* that doubtfully pollinate [Abd El-Wahab and Ibadah 2011].)

*Pulsatilla patens multifida* purplish-white: *Boloria freija*, *Erynnis persius*.

*Ranunculus acris* yellow: *Chlosyne gorgone*. In Europe *R. acris* is pollinated by muscid and anthomyid flies, and some Hymenoptera and Coleoptera. The Colorado *Ranunculus alismifolius* is pollinated by bees. The bee *Chelostoma florissomne* specializes on *Ranunculus* in California (Peng and Dobson 1997). In Europe, five *Ranunculus* species are pollinated by 50 species of flies (50% of visitors, mostly Syrphidae), Hymenoptera (25%, 20 bees and 2 wasps), Coleoptera (15%, 20 species), plus a few thrips and *Micropterix* moths and Hemiptera; the syrphids (mainly *Cheilosia*) and beetles were often covered with pollen (Steinbach and Gottsberger 1994).

*Ranunculus adoneus?* yellow (pinnate leaf and yellow buttercup flower): *Boloria titania*.

*Ranunculus ?glaberrimus* yellow: *Erynnis persius*.

*Ranunculus macounii* yellow: *Pieris rapae* 3x.

*Ranunculus* yellow: *Callophrys sheridanii lemberti* 2x, *Carcharodus flocciferus* (Europe), *Chlosyne palla palla*, *Coenonympha tullia californica* 2x, *Euchloe ausonides ausonides* 1x, *Junonia coenia* ~15x, *Junonia evarete nigrosuffusa* and hybrids ~7x, *Phyciodes pulchella camillus*, *Phyciodes tharos tharos*, *Vanessa cardui*.

*Ranunculus* yellow flower without usual yellow petals: *Adopaeoides prittwitzii*.

*Thalictrum dasycarpum* whitish: *Chlosyne gorgone*, *Epargyreus clarus*. *Thalictrum* have pollen but no nectar and are mostly wind pollinated, but are effectively pollinated by halictid bees and *Bombylius* flies (Willmer 2011).

*Trollius laxus* yellow: *Pyrgus centaureae*.

## PLATANACEAE

(*Platanus occidentalis* has tiny inconspicuous wind-pollinated flowers in balls. I saw no butterflies on the one tree near my house in Denver.)

## PAEONIACEAE

*Paeonia lactiflora* is not popular: *Euptoieta claudia* (white and yellow-centered flower), *Papilio glaucus rutulus* (pinkish flower) a couple sec. Most peonies lack nectar, but Oregon *Paeonia browni* provides it and is pollinated by solitary bees *Andrena* and *Lasioglossum* in the morning and syrphid flies and vespid and polistid wasps in the afternoon (N. Vance, <http://nps.Oregon.org>). In Britain *Anthophora plumipes* bees visit garden *Paeonia* for pollen.

## CRASSULACEAE

*Sedum lanceolatum* is very popular, but the others are not popular. Crassulaceae in general are pollinated by a variety of insects (some *Kalanchoe* are bird pollinated) (Judd et al. 2008).

*Sedum* cultivated "Hen and Chickens" pink and bluish-pink: *Pieris rapae* 3x.

*Sedum* (*Amerosedum*) *lanceolatum* yellow is enormously popular, esp. for *Argynnis* (*Speyeria*) *callippe*, *Coenonympha tullia*, *Euphydryas*, *Oarisma*, and *Parnassius*: *Aglais milberti* 5x, *Apodemia nais*, *Argynnis* (*Speyeria*) *aphrodite* 3x, *Argynnis* (*Speyeria*) *callippe* 27x, *Argynnis* (*Speyeria*) *coronis*, *Argynnis* (*Speyeria*) *edwardsii* 3x, *Argynnis* (*Speyeria*) *hesperis*, *Boloria titania*, *Callophrys eryphon*, *Callophrys gryneus siva* 2x, *Callophrys spinetorum* 2x, *Chlosyne gorgone* 4x, *Chlosyne palla calydon*, *Coenonympha tullia* 27x, *Colias alexandra*, *Colias eurytheme* 3x, *Colias meadii*, *Colias philodice* 2x, *Cupido amyntula* 2x, *Erebia callias* 7x, *Erebia epiroidea* 3x, *Erebia stibbendorffii* "theano" *ethela* 8x, *Erynnis martialis* 7x, *Erynnis pacuvius*, *Erynnis persius* 13x, *Euchloe olympia*, *Euphydryas anicia capella* 49x (including

one dead on flower), *Euptoieta claudia* 11x, *Eurema nicippe*, *Glaucopsyche piasus*, *Hemiargus isola* 5x, *Hesperia comma colorado* 2x, *Hesperia nevada* 8x, *Hesperia pahaska* 3x, *Lycaena florus*, *Lycaena nivalis*, *Lycaena rubidus*, *Nathalis iole*, *Neominois ridingsii* male, *Oarisma garita* 18x, *Oeneis calais altacordillera* 3x, *Oeneis chryxus* 3x, *Papilio polyxenes*, *Parnassius phoebus smintheus* 117x, *Parnassius phoebus hermodur* 7x, *Phyciodes cocyta* 3x, *Phyciodes pallida* 2x, *Phyciodes pulchella camillus* 7x, *Pieris rapae* 3x, *Plebejus glandon* 12x, *Plebejus icarioides* 5x, *Plebejus melissa*, *Plebejus shasta pitkinensis* 2x, *Poanes taxiles*, *Poladryas minuta arachne* 15x, *Polites draco*, *Polites themistocles*, *Polygonia gracilis zephyrus*, *Pontia protodice* 2x, *Pyrgus communis* 2x, *Satyrium ~californica*, *Thorybes mexicana*, *Vanessa cardui* 5x. This is reportedly pollinated by bees flies and butterflies (Clausen and Abbe 1975).

*Sedum (Clementsia) rhodanthum* pink: *Boloria eunomia* ~30x (incl. Richard O. Bray), *Boloria frigga* 5x, *Boloria titania* 5x, *Colias scudderii* 2x, *Erebia stubbendorfi* "theano" demmia, *Plebejus saepiolus*, *Pyrgus centaureae* 2x.

*Sedum (Rhodiola, Tolmachevia) roseum integrifolium* dark-rose-purple: *Boloria eunomia*, *Colias scudderii harroweri* 2x, *Erebia epipsodea*.

## GROSSULARIACEAE

*Ribes* are only moderately popular, and are usually avoided by butterflies with a small proboscis such as lycaenids. *Ribes* are pollinated by wild bees (Paget-Seekins 2012) and honeybees and bumblebees and megachilid bees (*Osmia lignaria*), sometimes by scotophagid and syrphid flies, and most can self-pollinate. *Ribes speciosum* is pollinated by hummingbirds (Grant 1994). The bee *Andrena nivalis* specializes on *Ribes*.

*Ribes cereum* pinkish-white: *Callophrys dumetorum homoperplexa*, *Erynnis persius*, *Erynnis telemachus* 2x, *Papilio glaucus glaucus*, *Papilio indra*, *Papilio multicaudata*, *Papilio polyxenes* 2x, *Papilio zelicaon* 8x (+ 1x f. nitra), *Pieris rapae* 2x, *Polygonia gracilis zephyrus* 10x incl. Janet Chu, *Vanessa atalanta* 3x.

*Ribes inerme* pinkish: *Celastrina lucia lumarco*, *Polygonia faunus*, *Polygonia oreas satellow*.

*Ribes leptanthum* pinkish-white: *Lycaena arota*.

## SAXIFRAGACEAE

These (including *Heuchera*) are unpopular. I have no records for most genera. Saxifragaceae in general are pollinated by small short-tongued insects (mainly flies and bees) gathering nectar and pollen (Judd et al. 2008).

*Astilbe* "Venus" pink: *Papilio multicaudata* 2x. *Astilbe* are reportedly pollinated by slugs and beetles and pollen-foraging insects.

~? *Heuchera* ~greenish/yellowish: *Pontia callidice occidentalis*. The bee *Colletes aestivalis* specializes on *Heuchera*.

(*Lithophragma parviflorum* is rare in Colorado. It is pollinated mostly by bombyliid flies, solitary bees, and also by the moth *Greya politella* [Prodoxidae] which pollinates as the female oviposits eggs through the corolla tube [Thompson and Pellmyr 1992].)

*Saxifraga* are unpopular flowers.

*Saxifraga (Micranthes) oregana* white: *Boloria titania*, *Plebejus glandon* 2x.

*Saxifraga (Micranthes) rhomboidea* white: *Erebia epipsodea*.

"Saxifrage" white: *Plebejus shasta*.

## VITACEAE

These have inconspicuous flowers that are not visited. Vitaceae are visited by bees wasps flies and beetles (Judd et al. 2008).

(*Parthenocissus quinquefolia* yellowish-green is reportedly pollinated by bees and wasps, and supposedly by butterflies but it is common in Denver where butterflies shun it so I have no records.)

(*Vitis riparia* [no calyx or corolla] is uncommon and I have no records. *Vitis vinifera* wine grapevines are usually wind-pollinated, but Muscadine grapevine *Vitis rotundifolia* pollination depends of insects, particularly bees [Sampson et al. 2001].)

#### ZYGOPHYLLACEAE

Zygophyllaceae in general are pollinated by various insects (Judd et al. 2008).

*Tribulus terrestris* yellow is not very popular: *Nathalis iole*, *Pontia protodice* 2x. It is pollinated by honeybees and other insects and is self-pollinated in India (Ganaie 2011, who misidentified the two butterflies he claimed pollinated, which his photos suggest are perhaps an orange *Colotis* and a *Glaucopsyche melanops*-like blue).

#### CELASTRACEAE (includes *Parnassia*)

These are not popular, but most are uncommon garden plants, except the native *Parnassia*. Celastraceae in general are pollinated by bees, flies, and beetles (Judd et al. 2008).

(*Euonymus* sp. with small yellow flowers is ignored in my yard.)

*Euonymus atropurpureus* with larger red flowers is spreading as a weed in Denver suburbs, and *Euonymus alatus* purple with orange fruit in Oct. is getting popular planted in suburbs, but I have never seen a butterfly on them. However, Bright and Ogard (2010) observed several Alabama Satyrinae butterflies on *E. atropurpureus* flowers (*Cyllopsis gemma* and *Megisto cymela*).

(*Helianthemum* “Ben Nevis” orange is beautiful but I have not yet seen a butterfly on the one local plant.

*Helianthemum* lack nectar and the pollen is gathered by bees, although *H. oelandicum* is wind-pollinated in Scandinavia.)

(*Parnassia* have small white flowers but I have no records. *Parnassia palustris* white is pollinated mostly by flies including various Syrphidae and Asilidae [plus Tipulidae, Calliphoridae, Culicidae], by non-social wasps [Ichneumonidae, Pompiloidea, Symphyta, Vespoidea], bees [Apoidea], beetles [Nitidulidae], and butterflies and moths; the scent from nectaries induces flies to land; in sunny weather Sutherland (2006) found that Syrphidae were the majority of pollinators, Asilidae nearly half of them. Beetles and self-pollination also help pollinate some *Parnassia*. The bee *Andrena parnassiae* is a specialist on *Parnassia glauca*.)

#### OXALIDACEAE

*Oxalis* are uncommon and inconspicuous and only occasionally visited by small butterflies. The *Oxalis* weeds in my garden were only visited several times by rare migrant pierid butterflies. Oxalidaceae in general are pollinated by various insects (Judd et al. 2008), and several German species are pollinated by flies.

*Oxalis dillenii* yellow: *Plebejus glandon*. *Oxalis montana* is pollinated by bumblebees, and *O. cornuta* and *O. violacea* pollinated by bees at least.

*Oxalis stricta* yellow: *Ancyloxypha numitor*, *Cupido comyntas* 7x.

*Oxalis ~stricta* weeds yellow: *Eurema nicippe* 2x, *Nathalis iole*.

#### VIOLACEAE

Violets are unpopular, with few records. Violaceae in general are pollinated by various flies, bees, wasps, and butterflies (Judd et al. 2008).

(*Hybanthus verticillatus* greenish-white small-flowered herbs are not visited. Several *Hybanthus* spp. self-pollinate and the flowers never open. In the tropical shrub *Hybanthus prunifolius* the main pollinator is *Melipona interrupta* bees seeking nectar and pollen [Roubik and Buchmann 1984].)

*Viola* are pollinated by numerous insects especially bumblebees, honeybees and other bees (*Anthophora plumipes*, *Osmia*, *Andrena*, *Lasioglossum*, *Halictus*), and hoverflies (Beattie 1971, 1972); and by bumblebees and other insects (Dodson and Dunmire 2007). The bee *Andrena violae* specializes on *Viola*.

Many *Viola* produce hidden self-pollinating flowers after the conspicuous flowers senesce.

*Viola canadensis scopulorum* white: *Colias eurytheme* 4x (violet to white?), *Erynnis telemachus* 2x.

*Viola labradorica* violet-purple: *Pyrgus centaureae*.  
*Viola nuttallii* yellow: *Colias philodice*, *Erynnis persius* (1x and one 2 sec.), *Euchloe olympia* 3x, *Euptoieta claudia* 5x, *Pontia sisymbrii* 3x, *Pyrgus communis*.  
*Viola ~odorata* blue: *Vanessa cardui* 2x.  
*Viola* ornamental blue: *Phyciodes tharos tharos* briefly.  
*Viola tricolor* var. *hortensis* ?white to purple: *Nathalis iole*.  
*Viola tricolor* var. *tricolor* purple: *Ancyloxypha numitor*, *Eurema nicippe* 3 sec., *Pieris rapae*, *Pyrgus communis* 2x.  
~*Viola*-similar yellow flower: *Pyrgus philetas*.

## SALICACEAE

The flowers (catkins) of *Salix* are very popular, but those of *Populus* are shunned. Judd et al. (2008) note that Salicaceae in general are pollinated by various unspecialized insects, but *Populus* is wind-pollinated and has reduced flowers, while *Salix* flowers (catkins) have nectar glands and an odor and attract insects but are probably also partly/mostly wind-pollinated (*Salix* pollen is almost as numerous in the air above Britain as *Populus* [Hyde 1950]).

*Salix*. Numerous bees specialize in visiting only *Salix* catkins: *Andrena andrenoides*, *A. bisalicis*, *A. erythrogaster*, *A. fenningeri* (also visits *Prunus* [plum, peach]), *A. frigida*, *A. illinoensis*, *A. mariae*, *A. salictaria*, *A. sigmundi*. In Europe *Andrena vaga* bees collect pollen only from *Salix*, attracted by 1,4 dimethoxybenzene emitted by the catkins (Dotterl et al. 2005).

catkin of *Salix ?amygdaloides*: *Phaeostrymon alcestis* several.

catkin of *Salix arctica* male flowers pinkish: *Pyrgus centaureae*; female flowers ~whitish: *Boloria improba harryi*.

catkin of *Salix exigua* female flower ~whitish: *Plebejus icarioides*, *Nymphalis antiopa* 2x Anne U. White.

catkin of *Salix monticola* ~whitish: *Aglais milberti* male catkin 5x, *Callophrys eryphon* 12x, *Callophrys spinetorum*, *Celastrina lucia sidara* 7x, *Nymphalis antiopa* 5x, *Papilio zelicaon* f. *nitra* female catkins 2x, *Polygonia faunus* 9x, *Polygonia gracilis zephyrus* 4x, *Polygonia satyrus* 6x.

catkin of *Salix planifolia* whitish: *Boloria freija* male catkin, *Boloria frigga* (another landed on dry catkin so flew after ~1 sec.), *Pontia callidice occidentalis*.

catkin of *Salix scouleriana* ~whitish: *Callophrys eryphon* several.

catkin of *Salix* spp. whitish: *Callophrys gryneus siva* 2x, *Callophrys sheridanii pseudodumetorum* some, *Pontia protodice*, *Strymon melinus*.

(*Populus* catkins have no visits. The tiny flowers are wind-pollinated.)

## HYPERICACEAE

(*Hypericum* has showy yellow flowers but *H. perforatum* occurs in few Colorado localities, is not popular and I have no records. Hypericaceae in general are pollinated by bees and wasps, and pollen is the usual reward [Judd et al. 2008]. *Hypericum* including *H. perforatum* are pollinated usually by bumblebees [*Bombus* spp. and *Lasioglossum* for N.J. *H. perforatum*, *Bombus* and sometimes syrphid flies and halictid bees for Illinois *H. prolificum*], and *H. perforatum* sometimes selfs.)

## EUPHORBIACEAE

Most genera are rarely visited by butterflies even though many are showy (I have no records for most *Euphorbia* [including *Chamaesyce* etc.] or *Tragia*). *Cnidoscopus* is a popular exception. Euphorbiaceae in general are pollinated by insects (flies, bees, wasps, butterflies) seeking nectar (Judd et al. 2008).

*Cnidoscopus angustidens* white is enormously popular in S Ariz.: *Codatractus arizonensis*, *Codatractus hippalus*, *Cogia hippalus*, *Copaeodes aurantiaca*, *Eurema proterpia*, *Codatractus valeriana*=*mysie*, *Zerene cesonia*. *Cnidoscopus urens* is pollinated by the butterfly *Eurema daira* in the dry season, and by nocturnal moths in the wet season (Bawa et al. 2008). *Cnidoscopus texanus* is pollinated by nectar-seeking sphingid moths (*Hyles lineata*, *Manduca quinquemaculata*) that carry copious amounts of pollen on their proboscis (Perkins et al. 1975).

*Croton texensis* whitish is not very popular: *Lycaena helloides*, *Ministrymon leda*, *Plebejus melissa* 2x, *Strymon melinus* 3x. Wasps are the most important pollinators of *Croton* species in Mexico (Narbona and Dirzo 2010) and Argentina (Freitas and Bernardello 2001), and sarcophagid flies pollinate others.

*Euphorbia* “*Agaloma*” *marginata* green and white is not popular: *Euptoieta claudia* ½ sec., *Nathalis iole* 2x, *Papilio polyxenes* 2 sec., *Phyciodes tharos orantain* 2x.

*Euphorbia esula* yellow-green is common but not very popular: *Argynnis* (*Speyeria*) *hesperis* 4x, *Callophrys eryphon* 2x, *Callophrys gryneus siva* 4x, *Celastrina humulus* lupine-ecotype 2x, *Erebia epipsodea*, *Euphilotes ancilla barnesi*, *Euphydryas anicia capella* 4x, *Euphyes vestris*, *Lycaena rubidus* tiny yellow flowers many, *Papilio multicaudata*, *Phyciodes cocyta* 3x, *Satyrium californica* tiny flowers 3x, *Satyrium liparops*, *Strymon melinus* (and palped its flowers some for 2 min. then flew), *Vanessa cardui* 3x. This is pollinated by Diptera and Hymenoptera in Finland, a soldier beetle in Iowa; ants bees flies and mosquitoes fed on the nectar in Saskatchewan.

*Euphorbia marginata* green and white: *Strymon melinus*.

## LINACEAE

*Linum lewisii* blue is common but not popular: *Amblyscirtes phylace*, *Celastrina humulus* lupine-ecotype landed below petals to ?feed once for ~10 sec., *Erynnis telemachus*, *Euchloe olympia* 4x, *Euptoieta claudia*, *Glaucopsyche lygdamus*, *Oarisma edwardsii* (Scott and Scott 1978), *Oarisma garita* 2x, *Paratrytone snowi* 2x, *Phyciodes pulchella camillus* 1x (+ one only ½ sec.), *Plebejus melissa*, *Pontia protodice* 1x, + another only 1 sec., *Pyrgus communis*. Small bees and generalist flies pollinate it in Colorado (Kearns and Inouye 1994); honeybees also pollinate it.

## FABACEAE=LEGUMINOSAE

These flowers in general are only moderately popular, though most *Astragalus*, *Melilotus*, *Medicago sativa*, *Oxytropis*, and *Trifolium* seem popular. Other *Astragalus* such as *A. bisulcatus* seem rather unpopular. *Amorpha*, *Coronilla*, *Dalea*, *Glycyrrhiza*, *Lathyrus*, *Lotus*, *Lupinus*, *Phaseolus*, *Robinia*, *Thermopsis*, and *Vicia* are not very popular. *Hedysarum boreale* is very popular but only to skippers, evidently because it has red flowers and requires a long proboscis. Skippers seem overrepresented as visitors for most legumes evidently because they have a longer proboscis, though the popular legumes (including the small-flowered *Astragalus flexuosus* and the small-flowered *Melilotus*) attract all butterflies including Papilionoidea. But *Psoralea* have small flowers yet are not popular. Judd et al. (2008) note that Fabaceae in general are pollinated by nectar-gathering bees wasps ants butterflies flies beetles birds and bats, but bee pollination is characteristic especially of most legumes with pea-type flowers the Faboideae (as contrasted with Mimosoideae and Caesalpinoideae with more primitive flowers that are pollinated by many animals—*Caesalpinia pulcherrima* is pollinated by butterflies [Cruden and Hermann-Parker, 1979]) in which the banner attracts bees and the two wings form a landing platform, then the bee depresses the keel which encloses the stamens and carpel so the stamens and stigma contact the bee’s underside (“the stigma and stamens of *Genista* and *Medicago* are explosively presented”). Literature search indicates that bumblebees are the major pollinators of Faboideae. The bees *Megachile rotundata* and *M. sculpturalis* and *Osmia caeruleascens* specialize on Fabaceae (*M. sculpturalis* visits other flowers also) and have been introduced into the U.S. (Cane 2003). But butterflies can sneak their narrow proboscis into many Faboideae flowers to steal the nectar.

*Acacia* (formerly in Mimosaceae) *angustissima* spineless white-flowered: *Codatractus arizonensis*, *Eurema proterpia*. Most *Acacia* elsewhere offer only pollen and are pollinated by social and solitary bees (some are visited by bees wasps Lepidoptera beetles flies), while those with nectar are pollinated by honeyeater birds; Australian *Acacia* are pollinated by a broad range of bees and wasps.

*Acacia greggii* yellow: *Lasaia maria*.

(*Amorpha canescens* has beautiful purple flowers but I have seen no butterflies on it. It is pollinated by a bee *Andrena quintilis* that specializes on *Amorpha* [the colletid bee *Colletes robertsonii* specializes on *Amorpha* and *Dalea*, while the andrenid bee *Calliopsis andreniformis* visits *Amorpha* and all Fabaceae] [Slagle and Hendrix 2009]. *A. canescens* in Illinois is visited by bumblebees, leaf-cutting bees

[*Megachile*], green metallic bees, and plasterer bees [*Colletes*], plus the specialist *Andrena quintilis*, plus wasps [Hilty 2013]. It is sometimes pollinated by clerid beetles *Phyllobaenus subfasciatus*. The bee *Hoplites cylindrica* is apparently an *Amorpha* specialist.)

(*Amorpha fruticosa* has beautiful purple flowers but has no records. *Amorpha fruticosa* is visited in Illinois primarily by small to medium bees seeking nectar and pollen including halictids [*Lasioglossum*], masked bees [*Hylaeus*], Andrenids [*Andrena*], little carpenter bees [*Ceratina*], cuckoo bees [*Nomada*, *Coelioxys*], plus the specialist *Andrena quintilis* [Hilty 2013].)

*Astragalus* spp.: *Amblyscirtes eos*, *Glaucopsyche lygdamus*, *Plebejus melissa*. *Astragalus americanus* is pollinated only by bumblebees (usually *Bombus flavifrons*) in Wyo. (Kudo and Hardes 2005). Five *Bombus* species visit *A. filipes* in Utah. A bee *Megachile concinna* that specializes on *Astragalus* has been introduced to the U.S. (Cane 2003). *Astragalus coccineus* is pollinated by hummingbirds (Grant 1994).

*Astragalus agrestis* purple: *Amblyscirtes phylace*, *Colias eurytheme* 2x, *Erynnis martialis*, *Erynnis pacuvius*, *Erynnis persius* 3x, *Glaucopsyche lygdamus* 2x, *Hesperia nevada* 33x, *Oarisma garita* violet 2x, *Papilio polyxenes*, *Phyciodes pulchella camillus* 1x + 2 sec, *Plebejus melissa* 2x, *Plebejus saepiolus* 18x, *Polites draco* 11x, *Polites themistocles* 5x.

*Astragalus alpinus* purple (or white with small purple areas): *Glaucopsyche lygdamus* 2x, *Pieris marginalis mcdunnoughii*, *Plebejus melissa pseudosamuelis*, *Plebejus saepiolus* 2x, *Polites sabuleti*.

*Astragalus bisulcatus* purple is not very popular: *Oarisma garita* 12x, *Plebejus melissa* 3x, *Poanes taxiles*, *Strymon melinus*.

*Astragalus ?bisulcatus* large tall pinkish-purple: *Hesperia viridis*, *Notamblyscirtes simius* [not on *A. miser*].

*Astragalus crassicaarpus* white: *Erynnis pacuvius*.

*Astragalus drummondii* white: *Callophrys gryneus siva* 3x, *Cupido amyntula*, *Erynnis brizo*, *Euphyes vestris*, *Glaucopsyche lygdamus*, *Glaucopsyche piasus*, *Hemiargus isola* 2x, *Hesperia nevada*, *Hesperia pahaska* 20x, *Hesperia uncas* 3x, *Notamblyscirtes simius* 5x, *Phyciodes pulchella camillus*, *Plebejus melissa* 3x, *Polites* (*Yvretta*) *rhesus* 3x (preferred, Scott and Scott 1978), *Polites draco* several, *Polites sonora*, *Satyrium behrii*, *Vanessa cardui* 5x, *Vanessa virginianensis*.

*Astragalus flexuosus* purple is popular as its tiny flowers are accessible even to small lycaenid butterflies: *Amblyscirtes vialis* 13x, *Callophrys dumetorum homoperplexa* 2x, *Colias eurytheme*, *Colias philodice*, *Cupido amyntula* 12x, *Erynnis martialis* 6x, *Erynnis pacuvius* 3x, *Erynnis persius* 14x, *Euphyes vestris* 2x, *Glaucopsyche lygdamus* 10x, *Glaucopsyche piasus* 3x, *Hemiargus isola* 2x, *Oarisma garita* 27x, *Piruna pirus* 5x, *Plebejus alupini texanus*, *Plebejus icarioides* 4x, *Plebejus melissa* 8x, *Plebejus saepiolus* 2x, *Polites draco* 3x, *Polites themistocles*, *Pyrgus communis* 2x, *Strymon melinus* 3x, *Vanessa cardui* 3x.

*Astragalus gracilis* var. *parviflorus* purple: *Hemiargus isola* 2x, *Phyciodes tharos tharos* 2x, *Pholisora catullus* 2x, *Polites peckius*?

*Astragalus hallii* purple: *Hesperia nevada*, *Paratrytone snowi* 60x.

*Astragalus kentrophyta implexus* blue: *Plebejus saepiolus*.

*Astragalus kentrophyta* yellowish-white: *Hesperia uncas*.

*Astragalus kentrophyta* or sericoleucus ~yellow-white: *Polites* (*Yvretta*) *rhesus*.

*Astragalus laxmannii*= “*adsurgens*” white: *Argynnis* (*Speyeria*) *coronis*, *Coenonympha tullia*, *Colias alexandra* 8x, *Colias eurytheme* 5x, *Erynnis persius* 3x, *Euphyes vestris*, *Glaucopsyche piasus daunia*, *Hesperia nevada* 2x, *Ochlodes sylvanoides*, *Papilio polyxenes* white with pink center 4x, *Papilio zelicaon*, *Parnassius phoebus smintheus* 2x, *Plebejus glandon*, *Plebejus icarioides* 2x, *Plebejus melissa*, *Polites themistocles* 3x, *Pontia protodice*, *Strymon melinus* 3x, *Vanessa cardui* 6x.

*Astragalus miser* white: *Neominois ridingsii*, *Paratrytone snowi*.

*Astragalus miser* pinkish-white: *Plebejus icarioides*.

*Astragalus miser* var. *oblongifolius* [not *A. bisulcatus* as reported by Scott 1973d] pale-violet: *Hesperia pahaska* 3x, *Notamblyscirtes simius* 7x [not *A. bisulcatus*], *Stinga morrisoni*.

*Astragalus missouriensis* rose-purple: *Colias philodice*, *Notamblyscirtes simius*, *Plebejus melissa*, *Polites* (*Yvretta*) *rhesus*.

*Astragalus parryi* white: *Chlosyne gorgone*, *Erynnis brizo* 11x, *Erynnis telemachus* 3x.

*Astragalus sericoleucus* blue-purple: *Plebejus alupini texanus* (on flower?).

*Astragalus shortianus* purple: *Polites (Yvretta) rhesus* dozens, *Strymon melinus*, *Thorybes pylades*.

*Astragalus spatulatus* 20 cm blue: *Argynnis (Speyeria) edwardsii*, *Colias edwardsii altiplano*.

*Astragalus* blue: *Plebejus acmon*, *Plebejus icarioides* 3x.

*Astragalus* ?bluish [whitish?]: *Oarisma edwardsii*.

*Astragalus* purple: *Paratrytone snowi*.

*Astragalus* red-purple: *Paratrytone snowi* 2x.

*Astragalus* yellow: *Euphydryas anicia alena*.

*Cercis* (formerly in *Caesalpinaceae*) *occidentalis* pink: *Papilio eurymedon*, *Callophrys augustinus*, *Callophrys mossii windi*, *Callophrys johnsoni* (Scott 1973b). This is pollinated by bumblebees (*Bombus*) and blue orchard mason bees (*Osmia lignaria*).

*Coronilla varia* pink is now common in Denver but is not very popular: *Colias eurytheme* 15x, *Pieris rapae*, *Pyrgus communis*, *Vanessa atalanta* 3x. *Thymelicus lineola* visits it in E U.S. It is pollinated primarily by honeybees even though it is not a good nectar source.

*Dalea candida* white: *Plebejus melissa*, *Strymon melinus*. In New Mexico *Dalea candida* is visited by colletid bees *Caupolicana yarrowi* and *Colletes* sp. that buzz-pollinate. Five *Bombus* species visit *Dalea* in Utah, and honeybees help pollinate it. 22 species of bees including bumblebees and honeybees and *Megachile rotundata* pollinate *Dalea ornata* and *D. searlsiae* in Oregon (especially *Bombus*, *Eucera*, *Melissodea*, *Anthidium*, *Colletes*), including the *Dalea* specialist *Colletes petalostemonis* (Cane et al. 2012).

*Dalea purpurea* pink-purple: *Atrytone arogos* 2x, *Hesperia leonardus montana*, *Strymon melinus* 2x Anne U. White and Janet Chu. In Utah, *Dalea purpurea* sometimes self-pollinates, but attracts a rich bee fauna and is pollinated by *Apis mellifera* and *Megachile rotundata*, alfalfa leaf-cutting bees, alkali bees (*Nomia elanderi*), wild bumblebees (*Bombus fervidus* and *B. nevadensis*), *Agapostemon*, *Anthophora*, *Dialictus*, *Halictus*, and *Hoplitis* bees; in Minnesota >65 species of bees visit including *Bombus* 10 sp., *Colletes* 7 (*Colletes albescens* and *C. susannae* specialize on *Dalea purpurea* and probably other *Dalea*, and *C. robertsonii* and *C. wilmattae* specialize on *Dalea*), *Dialictus* 16 sp., *Halictus* 4 sp., *Perdita* many (Cane 2006). 55 bee species are recorded visiting in Illinois, including *Melissodea* and *Megachile dentitarsus*, plus wasps, flies, butterflies and skippers, beetles, and plant bugs. There are so many bees recorded visiting *Dalea purpurea*, that it is considered a desirable species to plant for prairie restoration to support mostly ground-nesting bees.

(*Gleditsia triacanthos* trees are common in Denver but I have never seen a butterfly on the greenish-white flowers.)

*Glycyrrhiza lepidota* yellowish-white is unpopular: *Epargyreus clarus* 16x (one got proboscis caught ½ sec), *Glaucopsyche piasus*, *Hemiargus isola* 3x, *Plebejus alupini texanus*, *Strymon melinus*.

*Hedysarum boreale* red is visited by numerous Hesperiidæ with long proboscis, and shows why other butterflies (the Papilionoidea) seldom visit red flowers which are usually long: *Amblyscirtes oslari*, *Erynnis horatius*, *Erynnis pacuvius*, *Euphyes vestris*, *Hesperia pahaska*, *Oarisma edwardsii*, *Oarisma garita*, *Poanes hobomok* abundant, *Poanes taxiles*, *Polites origenes* abundant, *Polites themistocles* many, *Thorybes mexicana*, *Thorybes pylades*. This is pollinated usually by bumblebees (*Bombus* esp. *B. flavifrons*) (by *Megachile* also in Alaska) gathering pollen and nectar (Kudo and Hardes 2005). Nine species of bumblebees visit it in Utah.

*Lathyrus* or *Vicia* ?blue-purple-pink: *Thorybes pylades*.

*Lathyrus eucosmus* (pink unless noted): *Amblyscirtes nysa*, *Amblyscirtes oslari* (white), *Amblyscirtes vialis* (rose-purple), *Atrytonopsis lunus*, *Calephelis rawsoni arizonensis*, *Erynnis funeralis*, *Euphyes vestris* (red-purple), *Eurema proterpia*, *Piruna pirus* (rose-purple), *Poanes hobomok* (red-purple), *Thorybes pylades*. *Lathyrus* are pollinated by bumblebees (Proctor et al. 1996).

*Lathyrus latifolius* pink: *Poanes taxiles*. This species (and several other *Lathyrus*) are known to be pollinated by bumblebees, and the bee *Xylocopa latifolia* is also known to pollinate it.

*Lathyrus leucanthus* white: *Pontia sisymbrii*, *Thorybes pylades*, *Cupido amyntula* 3x, *Erynnis martialis* 3x, *Erynnis persius*.



*Lathyrus polymorphus incanus* purple and pink: *Amblyscirtes oslari*, *Colias eurytheme*, *Erynnis afranius*, *Euchloe olympia*, *Euphyes vestris*, *Thorybes pylades* 2x.

legume blue: *Atrytonopsis ovinia edwardsii*, *Copaedeoa aurantiaca*, *Erynnis funeralis*, *Hylephila phyleus*, *Lerodea arabus*, *Lerodea eufala*, *Pyrgus communis*, *Systasea zampa*, *Urbanus dorantes*.

legume blue-red: *Staphylus ceos*.

legume red-purple: *Amblyscirtes aenus* 3x.

legume purple: *Plebejus alupini texanus* several, *Erynnis brizo*.

*Lotus corniculatus* yellow: *Ancyloxypha numitor* 5x for a long time, *Colias eurytheme*, *Cupido comyntas* (2x but proboscis maybe not inserted because flowers are long). It is pollinated by bumblebees and sometimes by wasps in England, and can self-pollinate.

*Lotus greenei* low 3 cm plant with flowers yellow but basal part orange-brown: *Adopaeoides prittwitzii* several.

*Lupinus* is an unpopular flower, the nectar hard to obtain, so *Lupinus* is almost never visited by butterflies. However 36 visits were seen (two very short) on *Lupinus*, involving 20 species of butterflies (see below). At least some of these fed through a hole chewed in the side of the flower by bees (probably bumblebees) that rob the nectar, because the shape of *Lupinus* flowers makes it difficult for butterflies to insert their proboscis.

*Lupinus argenteus* blue: *Colias alexandra*, *Epargyreus clarus* 3x, *Erynnis afranius*, *Erynnis persius*, *Hemiargus isola*, *Hesperia uncas*, *Limenitis weidemeyerii* fed on, *Oarisma garita* 1x (+ one only ½ sec.), *Paratrytone snowi* 8x, *Pholisora catullus*, *Phyciodes pallida* 2 caught by crab spider on, *Polites mystic*, *Polites peckius*, *Polites themistocles* 3x, *Satyrium titus*, *Vanessa virginiensis*. This is pollinated by *Bombus* bumblebees (Gori 1989; Aluri and Robart 1991). Four species of *Bombus* pollinate *Lupinus monticola* in Utah (Bauer 1983). *Bombus terrestris* is the key pollinator of *Lupinus pilosus* and honeybees also visit (Nuttman and Willmer 2003), and a dozen genera of bees pollinate *Lupinus texensis* (Schaal and Leverich 1980). Bumblebees (and honeybees) are attracted to the yellowish or white banner spot of *Lupinus argenteus*, *L. monticola*, and *L. pilosus*, but after pollination that spot turns purple or blue (pink in *L. pilosus*) and they are no longer attracted (Gori 1989, Dodson and Dunmire 2007, Nuttman and Willmer 2003); the banner petal also changes in *L. nanus*, *L. bicolor*, *L. sparsiflorus*, and *L. blumeri* (Willmer 2011). *Lupinus* are reportedly “buzz-pollinated” by bees (Harder 1990).

*Lupinus argenteus* white: *Euphyes vestris* (unpopular flower, probed flower ½ sec. then left).

*Lupinus* blue: *Junonia coenia* 2x, *Papilio eurymedon* (violet), *Plebejus icarioides* 2x.

*Lupinus plattensis* blue: *Plebejus icarioides*.

*Medicago lupulina* yellow has tiny flowers that attract small lycaenid butterflies (even *Lycaena salustius* in New Zealand, Gillespie and Wratten 2012): *Ancyloxypha numitor* 3x, *Cupido comyntas* 4x, *Euphilotes ancilla barnesi* Janet Chu, *Hemiargus isola* yellow, *Plebejus melissa* 2x, *Vanessa cardui* Janet Chu. This self-pollinates 95% of the time as the tiny flowers attract few pollinators (J. Yan et al. 2009), while the larger *Medicago ruthenica* attracts bees, bumblebees, and butterflies.

*Medicago sativa* violet is very popular: *Aglais milberti* 2x, *Amblyscirtes aenus*, *Amblyscirtes vialis*, *Anatrytone logan lagus*, *Anatrytone logan logan*, *Ancyloxypha numitor* 133x, *Argynnis (Speyeria) aphrodite* 4x, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) coronis* ~9x, *Argynnis (Speyeria) cybele leto* 24x, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) mormonia* 2x, *Argynnis (Speyeria) zere* 55x, *Atalopedes campestris* 25x, *Atrytone arogos* ~38x, *Brephidium exilis*, *Cercyonis oetus*, *Cercyonis pegala* 110x, *Chlosyne gorgone* 2x, *Colias alexandra* 2x, *Colias eurytheme* 215x, *Colias philodice* 187x, *Cupido comyntas* 5x, *Danaus gilippus*, *Danaus plexippus* 13x, *Epargyreus clarus* 97x, *Erebia epipsodea*, *Erynnis afranius* 41x, *Erynnis funeralis*, *Erynnis tristis* many, *Euphyes vestris* 11x, *Euptoieta claudia* 24x, *Eurema lisa*, *Glaucopsyche lygdamus* 5x, *Hemiargus isola* 23x, *Hesperia comma* 6x, *Hesperia juba*, *Hesperia uncas* 2x, *Hesperia viridis* 5x, *Hesperopsis alpheus* (Maurice Howard, Scott and Scott 1978), *Hylephila phyleus*, *Junonia coenia* 7x, *Leptotes marina* 16x, *Lerodea eufala* 3x, *Libythea carinenta larvata*, *Limenitis weidemeyerii*, *Lycaena dione* 5x, *Lycaena helloides* 5x, *Lycaena heteronea* 2x, *Lycaena rubidus*, *Nathalis iole* 4x, *Oarisma garita* 7x, *Ochlodes sylvanoides* 89x, *Papilio machaon bairdii* forms 90x, *Papilio multicaudata*, *Papilio polyxenes* 6x, *Papilio zelicaon*, *Pholisora catullus* 3x,

*Phyciodes batesii anasazi* 2x, *Phyciodes batesii apsaalooke* 10x, *Phyciodes pallida*, *Phyciodes picta* 20x, *Phyciodes pulchella camillus* 10x, *Phyciodes tharos orantain* 4x, *Phyciodes tharos tharos* 9x, *Pieris rapae* 229x, *Piruna pirus* 161x, *Plebejus melissa* 25x, *Poanes taxiles* 79x, *Polites mystic* 12x, *Polites origenes* 11x, *Polites peckius* 163x, *Polites sabuleti* 4x, *Polites themistocles* 92x, *Pontia beckerii*, *Pontia callidice occidentalis* 9x, *Pontia protodice* 66x, *Pyrgus communis* 80x, *Satyrium acadica*, *Satyrium behrii*, *Strymon melinus* 45x, *Thymelicus lineola*, *Vanessa atalanta* 4x, *Vanessa cardui* 113x, *Vanessa carye* 13x, *Zerene cesonia*. Alfalfa is pollinated by 6 species of *Megachile* bees esp. *M. diligens*, and less successfully by bumblebees and honeybees who often do not trip the flowers (Sladen 1918). Alkali bees (*Nomia melanderi*) are effective pollinators also. The bee *Megachile rotundata* now pollinates alfalfa in most of the U.S. (its introduction into North America revolutionized the alfalfa seed crop industry), *M. concinna* pollinates it in southern U.S., and *M. dentitarsus* and *M. perihirta* pollinate it in Alberta. In India it is pollinated by two specialist bees *Megachile haryanaensis* and *Chalicodoma rubripes* (Sihag 1993). *Bembex* wasps can pollinate it and other small-flowered legumes.

*Melilotus alba* white: *Argynnis (Speyeria) edwardsii* 2x, *Brephidium exilis*, *Callophrys gryneus siva*, *Callophrys spinetorum*, *Cercyonis oetus* 2x, *Colias eurytheme* 3x, *Colias philodice* 6x, *Cupido comyntas* 2x, *Erynnis afranius* 2x, *Erynnis horatius* 4x, *Euphyes vestris*, *Euptoieta claudia*, *Glaucopsyche lygdamus*, *Hemiargus ceraunus gyas*, *Hemiargus isola* 6x, *Hesperia viridis* some, *Leptotes marina* 4x, *Lycaena arota* 20x, *Lycaena heteronea*, *Lycaena rubidus* 2x, *Neominois ridingsii*, *Oarisma edwardsii*, *Piruna pirus*, *Plebejus icarioides* 2x, *Plebejus melissa* 5x, *Poanes taxiles*, *Pontia protodice* 2x incl. Janet Chu, *Satyrium acadica* 11x, *Satyrium behrii* many, *Satyrium calanus*, *Satyrium californica*, *Satyrium liparops*, *Satyrium sylvinus*, *Satyrium tetra*, *Satyrium titus*, *Strymon melinus* 5x, *Vanessa carye*. *Melilotus* is pollinated by bees, and sometimes self-pollinates.

*Melilotus officinalis* yellow: *Callophrys gryneus siva* commonly (Scott 1973a), *Celastrina neglecta* 2x, *Cercyonis oetus*, *Chlosyne nycteis*, *Colias edwardsii altiplano*, *Colias eurytheme* 2x, *Colias philodice*, *Erynnis horatius*, *Euphyes bimacula*, *Glaucopsyche lygdamus*, *Hemiargus isola* 2x, *Hesperia pahaska* 2x, *Junonia coenia* [?Mel. *officinalis*] 10x, *Lycaena helloides*, *Lycaena rubidus* 3x, *Lycaena xanthoides* "editha" vurali 2x, *Oarisma garita*, *Oarisma edwardsii*, *Ochlodes yuma*, *Phyciodes pallida*, *Phyciodes tharos tharos*, *Plebejus alupini texanus*, *Plebejus glandon* 2x, *Plebejus icarioides*, *Plebejus melissa* 5x, *Polites sonora*, *Pontia protodice*, *Pyrgus communis* 2x, *Satyrium calanus* many, *Satyrium sylvinus nootka*, *Strymon melinus* 5x.

*Melilotus* white or yellow: *Plebejus melissa* common.

*Oxytropis deflexa* var. *sericea* white: *Hesperia uncas*, *Notamblyscirtes simius*, *Paratrytone snowi*.

*Oxytropis lambertii* mostly reddish-purple: *Amblyscirtes oslari* 9x, *Amblyscirtes phylace* ~20x, *Amblyscirtes vialis*, *Apyrothrix araxes* 5x, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) edwardsii*, *Battus philenor*, *Colias alexandra* 2x, *Colias eurytheme* 3x, *Colias philodice*, *Erynnis afranius* 4x, *Erynnis persius* 3x, *Erynnis tristis tatus*, *Eurema mexicana*, *Glaucopsyche lygdamus* 5x, *Hesperia nevada* 20x, *Hesperia pahaska* 20x, *Hesperia uncas*, *Hesperia uncas*, *Hesperia viridis*, *Notamblyscirtes simius* 3x, *Oarisma edwardsii* 2x, *Oarisma garita* 5x (one sucking each flower of inflor.), *Papilio eurymedon* 3x, *Papilio glaucus rutulus*, *Papilio polyxenes* 5x, *Papilio zelicaon* 4x (+ pinkish 1x f. *nitra*), *Paratrytone snowi* 82x, *Plebejus glandon*, *Plebejus icarioides*, *Plebejus melissa* 2x (one placed proboscis into base of flower), *Poanes taxiles* 2x, *Polites (Yvretta) rhesus-violet* 29x, *Polites draco* 4x, *Polites mystic* 3x, *Polites origenes*, *Polites themistocles* 2x, *Pyrgus communis* 3x, *Pyrgus scriptura*, *Stinga morrisoni* 14x, *Strymon melinus*, *Thorybes pylades*, *Vanessa cardui* 11x, *Vanessa virginiensis*, *Zerene cesonia*.

*Oxytropis sericea* white: *Euphydryas bernadetta rorina*, *Hesperia nevada* 2x, *Hesperia uncas* 2x, *Polites (Yvretta) rhesus* 5x, *Thorybes mexicana*. This is pollinated by bumblebees (usually *Bombus flavifrons*) in Wyo. (Kudo and Harder 2005), and *Oxytropis campestris* is pollinated by bumblebees in Montana (Bauer 1982).

pea flower: *Nathalis iole* (white flower), *Thorybes pylades*.

(*Pisum sativum* is unpopular. 71-96% of plants self-pollinate before the flower opens, but bumblebees visit the few flowers that open before selfing.)

*Phaseolus heterophyllus* flower with two orange hoods and yellow center with vine stem and tri-part leaves: *Amblyscirtes phylace*, *Leptotes marina*.

*Phaseolus vulgaris* whitish is unpopular: *Epargyreus clarus*, *Pieris rapae* (only 1 sec.). This self-pollinates but insects can also pollinate it. *Phaseolus coccineus* is pollinated by honeybees and usually by bumblebees.

*Psoralea tenuiflora* blue-purple is common but not popular (but *P. melissa* often visits it): *Erynnis aفرانيus* 2x, *Euptoieta claudia*, *Hemiargus isola* 2x, *Lycaena rubidus*, *Plebejus alupini texanus* 3x, *Plebejus melissa* 28x, *Pontia protodice* 2x, *Pyrgus communis*, *Strymon melinus* 6x. *Psoralea esculenta* is pollinated by small bumblebees and solitary bees in Iowa.

*Psoralea?* thin blue legume: *Hemiargus isola*, *Hesperopsis alpheus*.

(*Robinia pseudoacacia* white and *R. neomexicana* rose-pink have no records on the flowers, but other people have seen butterflies on them. *R. pseudoacacia* is reportedly pollinated by bumblebees [especially] and honeybees [it makes good unifloral honey] and hummingbirds, and sometimes by butterflies and moths [Hilty 2013], although Robertson [1929] wrote that butterflies and moths are not effective at cross-pollination, because strong bees are required to force the petals open for cross-pollination.)

*Senna hirsuta* var. *leptocarpa* yellow: *Amblyscirtes nysa*, *Ministrymon leda*. *Senna* (often placed in *Cassia*) is “buzz pollinated” by bumblebees and bees (the bee leaving the flower sends up a cloud of light pollen and some sticks to the bee—and reportedly the pollen on the bee picks up a positive electric charge during flight, and the flower has a negative charge, so the pollen is attracted to the next flower (Vaknin et al. 2000). The bees *Anthophora walshii* and *Svastra atripes* are specialists on “*Chamaecrista*” [often placed in *Cassia*] and possibly *Senna*.

*Thermopsis divaricarpa* yellow: *Amblyscirtes vialis* 5x, *Atrytonopsis hianna hianna*, *Erynnis aفرانيus*, *Erynnis persius* 12x and female tried to feed on flower twice, *Erynnis telemachus* 5x (2 were seen to feed on this by putting proboscis just inside sepals outside of corolla), *Glaucopsyche lygdamus* 8x (5 of these were seen placing proboscis between corolla and sepals), *Oeneis uhleri*, *Papilio zelicaon* 3x, *Polites peckius*, *Polygonia gracilis zephyrus*.

*Thermopsis montana* yellow: *Hesperia pahaska*. This is pollinated by bumblebees (Dodson and Dunmire 2007 and internet websites). *Thermopsis lanceolata* is pollinated primarily by *Megachile* and *Hoplitis* bees (who also chewed holes in flower bases to steal nectar) in Inner Mongolia (Hongyan et al. 2012).

*Trifolium dasyphyllum* purple/pink: *Boloria eunomia*. This is pollinated by bumblebees (Bauer 1983). *Trifolium* spp. are pollinated by bees (Proctor et al. 1996).

*Trifolium fragiferum* pink: *Cupido comyntas*, *Hemiargus isola* 23x popular, *Lycaena dione*, *Pholisora catullus*, *Phyciodes tharos orantain*, *Plebejus melissa* 6x, *Polites sabuleti*, *Pyrgus communis* 5x, *Strymon melinus*.

*Trifolium hybridum* pinkish-white: *Argynnis (Speyeria) cybele cybele*, *Callophrys gryneus siva*, *Colias eurytheme*, *Cupido comyntas* 4x, *Oarisma garita* 2x, *Plebejus saepiolus* 11x, *Thymelicus lineola* 2x.

*Trifolium pratense* red-purple is moderately popular: *Amblyscirtes vialis* 2x, *Ancyloxypha numitor* 6x (and one 5 sec.), *Argynnis (Speyeria) aphrodite* 11x (one only 1 sec.), *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) hesperis* 3x, *Argynnis (Speyeria) mormonia*, *Argynnis (Speyeria) nokomis* 8x, *Argynnis (Speyeria) zerene*, *Atalopedes campestris* 2x, *Celastrina neglecta*, *Colias alexandra* 8x, *Colias eurytheme* 58x, *Colias philodice* 35x, *Cupido amyntula*, *Cupido comyntas* 2x, *Danaus plexippus* 14x, *Epargyreus clarus* 27x, *Erynnis baptisiae*, *Euchloe ausonides*, *Euphyes vestris* 2x, *Euptoieta claudia* 4x, *Hemiargus isola* 2x, *Hesperia ottoe*, *Ochlodes sylvanoides* 7x, *Papilio polyxenes* 26x, *Paratrytone snowi*, *Phyciodes pulchella camillus*, *Pieris rapae* 5x, *Piruna pirus*, *Plebejus icarioides*, *Plebejus saepiolus* 2x, *Poanes taxiles* 8x, *Polites mystic* 13x, *Polites peckius*, *Polites themistocles* 3x, *Thymelicus lineola* 2x, *Vanessa atalanta* 47x, *Vanessa cardui* 73x, *Vanessa carye*, *Vanessa virginiensis* 2x. This is pollinated by bumblebees (*Bombus lapidarius*, *hortorum*, *pascuorum*, *terrestris*, etc., the longer-tongued spp. pollinate best) and leaf-cutter bees in the U.S. (honeybees are least effective at tripping the flowers), by bumblebees and sometimes honeybees in Europe. In New Zealand it is pollinated by honeybees and two species of long-tongued bumblebees (the shorter-tongued *Bombus terrestris* that is used in tomato greenhouses pollinates much less) (Palmer-Jones et al. 1966). In Italy

bumblebees are the main pollinators (*Bombus terrestris*, *Pyrobombus lapidarius*, and 5 *Megabombus* spp.); honeybees visit less but also pollinate (Manino and Ferrazzi 1990).

*Trifolium repens* whitish: *Ancyloxypha numitor*, *Argynnis* (*Speyeria*) *callippe*, *Argynnis* (*Speyeria*) *mormonia* 9x, *Atalopedes campestris* 3x, *Celastrina neglecta* 65x, *Colias eurytheme* 7x, *Colias philodice* 4x, *Cupido comyntas* 23x, *Euptoieta claudia*, *Hemiargus isola* 45x, *Hylephila phyleus* 3x, *Junonia coenia* 3x, *Leptotes marina*, *Libythea carinenta bachmanii* 6x, *Nathalis iole*, *Papilio polyxenes*, *Phyciodes diminutor*, *Phyciodes pulchella camillus*, *Phyciodes tharos tharos* 9x, *Pieris rapae* 7x + another only 1 sec., *Plebejus saepiolus* 7x, *Polites peckius*, *Pyrgus communis* 46x (it often visits this tiny flower and ignores many big flowers in Lakewood CO), *Strymon melinus* 8x, *Thorybes mexicana* 2x, *Vanessa cardui* 22x, *Vanessa virginiensis*. This is pollinated mainly by honeybees and other bees including bumblebees and solitary bees.

*Trifolium* (usually white to pink): *Chlosyne palla australomontana* some, *Erynnis horatius*, *Hesperia pahaska*, *Parnassius clodius*, *Satyrium favonius autolycaeus=violae* 2x, *Strymon melinus*.

*Vicia americana* purple: *Ancyloxypha numitor* 7x, *Colias philodice*, *Cupido amyntula*, *Glaucopsyche lydamus*, *Oarisma garita* 2x, *Papilio polyxenes*, *Polites themistocles*, *Polites* (*Yvretta*) *rhesus*, *Thorybes pylades*. *Vicia* are pollinated by bumblebees (Proctor et al. 1996). Honeybees and bumblebees pollinate cultivated *Vicia faba* (which usually self-pollinates).

*Vicia cracca* bluish-purple: *Anatrytone logan logan*, *Polites peckius*, *Vanessa atalanta*, *Vanessa cardui*. Bumblebees are frequent visitors (Lavery 1994).

*Vicia villosa* violet and white to rose: *Cupido comyntas*.

~*Vicia* tall skinny “wild pea” ?blue or purple: *Danaus plexippus*.

## ROSACEAE

In general, Rosaceae flowers are unpopular, although there are a number of records for common *Physocarpus*, *Potentilla*, and *Prunus* which are moderately popular (*Prunus americana* is a popular flower in early spring when there are not many other flowers around). This is surprising, as these flowers are usually showy (such as *Amelanchier*, *Crataegus*, *Chaenomeles*, *Dryas*, *Fragaria*, *Holodiscus*, *Pyrus*, *Rosa*, *Rubus*, and *Spiraea*), yet are unpopular. *Pyrus malus* is abundant in towns but is rarely visited. Wild roses are sometimes visited, but cultivated roses are generally ignored because breeders bred the aroma and nectar out of most roses and gave them hundreds of petals that block insects. Rosaceae in general have generalist pollinators, the smaller flowers visited by flies and short-tongued bees, the larger flowers pollinated by long-tongued bees wasps butterflies moths and beetles (Judd et al. 2008). Fruit trees (*Pyrus*, *Prunus*) are pollinated mostly by bees including honeybees, sometimes by flies (chironomids, mycetophilids, muscids and calliphorids etc.), and nitidulid beetles. The introduced bees *Osmia cornifrons* and *O. cornuta* specialize on Rosaceae flowers, and *O. cornifrons* visits old-world tree-fruit flowers (apple, peach, pear, etc., Cane 2003). The blue orchard mason bee *Osmia lignaria* is a more efficient pollinator of fruit trees than the honeybee.

(*Agrimonia striata* has small yellow flowers and is uncommon and has no records.)

*Amelanchier*? (white-flowered shrub similar to it): *Erynnis propertius meridianus*, *Libythea carinenta larvata*, *Ministrymon leda*. *Amelanchier* is reportedly pollinated by insects.

*Amelanchier* white: *Callophrys augustinus iroides*.

“*Cercocarpus*” (similar to, tiny white-yellow-flowered tiny-leaf, Ariz.): *Microtia dymas* several, *Ministrymon leda*.

*Chaenomeles japonica* orange-red: *Papilio glaucus rutulus*. This is pollinated by bees and sometimes other insects.

*Crataegus erythropoda* white: *Polygonia satyrus*. Other *Crataegus* species are reportedly pollinated by numerous bees including honeybees and bumblebees and solitary bees and wasps and flies and even a few beetles and midges and other insects, and the butterfly *Vanessa virginiensis*.

(*Cotoneaster* white or pink has no records. It is often visited by wasps in Britain [Proctor et al. 1996].)

*Dryas octopetala* white: *Argynnis* (*Speyeria*) *mormonia*, *Erebia magdalena*, *Euphydryas anicia brucei*, *Oeneis polixenes* 2x, *Vanessa cardui* 12x. The flowers track the sun to warm, and are pollinated by five

sp. of flies in Sweden (*Thricops* and *Phaenonia* feed exclusively on pollen and nectar) (Pont 1993, who notes that Muscidae flies are the predominant insect pollinators of open blossoms in arctic-subarctic habitats.)

(*Fallugia* white flowers: no *Polites peckius* were seen on this. *Fallugia paradoxa* is insect-pollinated and attracts a wide variety of insects.)

*Fragaria vesca* white is unpopular: *Callophrys spinetorum*. Commercial *Fragaria* strawberries are pollinated by honeybees and bumblebees etc., and *Calliphora* blowflies can pollinate them in greenhouses.

*Fragaria virginiana glauca* white is also unpopular: *Lycaena florus*, *Pieris marginalis mcdunnoughii* 2x, *Plebejus glandon* 1x + 1 sec., *Plebejus saepiolus* 2x, *Pyrgus centaureae* 2x. It is visited by ants, bees, and flies [Ashman 2000].)

*Geum (Acomastylis) rossii turbinatum* yellow: *Lycaena cupreus snowi* 2x, *Parnassius phoebus smintheus*, *Plebejus glandon*, *Plebejus saepiolus*.

*Geum aleppicum* yellow: *Euphydryas anicia capella*.

*Holodiscus discolor* whitish: *Apodemia nais*, *Argynnis (Speyeria) hesperis*, *Asterocampa celtis jeffermont* 2x, *Celastrina neglecta cinerea*, *Satyrium californica* 11x, *Satyrium behrii* 2x.

*Physocarpus monogynus* white is popular: *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) hesperis*, *Callophrys gryneus siva*, *Celastrina lucia sidara* 3x, *Chlosyne gorgone* 16x, *Erebia epipsodea*, *Euphydryas anicia capella* 19x, *Euptoieta claudia* 3x, *Hesperia juba*, *Limenitis weidemeyerii* 6x, *Nymphalis antiopa*, *Papilio eurymedon*, *Parnassius phoebus smintheus*, *Phyciodes pulchella camillus* 2x, *Polygonia gracilis zephyrus* 2x, *Polygonia satyrus* 2x, *Vanessa atalanta* 14x, *Vanessa cardui* 3x. Effective pollinators of *Physocarpus amurensis* are Apidae bees, sometimes butterflies.

*Potentilla concinna* yellow: *Callophrys spinetorum*, *Oarisma garita* 2x.

*Potentilla diversifolia* yellow: *Boloria eunomia*, *Boloria titania* 2x, *Erebia callias*, *Lycaena cupreus snowi*, *Plebejus glandon* 2x.

*Potentilla fissa* yellow is common but unpopular: *Callophrys dumetorum homoperplexa*, *Celastrina lucia sidara*, *Chlosyne gorgone* 6x, *Coenonympha tullia*, *Erynnis martialis* 2x, *Erynnis persius* 2x, *Euphydryas anicia capella* (and 1 briefly), *Oarisma garita*, *Papilio zelicaon*, *Parnassius phoebus smintheus*, *Plebejus glandon* 2x, *Poladryas minuta arachne*.

*Potentilla fruticosa*=*Pentaphylloides floribunda*=*Dasiphora fruticosa floribunda* yellow is common but not very popular: *Boloria eunomia* 3x, *Cercyonis oetus* 4x, *Lycaena florus* 16x, *Lycaena heteronea* 4x, *Lycaena rubidus* 2x, *Lycaena xanthoides "editha" vurali*, *Oeneis calais altacordillera?*, *Papilio glaucus rutulus*, *Pieris rapae*, *Plebejus glandon* 5x, *Plebejus melissa pseudosamuelis*, *Poanes taxiles* only 2 sec., *Pontia protodice* 2x, *Satyrium californica*, *Satyrium saepium* 14x. This is pollinated by bees and flies.

*Potentilla gracilis* yellow: *Argynnis (Speyeria) atlantis sorocko*, *Coenonympha tullia*, *Lycaena florus* 4x, *Lycaena rubidus* 3x, *Parnassius phoebus smintheus* 2x. In Oregon this species is pollinated by bees (*Ceratina nanula*, *Trichodes ornatus*, *Halictus ligatus*, *Lasioglossum sisymbrii*, and *L. olympiae*), while the weed *Potentilla recta* is pollinated by honeybees, *C. nanula*, *Halictus tripartrus*, *L. sisymbrii*, and *Bombus rufocinctus* (McIver and Erickson 2012). Other herbaceous *Potentilla* are pollinated mostly by bees including honeybees, sometimes by syrphid flies, mini wasps, and occasionally butterflies; some species (but not *P. gracilis*) are self-compatible.

*Potentilla hippiana* yellow: *Oarisma garita*, *Parnassius phoebus smintheus*, *Phyciodes pallida*, *Plebejus glandon*, *Poladryas minuta arachne* 4x.

*Potentilla hippianaXpulcherrima* yellow: *Oarisma garita*.

*Potentilla norvegica* yellow: *Ancyloxypha numitor* 12x, *Pieris rapae* 3x.

*Potentilla pensylvanica* yellow: *Hesperia uncas*.

*Potentilla pulcherrima* yellow: *Argynnis (Speyeria) mormonia* 3x, *Cupido amyntula*, *Euchloe ausonides*, *Hesperia comma colorado*, *Lycaena florus* 23x + 1/3 sec., *Lycaena rubidus* 2x, *Oarisma garita*, *Plebejus glandon* 7x, *Plebejus saepiolus* (1x + 1/2 sec. twice), *Pontia callidice occidentalis*, *Pontia protodice*.

*Potentilla* yellow: *Callophrys gryneus nelsoni* many, *Chlosyne whitneyi damoetas*, *Lycaena florus* 2x, *Lycaena xanthoides* “*editha*” *vurali*, *Lycaena xanthoides xanthoides*, *Paratrytone snowi* 1x, *Phyciodes pulchella camillus*, *Plebejus icarioides*, *Pontia protodice* (large leaves in garden).

*Potentilla subviscosa* yellow: *Pyrgus xanthus* often.

*Prunus americana* white is popular: *Aglais milberti* 4x, *Callophrys dumetorum homoperplexa* 4x, *Callophrys eryphon* 5x (including Janet Chu), *Callophrys mossii schryveri* 2x, *Callophrys spinetorum* 2x, *Euchloe ausonides*, *Nymphalis antiopa* 17x, *Nymphalis californica* 2x, *Papilio glaucus rutulus* Janet Chu, *Papilio zelicaon*, *Polygonia gracilis zephyrus* 7x, *Satyrium titus*, *Strymon melinus*, *Vanessa atalanta*, *Vanessa cardui* 3x. This is visited by bumblebees that surely pollinate it. And the megachilid blue orchard mason bee *Osmia lignaria* pollinates plums in Kansas orchards. Honeybees pollinate *Prunus amygdalus*.

*Prunus cerasus* white (sour cherry): *Vanessa atalanta*, *Vanessa cardui* 24x.

*Prunus domestica* white (plum) is rarely visited: *Nymphalis antiopa*.

*Prunus maackii* white: *Vanessa cardui*.

*Prunus pissardi rosea* white: *Vanessa cardui* 2x.

(*Prunus persica* pink [peach] is common in towns but I have not seen a butterfly on it.)

*Prunus virginiana* white is popular: *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) egleis oweni*, *Argynnis (Speyeria) hesperis*, *Callophrys augustinus*, *Callophrys eryphon* 2x, *Callophrys gryneus siva* 3x, *Celastrina humulus* lupine-ecotype, *Celastrina lucia sidara* 17x, *Chlosyne acastus arkanyon*, *Chlosyne gorgone* 8x, *Chlosyne nycteis*, *Coenonympha tullia*, *Erynnis icelus* 3x, *Euphydryas anicia capella* 10x, *Nymphalis antiopa* 3x, *Nymphalis californica*, *Oeneis uhleri* 2x, *Papilio eurymedon*, *Papilio polyxenes*, *Phyciodes pulchella camillus* 2x, *Phyciodes tharos tharos*, *Plebejus glandon*, *Plebejus icarioides*, *Polygonia satyrus*, *Vanessa atalanta* 9x, *Vanessa cardui* 17x. *Prunus virginiana* is pollinated by megachilid bees, and its pollen blows widely so there may be some wind pollination.

*Purshia tridentata* pale-yellow: *Coenonympha tullia*, *Callophrys gryneus chalcosiva*, *Papilio glaucus rutulus*, *Satyrium fuliginosum*. This is pollinated by various insects, also by wind, and by self-fertilization.

(*Pyracantha* white has no records.)

*Pyrus crabapple*: *Vanessa cardui* (1x + pink 3x, double-flowered crabapple pink 6x).

*Pyrus floribunda* pinkish-white: *Vanessa cardui*.

*Pyrus malus* (apple) white: *Vanessa cardui* 2x. Honeybees and bumblebees pollinate it (bumblebees can buzz-pollinate it); the megachilid blue orchard mason bees *Osmia lignaria propinqua* are claimed to be superior pollinators (*Osmia cornifrons* is used in Japan, *O. cornuta* in Europe, *O. rufa* and *Andrena* in Britain). *Andrena*, *Halictus*, and *Lasioglossum* bees pollinate fruit trees in Nova Scotia. Willmer (2011) notes that early midges and fungus gnats, some higher flies (bibionids, muscids), and also nitidulid beetles occur regularly on the flowers of orchard fruits (*Pyrus* apples and pears, *Prunus* plums and cherries).

(*Pyrus communis* [pear] has no records, but there are few trees to observe. It is pollinated by honeybees and the megachilid blue orchard mason bee *Osmia lignaria*.)

*Rosa* spp. are unpopular flowers. The bee *Synhalonia rosae* specializes on wild *Rosa*.

*Rosa ~woodsii* pink 5 cm flower: *Oarisma garita*, *Vanessa atalanta*.

*Rosa* pink: *Callophrys eryphon*, *Euphydryas gillettii*, *Cercyonis pegala* 1 sec. only.

*Rosa* red: *Papilio multicaudata* (cultivated red, one bushy, one had single petals) 6x (two only 2 sec.), *Vanessa atalanta* (red giant with few petals).

*Rosa* cream: *Poanes taxiles*.

Rosaceae shrub white: *Coenonympha tullia californica*, *Satyrium californica*, *Satyrium sylvinus dryope*.

*Rubus* sp. (“blackberry”) white: *Callophrys gryneus nelsoni*, *Euchloe ausonides ausonides*, *Pyrgus communis* (on Darrow Blackberry). *Rubus arcticus* is pollinated by honeybees in Estonia. Some *Rubus* can self-pollinate.

*Rubus deliciosus* white is unpopular: *Atrytonopsis hianna hianna*, *Callophrys eryphon*, *Chlosyne gorgone* (one 1/3 sec, another hovered over 1 sec then flew), *Coenonympha tullia*, *Euphydryas anicia capella* 2x, *Lycaena arota* 2x, *Papilio eurymedon*, *Vanessa cardui*.

*Rubus idaeus melanolasius* white: *Amblyscirtes vialis* 2x, *Erebia epipsodea*, *Pieris rapae*, *Polygonia gracilis zephyrus*. Raspberry varieties are pollinated by bumblebees and honeybees and solitary bees, sometimes by megachilid (*Osmia*) bees; bumblebees are better pollinators in Scotland (Willmer 2011).

(*Sibbaldia procumbens* is an unpopular flower; it is common near timberline but I saw no visits. It is reportedly pollinated by various insects [probably flies].)

(*Sorbus* has no records even though *Sorbus canadensis* is common in towns and *S. scopulina* is occasional in the high mts. In Illinois *Sorbus* [mostly *S. aucuparia*] is visited by honeybees, bumblebees, various solitary bees, syrphid flies, and beetles for nectar and pollen, and cross-pollination is necessary for fruiting [Hilty 2013].)

*Spiraea japonica*: *Poanes taxiles* (on “Gold Flame” pink-red), *Vanessa cardui* (pink). *Spiraea* is pollinated by honeybees (usually) and flies.

*Spiraea* ~*japonica* var. *ovalifolia* white: *Pontia protodice*.

## RHAMNACEAE

These flowers seem popular, though *Rhamnus cathartica* is shunned.

*Ceanothus fendleri* white is very popular: *Amblyscirtes phylace*, *Apodemia mormo pueblo*, *Apodemia nais* ~74x, *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) callippe* 4x, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) hesperis* 6x, *Callophrys dumetorum homoperplexa* 9x, *Callophrys gryneus siva* 26x incl. Janet Chu, *Celastrina humulus* hop-ecotype 4x incl. Janet Chu, *Celastrina humulus* lupine-ecotype, *Celastrina lucia sidara*, *Celastrina neglecta cinerea*, *Cercyonis oetus* 2x, *Chlosyne gorgone*, *Chlosyne leanira fulvia*, *Chlosyne palla calydon*, *Coenonympha tullia* 3x, *Colias alexandra*, *Erora laeta quaderna*, *Erynnis martialis* 13x, *Erynnis pacuvius* 9x, *Euphydryas anicia capella* 17x, *Euphyes vestris* 9x, *Glaucopsyche piasus*, *Hesperia viridis* 2x, *Limenitis weidemeyerii* 2x, *Lycaena heteronea* 3x, *Nymphalis californica*, *Oarisma edwardsii* 2x, *Oarisma garita* 5x, *Oeneis chryxus*, *Papilio eurymedon*, *Parnassius phoebus smintheus*, *Phyciodes cocyta* 3x, *Phyciodes pallida*, *Phyciodes pulchella camillus* 3x, *Piruna pirus* 3x, *Plebejus alupini* near-*lutzi* 11x, *Plebejus icarioides* 4x, *Plebejus melissa*, *Plebejus saepiolus*, *Poanes taxiles* 2x, *Poladryas minuta arachne* 4x, *Polites draco*, *Polygonia gracilis zephyrus* 4x, *Satyrium behrii* 30x, *Satyrium californica* 8x, *Satyrium liparops* Janet Chu, *Satyrium saepium* 7x, *Satyrium titus* 6x, *Strymon melinus* 4x, *Vanessa cardui*. *Ceanothus fendleri* and most *Ceanothus* are pollinated by bees, while some species are also pollinated by hoverflies and even hummingbirds.

*Ceanothus velutinus* white: *Aglais milberti*, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) zerene*, *Papilio glaucus rutulus*.

*Ceanothus* sp. whitish Calif.: *Callophrys johnsoni*, *Chlosyne palla palla*.

*Rhamnus californica* yellowish: *Callophrys augustinus* many.

(*Rhamnus cathartica* is a common weedy bush in towns but has ugly little greenish flowers that are shunned, so there are no records. It is pollinated by bees and flies.)

## ELEAGNACEAE

These are evidently unpopular.

*Eleagnus angustifolia* yellow is rarely visited: *Argynnis (Speyeria) edwardsii*. *Erynnis juvenalis* and *Atrytonopsis hianna hianna* visits are recorded in eastern U.S. The small fragrant yellow flowers are pollinated by honeybees and bees in Eurasia.

(*Shepherdia canadensis* has no records. It is fairly common but occurs in shade and has small brown flowers that are pollinated primarily by syrphid and empidid flies [Borkent and Harder 2007].)

## ULMACEAE

Butterflies do not visit wind-pollinated *Celtis* and *Ulmus* trees. Ulmaceae in general (including *Ulmus*, *Celtis* and *Trema*) are wind-pollinated (Judd et al. 2008).

## CANNABACEAE

*Humulus* has inconspicuous small flowers generally ignored by butterflies. Cannabaceae in general are wind-pollinated (including *Humulus* and *Cannabis*) (Judd et al. 2008).

*Humulus lupulus* female flower: *Hemiargus isola* (one wonders if it obtained any nourishment).

#### MORACEAE

*Morus alba* trees are scattered in Denver but have tiny greenish flowers that are wind-pollinated.

#### URTICACEAE

Butterflies very rarely visit the inconspicuous tiny wind-pollinated flowers of *Urtica* and shun *Parietaria*.

*Urticaceae* in general is usually wind-pollinated (Judd et al. 2008).

(*Parietaria pensylvanica* is uncommon and has tiny inconspicuous flowers and no records.)

*Urtica dioica gracilis* gray-green (maybe the butterfly was seeking water and not nectar?): *Paratrytone snowi*.

#### CUCURBITACEAE

All are unpopular flowers for butterflies (bees love them and pollinate Colorado garden squash and cucumbers). Cucurbitaceae in general are pollinated by various insects birds and bats seeking pollen and nectar (Judd et al. 2008). The Gourd Bee *Xenoglossa strenua* is a specialist on Cucurbitaceae including *Curcubita pepo*. *Cucumis melo* var. *cantalupensis* has a recorded visit by *Amblyscirtes nysa*.

*Cucumis sativus* (cucumber) yellow: *Pyrgus communis*, *Pieris rapae* 5x (proboscis sucking) (+ one only 1 sec). This is reportedly pollinated by honeybees and stingless bees (by *Scaptotrigona* aff. *depilis* and *Nannotrigona testaceicornis* in greenhouses). Bumblebees are better pollinators than honeybees (Stanghellini et al. 2002).

*Cucurbita maxima* yellow: *Pieris rapae* (only ½ sec). Butternut squash is common in my garden but is not visited.

*Cucurbita pepo* yellow is common in my garden (zucchini squash) but is not visited. It is pollinated by bumblebees and squash bees (*Peponapis pruinosa*) (Hladun and Adloer 2009). *Cucurbita pepo* and other *Curcubita* are pollinated by honeybees, and by *Peponapis pruinosa*, a specialist wild bee that gathers pollen before sunup (an hour before any other bees) and can pollinate whole squash fields (Sampson et al. 2008, Cane et al. 2011); *P. pruinosa* feeds only on wild and domestic *Curcubita* (Hurd et al. 1971).

Gourd Bees *Xenoglossa strenua* also visit.

*Echinocystus lobata* cream is not popular: *Danaus plexippus* 1 sec. The tiny flowers are pollinated by insects and by self-fertilization.

#### FAGACEAE

Butterflies do not visit the inconspicuous flowers of *Quercus*, which are wind-pollinated. Fagaceae in general are wind-pollinated, including *Quercus* and *Fagus*, though *Castanea* is pollinated by flies beetles and bees (Judd et al. 2008).

#### JUGLANDACEAE

(Butterflies do not visit the inconspicuous flowers of numerous *Juglans nigra* in Denver, which is wind-pollinated [thousand cankers disease transmitted by bark beetles has now killed almost all these trees]. Juglandaceae in general are wind-pollinated [Judd et al. 2008].)

#### BETULACEAE

*Alnus* and *Betula* and the uncommon *Corylus cornuta* are not visited and are wind-pollinated. Betulaceae are wind-pollinated (Judd et al. 2008). *Betula glandulosa* almost always selfs on Baffin Island but in central Quebec it is usually sexually pollinated (by wind).

#### GERANIACEAE



These are not very popular, although *Geranium caespitosum* is moderately popular and several tiny skippers love it. Geraniaceae in general are pollinated by a wide variety of insects for a nectar reward, and nectar guides are often present (Judd et al. 2008).

*Erodium cicutarium* violet is common but unpopular: *Euchloe ausonides ausonides*, *Junonia coenia* 2x, *Papilio zelicaon*.

*Geranium ?carolinianum* red: *Junonia coenia*.

*Geranium caespitosum* pink is popular, especially for *Piruna pirus*: *Amblyscirtes aenus*, *Amblyscirtes phylace* 2x, *Amblyscirtes vialis*, *Argynnis (Speyeria) aphrodite* 2x, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) hesperis* 3x, *Atrytone arogos*, *Callophrys gryneus siva*, *Celastrina humulus* hop-ecotype, *Celastrina humulus* lupine-ecotype (7x and white 6x), *Cercyonis meadii* only ½ sec., *Cercyonis oetus* 2x, *Cercyonis pegala* 6x, *Coenonympha tullia*, *Colias alexandra*, *Colias eurytheme* 2x, *Epargyreus clarus* 2x, *Erynnis horatius* (red flower), *Erynnis pacuvius*, *Euphyes vestris* 15x, *Euptoieta claudia*, *Eurema mexicana* ½ sec, *Glaucopsyche piasus*, *Hesperia comma*, *Hesperia leonardus montana*, *Hesperia nevada*, *Leptotes marina*, *Lycaena xanthoides "editha" vurali* 1 sec., *Oarisma edwardsii* 3x, *Oarisma garita* 13x (one seen placing proboscis on base of column), *Ochlodes sylvanoides* 8x, *Oeneis jutta*, *Paratrytone snowi* 4x, *Pholisora catullus*, *Pieris marginalis mcdunnoughii* sucking on top 2x, *Pieris rapae* 2x, *Piruna pirus* 404x incl. Janet Chu (This *Geranium* is the favorite flower of *Piruna*. When feeding, both sexes land on petals with head toward anthers/stigmas and put proboscis next to stamen column [they put proboscis down into holes by stamens] and the top of bend of proboscis often touches anther and labial palp tip sometimes touches anther, and an antenna often touches [near base] anther/stigma, so pollination is possible. [They may pollinate *Geranium* if pollen is found on their head, because adults land on petals and fit under the stamens and probably contact them sometimes while they suck nectar, but they are too small to often contact the 4 stigmas which rise in a column surrounded by the arching stamens, so they should be classified as illegitimate visitors.]), *Plebejus glandon* 3x, *Poanes taxiles* 8x, *Polites mystic* 3x (but another ignored it), *Polites origenes* 2x, *Polygonia gracilis zephyrus*, *Satyrium titus* 2x, *Strymon melinus*, *Vanessa atalanta*. Internet search indicates that bees are known to visit this species, which is self-compatible; Dodson and Dunmire (2007) note that lavender lines on the flowers help bees to get the nectar. Willmer (2011) notes that large brightly-colored *Geranium* (such as *G. pratense*, *G. sylvaticum*) are pollinated by insects especially bees, while smaller dull-pink *Geranium* (such as *G. molle*, *G. dissectum*) are self-pollinated. The bee *Andrena distans* is a specialist on *Geranium maculatum*.

*Geranium hybrida* orange: *Pieris rapae* 3x.

*Geranium* purplish: *Piruna polingii* 6x.

*Geranium richardsonii* white: *Argynnis (Speyeria) mormonia*, *Erebia epipsodea* 2x, *Nathalis iole*, *Pieris marginalis mcdunnoughii*.

*Geranium ~sanguiueum* red: *Papilio multicaudata* (+ others only 2, 2, 3 sec.).

## ONAGRACEAE

Most genera are shunned by butterflies, except *Epilobium danielsi* is moderately popular. *Clarkia xantiana* in California has two specialist bees (*Megachile gravita* and *M. pascoensis*) that evidently visit only *Clarkia* (Eckhart et al. 2006).

*Calylophus serrulata* yellow: *Euphyes vestris*. Other *Calylophus* spp. in Texas are pollinated by halictid bees, several chrysomelid and buprestid beetles, several syrphid flies, the sphingid moth *Hyles lineata*, several noctuid moths, and honeybees (Clinebell II et al. 2004). *Calylophus hartwegii* flowers open afternoon-evening and attract sphingid moths and hummingbirds.

*Epilobium brachycarpum*=*paniculatum* pink tiny flowers: *Pieris rapae*.

*Epilobium (Chamerion) danielsi "angustifolium"* red-purple: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) aphrodite* (or for *Epilobium leptophyllum?*), *Epargyreus clarus*, *Erebia stubbendorffii "theano" ethela* 2x, *Ochlodes sylvanoides* 3x, *Poanes taxiles* 2x, *Pontia protodice* 2x,. This *Epilobium "angustifolium"* is usually bumblebee-pollinated but often self-pollinates (Benham 1969). *Epilobium ("Zauschneria") canum* is pollinated by various bees, butterflies, and hummingbirds.

*Epilobium*-like flower: *Lasiommata megera* (Europe).

Evening primrose? pink was shunned by butterflies during several days.

*Gaura coccinea* 2x: *Euptoieta claudia*. Primary pollinators of this are a noctuid and a geometrid moth, while *G. villosa* is pollinated by ant lions (esp. *Scotoleon minusculus*), two noctuid moths, and two halictid bees (*Sphecodogastra*) (Clinebell II et al. 2004).

*Gaura* reddish: *Euphyes vestris*.

(*Gayophytum* whitish-turning-rose has no records. The tiny *Gayophytum ramosissimum* self-pollinates.

Flower flies and small bees pollinate some larger *Gayophytum*. In *Gayophytum diffusum* the smaller flowers self, larger ones cross-pollinate.)

*Oenothera albicaulis* white: *Colias philodice*. Most *Oenothera* have large white flowers and bloom from sunset to early morning and are pollinated by moths (Dodson and Dunmire 2007), while smaller yellow flowers of other species bloom in daylight and are pollinated by bees. *Andrena* bees are important pollinators of California *Oenothera*. In eastern U.S. 8 sp. of *Lasioglossum* bees (Halictidae) including *L. oenotherae* visit only flowers of Onagraceae including *Oenothera* for pollen (Zayed and Packer 2007). The halictid bee *Evyllaes* also specializes in *Oenothera*. The bee *Anthedonia compta* specializes on *Oenothera biennis* and probably other *Oenothera*.

(*Oenothera caespitosa* whitish aging pink or rose is common but is shunned. It is pollinated by the sphingids *Sphinx vachti* and *Hyles lineata* [whose larvae eat the plant], while small crepuscular bees *Lasioglossum* and *Andrena* and large crepuscular bees *Xylocopa* are all nectar thieves.)

*Oenothera hookeri* yellow: *Paratrytone snowi* 2x.

## LYTHRACEAE

*Lythrum* is very popular. Judd et al. (2008) state that Lythraceae in general are pollinated by bees, beetles, and flies (birds for *Cuphea*, bats for *Sonneratia*).

*Cuphea rosea* purple was very popular in a greenhouse for at least one butterfly: *Pieris rapae* 10x.

*Lythrum alatum* purple: *Ancyloxypha numitor*.

*Lythrum salicaria* purple was very popular in the tiny patch it occupied NE Bass Lake in Wheatridge Colo. before eradication as a weed: *Papilio multicaudata*, (Lazri and Barrows 1984 saw it on *Lythrum*); *Cercyonis pegala* 3x, *Epargyreus clarus* 6x, *Junonia coenia*, *Ochlodes sylvanoides* 8x, *Papilio polyxenes*, *Poanes taxiles* 2x. *Lythrum salicaria* and *L. alatum* are pollinated by honeybees, bumblebees, xylocopid bees, megachilid bees, and the butterflies *Pieris rapae*, *Colias philodice*, and *Cercyonis pegala* (Levin 1970, Levin and Kerster 1973). In Britain this is visited by *Bombus pascuorum* and short-tongued bees which surely pollinate, and by syrphid flies and butterflies. Butterflies transport some pollen in Washington D.C. (Lazri and Barrows 1984) so some pollination is possible. In Colo. *Lythrum* may be pollinated by butterflies also, in addition to honeybees.

## ANACARDIACEAE

*Rhus* are mostly shunned, but some lycaenids like them. *Toxicodendron* has tiny flowers and is rarely visited. Anacardiaceae in general are pollinated by various insects (Judd et al. 2008). *Anacardium* is reportedly pollinated by butterflies and moths and secondarily by bats, while *Anacardium occidentale* is pollinated by ants.

*Rhus glabra* greenish flowers: *Argynnis (Speyeria) hesperis* 6x, *Celastrina neglecta* (whitish or greenish-yellow) a long time 3x, *Cercyonis pegala*, *Limenitis weidemeyerii* 2x, *Satyrium behrii* 2x, *Satyrium behrii* 2x, *Satyrium californica* 5 min., *Satyrium saepium* 2x, *Satyrium titus* 2x, *Vanessa atalanta* 3x. This is pollinated by bees including honeybees. The cultivated *Rhus typhina* is pollinated by honeybees.

*Rhus aromatica trilobata* yellowish: *Callophrys augustinus* 2x, *Callophrys eryphon* 4x, *Callophrys gryneus siva* old flowers, *Callophrys johnsoni* several, *Chlosyne gorgone* 2x, *Cupido amyntula*, *Hemiargus isola*, *Nymphalis californica*, *Strymon melinus*.

*Toxicodendron rydbergii* “*radicans*” has tiny yellowish-white or greenish-white flowers and has no records by me, but Senchina (2008) saw 17 *Celastrina neglecta* butterflies sucking nectar from them, averaging 39 seconds per visit, and cited papers noting that cantharid, cerambycid, and clerid beetles and honeybees

have been reported to pollinate the flowers. Also reportedly pollinated by insects including honeybees, small bees, and flies.

#### SAPINDACEAE (includes Aceraceae and Hippocastanaceae)

*Acer* trees (formerly in Aceraceae) are wind-pollinated and are not visited by butterflies (though *Acer saccharum* is also partly animal-pollinated [Judd et al. 2008 p. 69]). Sapindaceae in general are pollinated by birds and a wide variety of insects that are rewarded by nectar (Judd et al. 2008).

*Aesculus californica* white to pale-rose (formerly in Hippocastanaceae) is enormously popular in Calif. especially for hairstreaks: *Adelpha californica* 3x, *Atlides halesus* 1x, *Battus philenor hirsuta*, *Celastrina neglecta echo*, *Euphydryas chalcedona chalcedona* 2x, *Hesperia lindseyi* 12x, *Junonia coenia* 1x, *Lycaena gorgon* 3x [*Lycaena arota* is also recorded], *Ochlodes agricola* 6x, *Poanes melane* 2x, *Phyciodes mylitta*, *Plebejus icarioides*, *Satyrium auretteum* 32x, *Satyrium californica* 21x, *Satyrium saepium*, *Satyrium sylvinus dryope*, *Satyrium sylvinus sylvinus* 1x, *Satyrium tetra* 203x, *Strymon melinus*, *Thorybes pylades* 1x, *Vanessa carye*. *Aesculus californica* is pollinated by butterflies (Moldenke 1976), and its nectar is toxic to the imported honeybee (but not to native bees or butterflies). Other *Aesculus* are pollinated by bees (*A. turbinata* and *A. glabra* by bumblebees, Macior 1978), and the red flowers of *Aesculus pavia* are pollinated by hummingbirds in SE U.S.

(*Koelreuteria paniculata* little trees are becoming popular in Denver, but so far I have seen no butterflies on the beautiful yellow flowers.)

(*Sapindus saponaria* var. *drummondii* has white flowers but I saw no butterflies on them in one visit.

*Sapindus emarginatus* is visited by butterflies *Baoris zelleri* and *Euploea core* in India [Reddi and Bai 1984].)

#### RUTACEAE

*Ptelea trifoliata* occurs in SE Colorado, but the small greenish-white foul-smelling flowers are pollinated by carrion flies (Elias 1980). Rutaceae in general are pollinated by insects esp. bees and flies (Judd et al. 2008).

#### SIMAROUBACEAE

Simaroubaceae in general are pollinated by various insects (esp. bees) and birds (Judd et al. 2008).

(*Ailanthus altissima* trees have tiny yellowish-green flowers [the male flowers produce an unpleasant odor] and are frequent in towns but I have not seen butterflies on them. *A. altissima* is pollinated by large bees and honeybees [*Bombus*], flies [Anthomyiidae, Calliphoridae, Muscidae, Syrphidae, Tachinidae], and abundant cantharid beetles [*Chauliognathus marginatus*] that pollinate it, and numerous ants [*Formica*, *Prenolepis*, *Camponotus*] are not pollinators because they cannot travel from male to female trees [Thompson 2008; Aldrich et al. 2008].)

#### THYMELAEACEAE

(*Daphne Xburkwoodii* “Variegata” grows around some houses, but I have seen no butterflies on the pink flowers. *Daphne laureola* is pollinated by nitidulid beetles, solitary bees, and noctuid moths [Alonso 2004]).

#### MALVACEAE (includes Tiliaceae)

These flowers are showy but mostly unpopular. The flowers of *Tilia* trees are moderately popular especially to butterflies that can fly at tree height especially Nymphalinae and *Papilio*. Malvaceae in general are pollinated by bees wasps ants flies moths birds and bats (Judd et al. 2008). *Sida* and *Malvastrum* are pollinated by Andrenidae and Apidae bees (Morato and Antonio de O. Campos, 2000). *Abutilon indicum* is pollinated mostly by honeybees, *Bembix* wasps visited for nectar and pollen, while butterflies (*Pieris*, *Eurema*, *Anthocharis*, *Colotis*, “*Lycaena*” [actually a Polyommata blue resembling *Hemiargus* based on the photo], and *Danaus*) regularly visited the flowers but butterflies are “merely visitors as not a single pollen grain was found on their body parts” (Abid et al. 2010).

*Alcea=Althaea rosea* whitish?: *Euchloe ausonides ausonides* 1x. This common garden flower of many colors is mostly shunned. It is pollinated by honeybees.

(*Hibiscus syriacus* is cultivated in Denver, but is shunned. In Illinois a specialist bee *Ptilothrix bombiformis* [Apoidea] visits only *Hibiscus* flowers including *H. lasiocarpus*, and resembles a bumblebee. Hummingbirds pollinate some *Hibiscus*, while bumblebees and anthophorid bees pollinate *H. moscheutos* [Snow et al. 1996].)

*Malva neglecta* pinkish-white: *Chlosyne gorgone*, *Colias philodice*, *Pyrgus communis* 3x. *M. neglecta* can self-pollinate, and its pollen easily becomes airborne and spreads. Honeybees pollinate some *Malva* spp., and solitary bees visit.

*Malva sylvestris* pink: *Polites peckius*.

*Sidalcea malvaeflora* purple: *Pyrgus communis*.

*Sphaeralcea coccinea* orange: *Hemiargus isola*, *Pholisora catullus* 3x, *Pontia protodice*, *Pyrgus communis* 3x, *Strymon melinus*. This is pollinated by the bumblebee *Bombus huntii*, *Diadasia* bees and honeybees in Utah.

*Tilia* trees are sometimes visited by large butterflies that often fly at tree height.

*Tilia americana* yellowish-cream: *Asterocampa celtis jeffermont*, *Nymphalis antiopa*, *Polygonia interrogationis*, *Vanessa cardui*, *Epargyreus clarus* 2x, *Papilio glaucus rutulus* 2x, *Papilio multicaudata* 2x, *Vanessa atalanta* 6x. 66 species in 29 families of insects were identified as pollinators of the tiny flowers (which are evidently partially wind-pollinated); bees and flies were the most common diurnal visitors and moths the primary nocturnal visitors (Anderson 1976). Honeybees make great honey from *Tilia*.

*Tilia europaea* ochre: *Limenitis weidemeyerii*, *Nymphalis antiopa* 4x, *Papilio glaucus rutulus* 3x, *Papilio multicaudata* 4x (two briefly when flowers old), *Vanessa atalanta*, *Vanessa cardui* 2x.

#### BRASSICACEAE=CRUCIFERAE (includes Cleomaceae Capparaceae and Tropaeolaceae)

Most genera are only slightly attractive to butterflies, although *Barbarea* is popular, *Berteroa* and *Brassica* and *Raphanus* are moderately popular, and *Erysimum* is very popular. *Cleome* (sometimes placed into Cleomaceae) is moderately popular. Brassicaceae in general are pollinated by bees flies butterflies moths and beetles seeking nectar (by birds or bats in some tropical *Capparis* [which is often placed in the family Capparaceae]) (Judd et al. 2008). *Osmia* bees are good pollinators. The bee *Andrena arabis* specializes on Brassicaceae.

*Alyssoides utriculata* light-yellow: *Vanessa cardui*.

*Alyssum saxatile* yellow *Vanessa cardui* 4x. *Alyssum* “*Lobularia*” *maritimum* (white to yellow pink violet purple) is pollinated by bees so much that plantings help pollination of adjacent fruit trees; and in summer it is pollinated by ants as much as by flying insects. *Alyssum alyssoides* mostly selfs.

*Arabis divaricarpa* blue: *Hesperia uncas* 2x.

*Arabis fendleri*: (blue 1x + pinkish-white 1x) *Pontia sisymbrii*.

*Arabis glabra* pink-purple: *Pontia sisymbrii* 4x, *Euchloe ausonides coloradensis*.

*Arabis glabra* white: *Euchloe ausonides coloradensis* 5x. *A. glabra* is pollinated by insects and self-pollination. The bee *Andrena arabis* visits the flowers.

*Arabis pycnocarpa* “*hirsuta*” white: *Pontia sisymbrii* 2x.

*Arabis stricta* white: *Euchloe ausonides*, *Plebejus saepiolus*.

*Barbarea orthoceras* yellow is popular: *Aglais milberti* 9x, *Amblyscirtes phylace*, *Argynnis* (*Speyeria*) *coronis*, *Callophrys dumetorum homoperplexa* 3x, *Callophrys eryphon* 35x, *Callophrys polios* 2x, *Celastrina humulus* hop-ecotype 3x, *Celastrina humulus* lupine-ecotype 4x, *Celastrina lucia sidara* 14x, *Chlosyne gorgone* 12x, *Coenonympha tullia* 3x, *Colias scudderii*, *Erebia epipsodea* 12x, *Erynnis persius* 4x, *Erynnis telemachus* 10x, *Euchloe ausonides* 8x, *Euchloe olympia*, *Glaucopsyche lygdamus* 9x, *Glaucopsyche piasus* 5x, *Hesperia juba* 2x, *Phyciodes cocyta* 2x, *Phyciodes pallida* 2x, *Phyciodes pulchella camillus* 13x, *Pieris rapae* 6x, *Plebejus glandon*, *Plebejus melissa*, *Plebejus saepiolus*, *Polygonia faunus*, *Polygonia gracilis zephyrus* 4x, *Polygonia satyrus*, *Pyrgus centaureae* 2x, *Thorybes pylades*, *Vanessa cardui* 3x.

(*Barbarea vulgaris* is similar to *B. orthoceras* but is scarce in Colorado. It is pollinated by flies, bees, beetles, and self-pollination.)

*Berberoa incana* white is moderately popular: *Argynnis* (*Speyeria*) *zerene* 2x, *Cercyonis oetus* 23x, *Colias eurytheme*, *Colias philodice*, *Erynnis persius*, *Hemiargus isola*, *Hesperia comma*, *Lycaena rubidus* 4x, *Neophasia menapia*, *Ochlodes sylvanoides* 3x, *Phyciodes pulchella camillus* 2x, *Pieris rapae* 7x, *Plebejus alupini lutzii* 2x, *Plebejus melissa* 2x, *Polites sonora*, *Pontia callidice occidentalis* 2x, *Pontia protodice* 3x, *Satyrium behrii* 3x, *Satyrium saepium* 2x, *Strymon melinus*, *Vanessa atalanta* 2x, *Vanessa cardui*. *Berberoa incana* is pollinated by insects seeking nectar and/or pollen, primarily small ones including syrphid and other flies, wild bees, and wasps.

*Brassica nigra* yellow is moderately popular: *Argynnis* (*Speyeria*) *coronis snyderi*, *Coenonympha tullia californica* 23x, *Euchloe ausonides ausonides* 41x, *Junonia coenia* 119x, *Lycaena xanthoides nigromaculata*, *Papilio zelicaon* 2x, *Plebejus acmon*, *Satyrium sylvinus dryope*. Brassicaceae similar to *Brassica* yellow: *Satyrium auretorum*. Bumblebees reportedly buzz-pollinate *Brassica* (including cultivated *B. oleracea*), and *Osmia* bees and honeybees and alfalfa leafcutter bees also pollinate it, even *Calliphora* flies less well. Bees and syrphid flies are important pollinators of *Brassica napus* (Willmer 2011).

Brassicaceae: *Plebejus acmon*.

Brassicaceae white: *Glaucopsyche piasus*.

Brassicaceae yellow: *Argynnis* (*Speyeria*) *callippe* 2x, *Papilio zelicaon*, *Pontia sisymbrii* 3x.

(*Capsella bursa-pastoris* has small white flowers and is unpopular, and has no visits. It is mostly self-pollinated.)

*Cardamine cordifolia* white: *Argynnis* (*Speyeria*) *zerene* 2x, *Boloria eunomia*, *Boloria frigga* 3x, *Boloria titania* 4x (+ one only 3 sec), *Euchloe ausonides* 2x, *Pieris marginalis mcdunnoughii* 2x.

*Cardaria* (*Lepidium*) *latifolium* white: *Vanessa cardui*. *Cardaria draba* is reportedly pollinated by bees and other insects, and by self-fertilization.

(*Cardaria chalepensis* white is not visited. It often self-pollinates.)

*Chorispota tenella* purple-rose is common but unpopular: *Euchloe olympia* (pink flowers 4x, purple flowers 1x), *Pontia protodice* 2x.

*Cleome lutea* yellow: *Amblyscirtes nysa*, *Battus philenor* 2x, *Papilio polyxenes*. Honeybees help pollinate it. *Cleome* spp. are moderately popular.

*Cleome* (*Peritoma*) *serrulata* pinkish: *Argynnis* (*Speyeria*) *aphrodite?*, *Argynnis* (*Speyeria*) *nokomis*, *Callophrys gryneus siva*, *Cercyonis pegala* 2x, *Chlosyne gorgone*, *Colias eurytheme*, *Colias philodice* 2x, *Danaus plexippus* 2x, *Hesperia ottoe* Janet Chu, *Hesperia pahaska* 3x, *Hesperia viridis*, *Limenitis archippus* 2x, *Lycaena rubidus*, *Neophasia menapia* 3x, *Oarisma garita*, *Papilio machaon bairdii* 4x (+ pinkish 4x [incl. for form *hollandi* and f. *brucei*], whitish 1x), *Papilio zelicaon* (Scott and Scott 1978), *Pholisora mejicanus* briefly on, *Pieris rapae*, *Polites sabuleti*, *Pontia beckerii*, *Pontia callidice occidentalis* 2x, *Pontia protodice* 7x, *Satyrium titus* 2x, *Vanessa cardui*. This *Cleome* is pollinated by bees (Dodson and Dunmire 2007).

*Descurainia* is unpopular.

*Descurainia pinnata* yellow: *Pontia protodice*, *Vanessa cardui*.

*Descurainia sophia* yellow: *Hesperia pahaska*.

*Draba lanceolata* white: *Boloria freija*.

*Draba stenoloba?* yellow: *Euchloe ausonides*.

*Draba* yellow: *Colias philodice*, *Cupido amyntula*, *Euchloe olympia*.

*Erysimum* is popular:

*Erysimum asperum* yellow: *Aglais milberti*, *Amblyscirtes aenus*, *Argynnis* (*Speyeria*) *callippe*, *Atrytonopsis hianna hianna* 7x, *Callophrys gryneus siva*, *Chlosyne acastus arkanyon* 4x, *Chlosyne gorgone* 2x, *Colias alexandra*, *Colias edwardsii altiplano* 4x, *Colias philodice* 2x, *Erynnis brizo*, *Erynnis horatius*, *Euchloe olympia* 10x, *Euptoieta claudia* 5x, *Glaucopsyche lygdamus*, *Hesperia pahaska* 10x, *Hesperia uncas* 4x, *Notamblyscirtes simius* 1x, *Papilio indra* 2x, *Papilio polyxenes* 2x, *Papilio zelicaon*, *Phyciodes pulchella camillus*, *Plebejus melissa*, *Polites* (*Yvretta*) *rhesus* 39x, *Pontia protodice*, *Pyrgus communis* 4x, *Vanessa*

*cardui* 15x. *Erysimum* is pollinated by numerous insects (visited by more than 100 species in Spain), including bees, syrphid and other flies, beetles, ants, butterflies.

*Erysimum capitatum* usually orange sometimes yellow: *Argynnis (Speyeria) aphrodite* (yellow), *Argynnis (Speyeria) callippe* (yellow 2x, orange 9x), *Argynnis (Speyeria) coronis* (yellow 2x, orange 6x), *Argynnis (Speyeria) edwardsii* (yellow + 1 sec twice), *Argynnis (Speyeria) edwardsii* (16x + one red-orange), *Coenonympha tullia*, *Colias alexandra* 2x, *Colias eurytheme* (1 yellow, 2 orange), *Colias philodice* (yellow 1x, orange ½ sec. 2x), *Erynnis brizo* (orange–yellow), *Erynnis martialis* (orange 1x, yellow 2x), *Erynnis pacuvius* (yellow), *Erynnis persius*, *Erynnis telemachus* 2x, *Euchloe ausonides* 12x (orange except 1 yellow-orange and 1 yellow), *Euchloe olympia* (yellow) 6x, *Euchloe olympia* 3x, *Euphydryas anicia capella* (orange 5x, yellow 2x); *Euptoieta claudia* (yellow, orange) 2x, *Hesperia juba*, *Hesperia nevada* (usually orange) 52x, *Papilio eurymedon* 4x (2 orange, 1 yellow), *Papilio indra* (orange 14x, yellow-orange 2x, yellow 4x), *Papilio multicaudata* 4x, *Papilio polyxenes* 8x, *Papilio zelicaon* (yellow 4x + 8x f. nitra), *Papilio zelicaon* (7x + 2x f. nitra), *Parnassius phoebus smintheus* (orangish-yellow) 3x, *Phyciodes cocyta*, *Phyciodes pulchella camillus* 2x, *Poladryas minuta arachne* (1x + yellow 1x), *Polites draco* (yellow 1x, orange) 3x, *Polygonia gracilis zephyrus* (yellow), *Stinga morrisoni* (yellow), *Vanessa cardui* (orange 6x, yellow 3x).

*Hesperis matronalis* pink is not very popular in my back yard: *Papilio eurymedon*, *Papilio glaucus rutulus* 2x, *Papilio multicaudata* 21x (but 4 were only 1 sec. and two were 2 sec.), *Pieris rapae* 30x (+ several only 3 sec.), *Poanes taxiles*, *Polites peckius*, *Pontia protodice* 4x, *Strymon melinus* 1x (+another only 2 sec.), *Vanessa cardui* 4x. It is pollinated predominantly by bumblebees (*Bombus*) and honeybees and syrphid flies (80% of visitors in Pennsylvania and Ohio), with occasional visits by butterflies and crepuscular moths (Majetic et al. 2009) and is partially self-compatible. In Illinois it is visited by butterflies such as pierid and moths, syrphid flies (including long-proboscis *Rhingia*) and Soldier flies, halictid and andrenid bees, and honeybees (Hilty 2013; this site claims that butterflies and moths pollinate because other insects have mouthparts that are too short so they are attracted to pollen [but pollen visitors surely pollinate also]).

*Hesperis matronalis* var. *alba* white: *Argynnis (Speyeria) edwardsii*, *Epargyreus clarus*.

*Lepidium campestre* white is very common but is seldom visited: *Euchloe olympia*, *Glaucopsyche lygdamus*, *Pieris rapae* 4x, *Pontia protodice* 5x, *Vanessa virginiensis*. This species mainly self-pollinates, but occasionally is pollinated by flies. *Lepidium meyenii* also self-pollinates. *Lepidium papilliferum* is visited by 25 insect families of 5 orders, and the most likely pollinators are bees (Apidae, Colletidae, Halictidae).

*Lepidium eastwoodiae* white: *Hesperia uncas tomichi* ½ sec.

*Lepidium montanum* white: *Chlosyne gorgone*, *Neophasia menapia*, *Pieris rapae*, *Pontia protodice* 2x incl. "Lepidium white tall".

*Lepidium ?ramosissimum* white: *Pieris rapae*.

*Lepidium virginicum* white: *Lycaena helloides* 6x, *Pieris rapae*.

*Lesquerella* yellow: *Callophrys sheridanii paradoxa*. *Lesquerella* is pollinated most commonly by bees and flies (Rollins and Shaw 1973).

*Lesquerella montana* yellow is moderately popular: *Argynnis (Speyeria) coronis*, *Callophrys dumetorum homoperplexa* 2x, *Callophrys mossii schryveri*, *Callophrys sheridanii*, *Celastrina lucia sidara*, *Chlosyne gorgone* 2x, *Coenonympha tullia* 7x, *Colias philodice* 5x, *Erynnis afranius* 2x, *Erynnis brizo* 5x, *Erynnis martialis* 4x, *Erynnis pacuvius* 4x, *Erynnis persius* 16x, *Erynnis telemachus* 5x, *Euchloe ausonides*, *Euchloe olympia* 16x, *Euphydryas anicia capella*, *Euptoieta claudia* 3x, *Glaucopsyche lygdamus* 3x, *Hemiargus isola*, *Oarisma edwardsii*, *Papilio indra*, *Parnassius phoebus smintheus* 2x, *Phyciodes pulchella camillus*, *Pieris rapae*, *Plebejus melissa* 2x, *Pontia sisymbrii*, *Stinga morrisoni* 2x, *Strymon melinus*, *Vanessa cardui*.

*Lesquerella parvula* yellow: *Euphydryas editha*.

*Lobularia maritima* "blue Alyssum": *Pyrgus communis*. This *Lobularia* is visited by 50 species of insects, especially ants (*Camponotus micans* and three other sp., Formicidae) that pollinated the flowers just as much as all winged insects put together, and bees (Halictidae, Eumenidae) wasps (Tenthredinidae,

Vespidae, Ichneumonidae, Chalcididae), flies (11 families), Lycaenid butterflies, beetles (7 families), but the flowers visited only by winged visitors set no more seed than self-pollination (Gomez 2000).

mustard (usually white tiny flowers): *Aglais milberti*, *Celastrina lucia sidara* “mustard” Janet Chu, *Glaucopsyche lygdamus* white and yellow Janet Chu, *Nymphalis antiopa*, *Polygonia gracilis zephyrus*, *Polygonia satyrus*.

*Nasturtium officinale* white is only slightly popular: *Adopaeoides prittwitzii* many, *Cercyonis pegala* Janet Chu, *Chlosyne leanira fulvia*, *Euphydryas chalcedona mcglashani-wheeleri*, *Lethe eurydice*, *Pieris rapae* 23x, *Piruna pirus*, *Vanessa cardui*. Reportedly pollinated by bees (including honeybees), flies, and self-pollination.

*Physaria vitulifera* yellow: *Erynnis persius*, *Euchloe olympia*, *Glaucopsyche lygdamus* 2x. *Physaria filiformis* pollen carriers were 38 species of bees (Andrenidae [*Andrena* 8 sp.], Apidae [honeybees, *Bombus griseocollis*, *Ceratina* 5 sp.], Colletidae [*Hylaeus* 4 sp.], Halictidae [*Agapostemon texanus*, *Augochlora* 3 sp., *Augochloropsis fulgida*, *Halictus* 3 sp., *Lasioglossum* 11 sp.], Megachilidae [*Osmia* 2 sp., *Hoplitis simplex*]), several syrphid flies and a calliphorid fly, Lepidoptera (the butterflies *Callophrys* “*Mitoura*” *gryneus*, *Junonia coenia*, the diurnal moth *Alypia octomaculata*) while mordellid beetles that visited had no pollen (Edens-Meier et al 2011). *Physaria obcordata* visitors are generalist insects including Tachinid flies (*Gonia*), but the primary visitors are ground-nesting solitary bees (Andrenidae and Halictidae), and only two bee species were likely mustard specialists.

(*Polanisia dodecandra* whitish: I have not seen enough *Polanisia* to assess its popularity, but it is reported to be popular in south Texas, where it is pollinated by bees and butterflies and visited by many species of butterflies.)

*Raphanus sativus* bluish-white is moderately popular: *Copaeodes aurantiaca* 3x, *Erynnis tristis tatus*, *Euchloe ausonides ausonides* 26x, *Eurema nicippe*, *Junonia coenia* 3x, *Neophasia menapia*, *Papilio zelicaon*, *Pieris rapae* 6x, *Pontia callidice occidentalis*, *Pyrgus (communis?) albescens*, *Vanessa cardui* common, *Vanessa carye* 2x, *Vanessa virginiensis* 2x. Many insects visit the flowers of this (including its wild weedy progenitor *Raphanus* variety “*raphanistrum*”), but Lathri and Barrows (1984) found *Pieris rapae* butterflies transported pollen of *Raphanus* enough to evidently pollinate it, and Kay (1976) found that *Pieris* and *Eristalis* flies pollinated it sometimes and preferred yellow flowers (rather than white or pink or bronze flowers) (honeybees were the major pollinators with 90% of the visits, and honeybees preferred yellow or white flowers, while syrphid flies preferred pink ones, Stanton 1987). *Raphanus* “*raphanistrum*” is pollinated by *Pieris rapae*, honeybees, many small solitary bees and syrphid flies (Koelling and Karoly 2007).

*Rorippa sinuata* yellow: *Argynnis (Speyeria) edwardsii*, *Colias philodice* 2x, *Hemiargus isola*, *Phyciodes pulchella camillus*, *Plebejus melissa*, *Pyrgus communis* 2x, *Vanessa atalanta* 2x, *Vanessa cardui* 2x. *Rorippa palustris* is pollinated by tiny flower flies in Finland.

*Schoenocrambe linifolia* yellow: *Callophrys gryneus siva*, *Chlosyne acastus arkanyon* 18x.

*Sisymbrium altissimum* yellow: *Cercyonis oetus*, *Colias alexandra*, *Oarisma garita*, *Phyciodes pallida*, *Pieris rapae* 7x, *Pyrgus communis*. This is pollinated by insects.

*Thlaspi* is very common but not very popular.

*Thlaspi arvense* white: *Callophrys dumetorum homoperplexa* landed 2x but I didn’t see proboscis, *Callophrys augustinus*, *Callophrys sheridanii* 2x, *Erynnis afranius*, *Erynnis pacuvius*, *Erynnis persius* 4x, *Euchloe ausonides*, *Euchloe olympia* 6x, *Glaucopsyche lygdamus* 17x, *Hemiargus isola* 10x, *Pieris rapae*, *Pontia sisymbrii* 18x, *Vanessa cardui* 4x.

*Thlaspi (Noccaea) fendleri* “*montanum*” white: *Callophrys eryphon*, *Callophrys sheridanii* 4x, *Celastrina lucia sidara* 3x, *Chlosyne gorgone*, *Cupido amyntula*, *Erynnis persius*, *Euphydryas anicia brucei* 2x, *Euptoieta claudia*, *Glaucopsyche lygdamus* 2x, *Phyciodes pulchella camillus*, *Polygonia gracilis zephyrus*, *Pontia sisymbrii* 5x, *Vanessa atalanta*, *Vanessa cardui*. The similar *Thlaspi* “*alpestre*” [true *alpestre* is European] is pollinated by bees and flies, and self-pollination. In the Colorado alpine zone, *Thlaspi montanum* “*alpestre*” pollen-carrying visitors were the chrysomelid beetle *Phyllotreta albionica* most often, the ant *Formica neorufibarbis* often, the muscid fly *Quadrularia laetifica* sometimes, and

other insects sometimes, and it often self-pollinates (Petersen, 1977); elsewhere bees and flies reportedly pollinate it and it selfs.

(*Tropaeolum majus* [sometimes placed in Tropaeolaceae] is a garden plant with pretty flowers of all colors, but I have seen no butterflies on it. It is pollinated by hummingbirds in native habitats. The sphingid moth *Hyles lineata* visits it. *Tropaeolum tricolor* is pollinated by the hummingbird *Sephanoides sephanoides* in Chile.)

#### SANTALACEAE (includes Viscaceae)

This family of mostly parasitic plants is mostly shunned by butterflies.

(*Arceuthobium* are probably shunned by butterflies as they have ugly tiny flowers. Penfield et al. [1976] found that pollination is done both by insects and wind; they found 200 sp. of insects bearing *Arceuthobium* pollen, the principle pollinators being the ant *Formica fusca* for *Arceuthobium americanum*, and an encyrtid wasp *Copidosoma bakeri* for *Arceuthobium cryptopodum* and *A. cyanocarpum*.)

*Comandra umbellata* whitish is common but unpopular: *Erynnis persius*, *Callophrys dumetorum homoperplexa* 2x, *Callophrys gryneus siva*, *Euptoieta claudia* 2x, *Phyciodes pulchella camillus*. It is pollinated by long- and short-tongued bees, and by Diptera.

*Phoradendron* flowers are also tiny and ugly yet Bright and Ogard (2010) observed *Atlides halesus* feed on them in Alabama. *Phoradendron serotinum* is pollinated by wasps bees and possibly ants.

*Phoradendron leucarpum* nectar is used by bees, and the flowers are also pollinated by ants flies and beetles.

#### TAMARICACEAE

*Tamarix chinensis*=*ramosissima* pink (some rosy-white) is very popular where it occurs along drainages in S and W Colo: *Cercyonis pegala* 30x, *Danaus gilippus*, *Epargyreus clarus*, *Hesperia uncas*, *Limenitis archippus*, *Lycaena heteronea*, *Satyrium acadica*. The flowers have nectar, and bloom for months, and are pollinated by bees (it makes good honeybee honey) and other insects and Lepidopera (butterflies evidently).

#### POLYGONACEAE

*Eriogonum* species are popular. They attract many butterfly species, and are almost the sole adult foods of *Euphilotes* species and *Apodemia* “*mormo*” species whose larvae feed only on *Eriogonum* (*Plebejus acmon* and *P. alupini* larvae mostly eat *Eriogonum* but adults visit many flowers). *Eriogonum*, *Fagopyrum*, and *Polygonum* have exposed floral nectaries that are easily accessible. *Polygonum* is moderately popular. *Rheum* and *Rumex* have inconspicuous wind-pollinated flowers that are shunned. Polygonaceae in general are pollinated by insects especially bees and flies, while *Rumex* is wind-pollinated (Judd et al. 2008).

(*Eriogonum kennedyi* is reportedly usually pollinated by bees, and flies wasps and butterflies also carry a few grains of pollen. *Eriogonum pelophilum* is visited by over 50 insect species, mostly native bees, and 18 native ants.)

*Eriogonum* (bluish-gray with no or small leaves, bushy 1.5’ tall) white: *Apodemia mormo mormo*, *Euphilotes rita emmeli*.

*Eriogonum alatum* has tiny yellowish flowers that are not popular: *Strymon melinus* (ovipositing?).

*Eriogonum annuum* whitish: *Plebejus alupini texanus* 2x.

*Eriogonum brevicaulis* yellow: *Argynnis (Speyeria) zerene*, *Hesperia comma* 3x, *Plebejus alupini texanus*, *Plebejus melissa*, *Pyrgus communis*.

*Eriogonum compositum* cream “dense *Eriogonum* vaguely like *effusum*”: *Apodemia mormo mormo* 11x, *Argynnis (Speyeria) zerene picta*, *Coenonympha tullia ampelos* few, *Heliopetes ericetorum* 3x, *Hesperia comma*, *Hesperia juba*.

*Eriogonum corymbosum* var. *velutinum* whitish: *Hemiargus isola*, *Plebejus alupini texanus*, *Strymon melinus*, *Euphilotes battoides (ellisii) anasazi* many. Reportedly pollinated by bees.



*Eriogonum corymbosum* var. *orbiculatum* white: *Apodemia mormo mormo* 12x.

*Eriogonum corymbosum* whitish: *Euphilotes battoides ellisii* many.

*Eriogonum effusum* white: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) edwardsii*, *Cercyonis pegala* 2x, *Chlosyne gorgone*, *Colias eurytheme*, *Colias philodice*, *Cupido amyntula*, *Euphilotes rita coloradensis* 30x, *Euptoieta claudia* 2x, *Hesperia comma* 8x, *Hesperia leonardus pawnee* raiting=perching?, *Phyciodes pulchella camillus* 3x, *Plebejus alupini texanus* 59x, *Plebejus icarioides*, *Plebejus melissa* 5x, *Poladryas minuta arachne*, *Pontia protodice*, *Pyrgus communis*, *Satyrium saepium*, *Strymon melinus* 17x.

*Eriogonum fasciculatum* var. *polifolium* whitish: *Euphilotes bernardino martini* many. This is pollinated by honeybees and many species of small native bees, flies, wasps, and beetles.

*Eriogonum flavum* var. *chloranthum* cream: *Plebejus alupini cotundra*, *Plebejus shasta pitkinensis*, *Strymon melinus*.

*Eriogonum flavum* (=E. *jamesii* var. *flavescens*) yellow: *Apodemia nais* 2x, *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) callippe* 20x, *Argynnis (Speyeria) hesperis* 8x, *Asterocampa celtis jeffermont*, *Atrytone arogos*, *Callophrys dumetorum homoperplexa*, *Callophrys gryneus siva* 2x, *Cercyonis oetus* 21x, *Chlosyne gorgone* 2x, *Euphilotes ancilla barnesi* 2x, *Euphydryas anicia capella* 3x, *Euptoieta claudia* 3x, *Hesperia comma* 3x, *Hesperia pahaska*, *Lycaena heteronea* 29x, *Neominois ridingsii* 2x, *Ochlodes sylvanoides*, *Papilio polyxenes*, *Parnassius phoebus smintheus*, *Phyciodes pulchella camillus* 2x, *Plebejus alupini lutzi*, *Plebejus melissa*, *Plebejus shasta minnehaha* 3x, *Polygonia gracilis zephyrus*, *Satyrium behrii* 8x, *Satyrium californica*, *Satyrium saepium* 55x, *Satyrium titus* 16x, *Strymon melinus* 9x.

*Eriogonum heermannii* var. *humilius* white: *Euphilotes battoides (ellisii) basinensis* 2x.

*Eriogonum incanum* yellow: *Euphilotes enoptes enoptes*.

*Eriogonum jamesii* cream: *Apodemia mormo pueblo* ~49x, *Euphilotes glaucon centralis* 24x, *Euphilotes spaldingi pinjuna*, *Lycaena arota* 97x, *Paratrytone snowi* 4x, *Plebejus alupini ?texanus*, *Satyrium behrii*, *Satyrium californica*, *Strymon melinus*, *Vanessa cardui*.

*Eriogonum kearneyi* var. *kearneyi* whitish: *Euphilotes rita pallescens*.

*Eriogonum latifolium* whitish: *Apodemia mormo langei*, *Euphilotes enoptes bayensis* abundant, *Hylephila phyleus*, *Junonia coenia* 16x, *Lerodea eufala*, *Papilio zelicaon*, *Plebejus acmon* 12x, *Strymon melinus* 4x.

*Eriogonum leptocladon*: *Euphilotes rita emmeli* (var. *leptocladon* yellow many visits, var. *ramosissimum* white several).

*Eriogonum leptophyllum* whitish: *Hesperia viridis*.

*Eriogonum* like *E. shockleyi* 1" cream balls with gray spoonlike leaves: *Euphilotes glaucon*.

*Eriogonum lobbii* var. *robustius* cream: *Aglais milberti*, *Argynnis (Speyeria) callippe nevadensis*, *Argynnis (Speyeria) zerene malcolmi*, *Callophrys eryphon*, *Colias alexandra*, *Cupido amyntula*, *Euphilotes ancilla gilvatunica*, *Hesperia comma* abundant, *Plebejus acmon* many, *Plebejus icarioides*, *Satyrium behrii* several, *Satyrium californica*.

*Eriogonum lonchophyllum* var. *lonchophyllum* whitish/cream: *Apodemia mormo mormo* many, *Hesperia nevada*, *Hesperia uncas tomichi* 22x, *Neominois ridingsii* 6x, *Papilio glaucus rutulus*, *Plebejus alupini texanus* 2x, *Pontia beckerii* 10x, *Satyrium behrii* 2x, *Strymon melinus* 2x.

*Eriogonum marifolium* yellow: *Plebejus alupini alupini*, *Vanessa cardui*.

*Eriogonum nudum* yellowish: *Euphilotes enoptes enoptes* 12x.

*Eriogonum ~nudum ~yellowish* ½ m tall: *Euphilotes battoides intermedia* many, *Plebejus alupini alupini* many.

*Eriogonum ovalifolium* var. *ovalifolium* pinkish or cream: *Callophrys gryneus siva*, *Euphilotes ancilla stanfordorum* 6x.

*Eriogonum racemosum* cream: *Euphilotes spaldingi pinjuna*.

*Eriogonum subalpinum* [pinkish]-cream is very popular: *Argynnis (Speyeria) callippe* 4x, *Argynnis (Speyeria) callippe calgariana*, *Argynnis (Speyeria) mormonia*, *Argynnis (Speyeria) zerene platina*, *Cercyonis oetus*, *Callophrys dumetorum affinis* 2x, *Callophrys spinetorum* 3x, *Chlosyne palla flavula*, *Coenonympha tullia*, *Erebia epipsodea* 4x, *Euphilotes ancilla ancilla* 5x, *Euphilotes ancilla barnesi* 5x, *Euphydryas bernadetta rorina* 2x, *Euphydryas editha lehmani*, *Hesperia nevada* 3x, *Lycaena florus* 9x,

*Lycaena heteronea heteronea* 25x, *Neominois ridingsii*, *Oarisma garita* 14x, *Oeneis calais altacordillera* often, *Oeneis uhleri* 2x, *Parnassius phoebus smintheus*, *Phyciodes pulchella camillus* 6x, *Pieris marginalis mcdunnoughii*, *Plebejus alupini lutzi* 15x, *Plebejus glandon* 4x, *Plebejus icarioides* 45x, *Plebejus melissa*, *Plebejus saepiolus* 2x, *Polites draco* 4x, *Satyrium californica* 48x, *Satyrium fuliginosum* 24x.

*Eriogonum* tiny white flowers: *Euphilotes enoptes enoptes*.

*Eriogonum umbellatum* var. *furcosum* yellow: *Euphilotes battoides comstocki*, *Plebejus chlorina monticola*.

*Eriogonum umbellatum* yellow is very popular: *Argynnis (Speyeria) aphrodite* some, *Argynnis (Speyeria) callippe* 8x, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) zerene*, *Callophrys dumetorum homoperplexa* 5x, *Callophrys gryneus siva* 10x incl. Janet Chu, *Callophrys sheridanii* 2x, *Cercyonis oetus* 19x incl. Janet Chu, *Chlosyne gorgone* 3x, *Chlosyne nycteis* 2x, *Coenonympha tullia* 6x, *Colias eurytheme* 2x, *Erynnis martialis*, *Erynnis persius* 3x, *Euphilotes ancilla barnesi* 100x, *Euphilotes battoides intermedia* 2x, *Euphilotes glaucon glaucon*, *Euphilotes glaucon hadrocheilus*, *Euphydryas anicia capella* 19x, *Euphydryas bernadetta rorina*, *Euphyes vestris* 2x, *Glaucopsyche lygdamus*, *Glaucopsyche piasus* 2x, *Hemiargus isola* 2x, *Hesperia comma* 4x, *Hesperia juba*, *Hesperia leonardus pawnee*, *Hesperia pahaska*, *Hesperia viridis*, *Leptotes marina*, *Lycaena helloides*, *Lycaena heteronea* 60x [incl. Janet Chu] and var. *porteri* 1x, *Lycaena rubidus*, *Lycaena xanthoides editha*Xxanthoides = "pseudonexa", *Neominois ridingsii*, *Nymphalis californica*, *Oarisma garita* 2x, *Oeneis chryxus* ~5x 12 minutes, *Papilio zelicaon*, *Parnassius phoebus smintheus* 4x, *Phyciodes batesii anasazi*, *Phyciodes cocyta* 3x, *Phyciodes pallida*, *Plebejus alupini alupini* 2x, *Plebejus alupini lutzi* 11x, *Plebejus alupini texanus*, *Plebejus glandon* 10x, *Plebejus icarioides* 9x, *Plebejus melissa* 5x, *Plebejus shasta minnehaha*, *Poladryas minuta arachne* 2x, *Polites mystic*, *Polygonia gracilis zephyrus*, *Pontia protodice* 3x, *Pyrgus communis*, *Satyrium behrii* 28x, *Satyrium fuliginosum* 22x, *Satyrium saepium* 31x, *Satyrium titus* 9x, *Strymon melinus* 9x, *Thorybes pylades* 2x, *Vanessa atalanta* 2x, *Vanessa cardui* 4x, *Vanessa virginiensis* 2x. It is reportedly pollinated by bees and other insects, surely sometimes by butterflies.

*Eriogonum* white (bluish-gray with no or small leaves, bushy 1.5' tall): *Apodemia mormo mormo*.

*Eriogonum wrightii* white: *Apodemia mormo mormo* 18x, *Apodemia virgulti duryi* several, *Apodemia palmerii*, *Euphilotes rita rita* 3x, *Plebejus alupini texanus* 32x.

*Fagopyrum esculentum* white: *Vanessa virginiensis* (P. Allen Smith TV show). These buckwheat flowers are pollinated mainly by honeybees, plus *Bombus* and Syrphidae (Cawoy et al. 2009).

*Polygonum* is moderately popular.

*Polygonum amphibium coccineum* pink: *Danaus plexippus* 2x, *Euptoieta claudia*, *Lycaena helloides* 85x, *Lycaena hyllus* 11x, *Pieris rapae*, *Satyrium acadica*, *Strymon melinus* 5x.

*Polygonum (Bistorta) bistortoides* whitish: *Boloria alaskensis halli* sometimes, *Boloria eunomia* 16x, *Boloria frigga*, *Boloria improba harryi*, *Boloria titania* 10x, *Chlosyne whitneyi damoetas* (whitish-pink) only 1/3 sec., *Colias scudderii*, *Erebia epipsodea* 3x, *Parnassius phoebus smintheus* (photo Dodson and Dunmire 2007), *Plebejus glandon* 3x, *Plebejus saepiolus* 2x, *Pyrgus centaureae* 2x. This is self-incompatible, and is pollinated by bumblebees (Aluri and Robart 1991).

*Polygonum pensylvanicum* pink: *Atalopedes campestris*, *Chlosyne gorgone* 2x, *Colias philodice*, *Junonia coenia*, *Lerodea eufala* ~5x, *Limenitis archippus*, *Lycaena helloides* 6x, *Ochlodes sylvanoides* several, *Ochlodes yuma* 3x, *Pieris rapae* 11x, *Plebejus acmon*, *Polites sabuleti*, *Vanessa cardui*. This species commonly self-pollinates. In the northern Cascade Mts. the prostrate small-open-flowered *Polygonum cascadenense* is pollinated by ants.

*Polygonum ?pensylvanicum* pink S Ariz.: *Apyrrothrix araxes* 4x, *Codatractus arizonensis* some, *Codatractus valeriana*, *Cogia hippalus* several, *Copaeodes aurantiaca* several, *Emesis zela*, *Erynnis tristis tatius*, *Hemiargus ceraunus gyas* some, *Hemiargus isola*, *Hesperia pahaska* 2x, *Leptotes marina*, *Libythea carinenta bachmanii*, *Microtia dymas* some, *Microtia (Texola) elada* many, *Ministrymon leda* many, *Polites (Yvretta) carus*, *Pyrgus philetas* some, *Staphylus ceos* 2x.

(*Polygonum [Bistorta] viviparum* has tiny white flowers and is not visited. In North America and Colorado it reproduces only by bulbils (bulblets growing within the inflorescence) because the fertilization process is defective and embryos abort [Diggle et al. 2002].)

(*Rheum rhaponticum* [rhubarb] has tiny ugly wind-pollinated flowers [with no records, although a visit by *Celastrina ~neglecta* is recorded in eastern U.S.], although *Calliphora* blowflies are sometimes used to pollinate it in greenhouses.)

(*Rumex* spp. have inconspicuous ugly wind-pollinated flowers that are not visited.)

## PLUMBAGINACEAE

*Ceratostigma plumbaginoides* violet. I have seen very few bushy plants in gardens, but they were popular: *Poanes taxiles* 2x, *Polites peckius*, *Vanessa cardui* 2x.

*Limonium latifolium* (which looks like a wispy *Eriogonum*) violet-blue tiny flowers in gardens are popular for tiny lycaenids: *Hemiargus isola* 6x, *Pontia protodice*. This is pollinated by bees (*Bombus terrestris*, *B. hortorum*, and *Melithreptus*) and probably tiny parasitoid wasps. Elsewhere, *Limonium vulgare* is self-pollinated, and sometimes pollinated by bees (including bumblebees *Bombus lucorum* and *B. lapidarius*) and flies; *Limonium otolepis* primary pollinators are bees and hoverflies (Huang et al. 2012).

## CARYOPHYLLACEAE (includes Alsinaeae)

In general these plants are not popular, but *Cerastium* and *Silene* are fairly popular, cultivated *Lychnis* is visited by some Hesperinae, and *Arenaria (Eremogone)* has some visits. Caryophyllaceae in general are pollinated by insects (flies, bees, butterflies, moths) (Judd et al. 2008).

*Arenaria (Eremogone) fendleri* white: *Argynnis (Speyeria) mormonia*, *Oeneis polixenes*, *Parnassius phoebus smintheus* 2x. *Arenaria uniflora* and *A. glabra* have nectar-rich flowers that are pollinated by generalist flies (Syrphidae, Bombyliidae), small bees (Halictidae) and honeybees, and *A. uniflora* self-pollinates where it overlaps the range of *A. glabra* (Fishman and Wyatt 1999).

*Cerastium strictum* "arvense" white is moderately popular: *Callophrys augustinus*, *Callophrys mossii schryveri*, *Callophrys sheridanii* 4x, *Celastrina humulus* hop-ecotype landed on and flew, *Celastrina lucia sidara* 3x, *Chlosyne gorgone* 5x, *Coenonympha tullia* 12x, *Cupido amyntula* 2x, *Erebia epipsodea* 5x, *Erynnis brizo*, *Erynnis icelus* 2x, *Erynnis martialis* 3x, *Erynnis pacuvius*, *Erynnis persius* 5x, *Erynnis telemachus* 3x, *Euchloe ausonides* 9x and 2 sec., *Euchloe olympia* 2x, *Euchloe olympia* 36x, *Euphydryas anicia capella*, *Glaucopsyche lygdamus*, *Nathalis iole*, *Oarisma garita* 5x, *Ochlodes sylvanoides*, *Phyciodes pulchella camillus*, (*Pieris rapae* did not land on it), *Plebejus alupini lutzi*, *Plebejus glandon* (? tiny leaves), *Pontia sisymbrii*. *Cerastium strictum* is reported to be pollinated by bees, and flies such as bombyliids.

*Dianthus barbatus* is not popular: *Papilio multicaudata* (orange flower), *Poanes taxiles* (orange), *Papilio polyxenes* (red flowers 3x), *Vanessa cardui* (red flower). *Dianthus* have a leathery calyx to prevent nectar-robbing by hole-chewing. Some *Dianthus* are reportedly pollinated by butterflies (and honeybees): *Dianthus carthusianorum* red is pollinated by the butterflies *Satyrus ferula* and *Melanargia galathea*, also by *Ochlodes venatus*, *Thymelicus* and other butterflies and zygaenid and sphingid moths (Bloch et al. 2006); *Dianthus deltooides* red is pollinated by butterflies (Jennersten 1984) including *Ochlodes venatus*, *Thymelicus lineola*, and also by syrphid flies. Elsewhere, *Dianthus sylvestris* is pollinated by nocturnal moths (*Hadena compta* primarily, whose caterpillars eat the seeds), and also by the sphingid moth *Herse convolvuli*, *Macroglossum stellatarum* bees, and syrphid flies. *Dianthus gratianopolitanus* is pollinated mainly by the sphingid *Macroglossum stellatum* in Europe (Erhardt 1990).

*Dianthus* "Pink Delight" pink: *Vanessa carye*.

(*Gypsophila paniculata* white is uncommon but I have seen no visits [*Polites* ignore it, etc.]. It is visited by numerous small insects and predominantly pollinated by bees and flies (Darwent and Corpland 1966.)

*Lychnis coronaria* red is not very attractive though *Polites peckius* visits it somewhat: *Papilio multicaudata* 3x (all 1 sec., not very attractive in scent or nectar evidently), *Poanes taxiles* 4x, *Polites peckius* 12x, *Polites themistocles*. (This is visited by bees, flies, butterflies, and moths, and mosquitoes etc. and at least the bees surely pollinate it. *Lychnis flos-cuculi* is pollinated by *Bombus lapidarius*, also by *Rhingia*

*campestris* and the noctuid moth *Hadena bicruris*, and is visited occasionally by the butterfly *Pieris napi*. Aphids pollinate some *Lychnis* spp.)

(*Paronychia pulvinata* and *P. jamesii* have tiny yellowish flowers and have no records. *Paronychia pulvinata* is an alpine cushion plant that in the Cascade Mts. is pollinated by ants [*Formica neorufibarbis gelida*] that harvest nectar and lipids and pollinate on 45% of their visits [Puterbaugh 1998]. Other *Paronychia* spp. are visited by *Dialictus* bees [*P. chartacea* by *D. miniatulus*, *D. nymphalis*, and *D. placidensis*; *Paronychia herniarioides* by *D. nymphalis*; *Paronychia americana* by *D. nymphalis* and *D. placidensis*].)

*Pseudostellaria* “*Stellaria*” *jamesiana* white: *Erynnis persius*, *Erynnis telemachus*.

*Saponaria officinalis* pinkish (white to pink) is not popular: *Papilio multicaudata* 4x (one on var. *caucasica*). This is pollinated at night primarily by the noctuid moth *Autographa gamma*, also by the noctuid *Hadena bicruris*; its nectar production is greatest at night and it gets few daytime visits. But *Autogramma* is a very ineffective pollinator, and up to 5% of visitors were sphingid moths which produced higher seed set (Wolff et al. 2006).

*Silene acaulis* pink/purplish is moderately popular: *Boloria improba acrocneuma* 3x (Scott 1982), *Boloria improba harryi* 4x, *Chlosyne whitneyi damoetas* 4x, *Erebia magdalena* 11x, *Euphydryas anicia brucei* 3x, *Vanessa cardui* 19x. This is an alpine/arctic plant, which is pollinated also by bumblebees *Bombus lapidarius*, butterflies, flies, moths and beetles. Andersson (2006) noted it is butterfly pollinated in northern Sweden, and noted other reports of pollination by bumblebees and flies. There is considerable research on pollination of other *Silene* (see Kephart et al. 2005). Several showier *Silene* such as *Silene virginica* are pollinated by hummingbirds (Grant 1994), many are pollinated by bumblebees (sometimes honeybees), several are pollinated by flies, and several by selfing. And the night-bloomer *Silene latifolia* is mostly pollinated by the noctuid moth *Hadena bicruris* (whose caterpillars eat the seeds of *S. latifolia*) and by sphingid moths and the geometrid moth *Perizoma* (*S. vulgaris* and *S. alba* are similarly pollinated, and *Silene alba* is also pollinated some by bees flies wasps until flowers close in midmorning).

*Silene armeria* pink: *Poanes taxiles* 1x.

(*Stellaria* spp. are evidently not popular [I have no certain records because most or all of what I identified long ago as *Stellaria* was actually *Cerastium strictum*]. The lawn weed *Stellaria media* white attracts andrenid and halictid bees, syrphid and muscid and sarcophagid and anthomyiid flies, and it can self-pollinate [Hilty 2013]. *Stellaria pubera* in North Carolina is usually visited by *Bombylius major* flies, and often by anthophorid bees [*Nomada*] and andrenid bees [*Andrena nigrihirta* and *A. erigeniae*], and seldom by other bees and flies and skippers and the butterflies *Celastrina neglecta* [called “*argiolus*”] and *Pieris protodice* [misidentified as “*Euchloe creusa lotta*”] [Campbell 1985].)

#### AMARANTHACEAE (includes Chenopodiaceae)

The native genera such as *Amaranthus* weeds and *Froelichia* are not visited and are wind-pollinated, but the cultivated *Gomphrena* is moderately popular. The common plants formerly placed into Chenopodiaceae (*Salsola*, *Atriplex*, *Suaeda*, *Chenopodium* weeds and shrubs) have tiny ugly wind-pollinated flowers that are rarely visited by butterflies (oddly Gillespie and Wratten noticed 28 visits of *Lycaena salustius* butterflies on *Chenopodium* sp. in New Zealand [New Zealand lacked a typical pollinator fauna so dozens of bees were introduced there to pollinate crops and fruits]). The edible greens *Beta vulgaris* [swiss chard and beets] and *Spinacia oleracea* [spinach] are similarly wind-pollinated, though thrips can transfer *Beta* pollen. Amaranthaceae in general is pollinated by wind [most of them] or insects [*Gomphrena* evidently] (Judd et al. 2008).

(*Amaranthus graecizans*, *A. retroflexus* etc. have tiny flowers and are not visited. *Amaranthus palmeri* is usually wind-pollinated, but also pollinated by the solitary bee *Melissodea thelypodii* [Cane 1992]).

(*Celosia argentea* [orange etc.] did not attract any *Polites themistocles*.)

*Gomphrena globosa* purple or bright purplish-crimson is moderately popular: *Hylephila phyleus*, *Polites peckius* 13x (prefers *Gomphrena* over *Salvia*), *Polites themistocles* 35x, *Pyrgus communis*, *Vanessa cardui* some.

## AIZOACEAE

The prostrate cultivated garden flowers are rarely visited. The family in general has showy flowers visited by bees, wasps, butterflies, flies, and beetles (Judd et al. 2008).

*Aptenia cordifolia* purple-pink: *Pyrgus communis*. Pollinated by honeybees.

*Delosperma ~cooperi* yellow: *Papilio multicaudata*.

*~Melephora crocea* yellow: *Pontia protodice*.

## SARCOBATAACEAE

(I have no records for wind-pollinated *Sarcobatus* weeds.)

## NYCTAGINACEAE

These are rarely visited. Nyctaginaceae in general are pollinated by bees, butterflies, moths, and birds, for a nectar reward (Judd et al. 2008).

*Abronia elliptica* white: *Pontia protodice*.

*Abronia fragrans* whitish: *Strymon melinus*. Its fragrance is strong at night when it is pollinated by moths such as *Nycterothaena luna* (Keeler and Fredericks 1979).

*Mirabilis multiflora* purplish-pink: *Hesperia pahaska*. This is pollinated by sphingid moths (*Hyles lineata* and *Manduca quinquemaculata* [with a proboscis 11-12 cm long], and sometimes by *Sphinx chersis* (S. Hodges). *Mirabilis longiflora* is also pollinated by *M. quinquemaculata* (Grant and Grant 1983).

*Mirabilis jalapa* is pollinated by sphingid moths in late afternoon-evening, and can self-pollinate (Martinez and Burquez 1986); the red flowers appear dark late in the day but the corolla base appears yellow (the pollen absorbs ultraviolet and fluoresces blue, which would evidently not occur at night when uv is minimal). *Mirabilis macfarlanei* pink in Idaho-Oregon is pollinated by solitary bees and *Bombus fervidus*.

(*Mirabilis [Oxybaphus]* pink has no records. *Oxybaphus* is pollinated by bees and hummingbirds and self-pollination.)

## MOLLUGINACEAE

(*Mollugo verticillata* is a prostrate weed with tiny white flowers, but is too uncommon for me to determine if butterflies visit it. It is reported to be pollinated by selfing and insects.)

## PORTULACACEAE

Cultivated *Portulaca* has pretty flowers of many colors that are not visited, and butterflies ignore small *Portulaca oleracea* weeds, but *Claytonia* is pretty and moderately popular, and *Calyptridium* is showy and very popular. Portulacaceae in general are pollinated by bees, flies, beetles, and butterflies, and the flowers are open only a short time (Judd et al. 2008).

*Calyptridium umbellatum* white is very popular in Calif.: *Argynnis (Speyeria) callippe juba* some, *Argynnis (Speyeria) callippe shasta* 2x, *Argynnis (Speyeria) egleis egleis* many, *Argynnis (Speyeria) egleis oweni*, *Argynnis (Speyeria) hesperis irene* 2x, *Argynnis (Speyeria) zerene zerene*, *Boloria epithore*, *Callophrys augustinus*, *Callophrys eryphon*, *Carterocephalus "palaemon" skada* Cal., *Chlosyne hoffmannii*, *Erynnis propertius propertius*, *Euphydryas chalcedona sierra* many, *Hesperia comma harpalus* many, *Lycaena cupreus cupreus*, *Lycaena nivalis nivalis* some, *Nymphalis californica*, *Parnassius clodius* 12x, *Phycodes orseis orseis*, *Polites sonora sonora* some, *Polygonia gracilis zephyrus*, *Vanessa cardui*, *Vanessa carye* 2x. This is reportedly "self-pollinated" by insects.

*Claytonia rosea* pinkish-white: *Callophrys sheridanii* 5x, *Celastrina humulus* lupine-ecotype, *Erynnis persius*, *Erynnis telemachus*, *Pontia sisymbrii*. In eastern U.S. it is visited by *Erynnis icelus*, *E. brizo*, *E. juvenalis*, *Pyrgus centaureae*, *Anthocharis midea*, *Anaea andria*, *Aglais milberti*, and *Glaucopsyche lygdamus*. *Claytonia virginica* is pollinated usually by the solitary bee *Andrena erigeniae* (a specialist on *C. virginica*), and frequently by the bee fly *Bomblylius major* which visits many different flowers (Motten et al. 1981).

(*Phemeranthus* [formerly *Talinum*] *parviflorus* pink is too uncommon to observe much and has no records. Several *Phemeranthus* are reportedly pollinated by selfing and by insects, and *P. calycina* is supposedly attractive to honeybees and butterflies.)

(*Portulaca grandiflora* has pretty red yellow to white flowers but is shunned.)

(*Portulaca oleracea* is a superabundant prostrate weed with tiny yellow flowers but is shunned. It usually self-pollinates but is sometimes visited by bees and other insects [the pollen is too sticky to be wind-pollinated] [Miyajima 2006].)

## CACTACEAE

Cactus flowers—at least *Opuntia*--are popular with some Hesperinae skippers that have a long proboscis to get through the forest of stamens, including *Notamblyscirtes* which often crawl right in among the stamens! Cactaceae in general are pollinated by various insects (bees, flies, sphingid moths), birds, and bats (Judd et al. 2008). The giant Saguaro and Cardon cactuses in SW U.S. are pollinated by bats, but apparently none are pollinated by bats in Colorado. *Echinocereus triglochidiatus* is pollinated by hummingbirds (Grant 1994). Barrel cactus *Ferocactus wislizenii* is pollinated by four generalist bees and two specialist bees that visit only that cactus, and is visited by other bees and flies (Mcintosh 2005).

*Coryphantha vivipara* purple: *Papilio zelicaon* f. *nitra*.

*Opuntia (Cylindropuntia) imbricata* purplish: *Satyrium titus*.

*Opuntia macrorhiza* yellow: *Hesperia uncas*, *Hesperia viridis*, *Notamblyscirtes simius* 26x. The similar species *Opuntia humifusa* is pollinated by the cactus-specialist bee *Lithurgus gibbosus* in Florida (Archbold Biol. Station research). *Diadasia* and *Lithurgis* bees may have evolved with *Opuntia*. In Texas, *Opuntia macrocentra* is pollinated by *Diadasia rinconis* (Apidae), *Lithurgis littoralis*, *Ashmeadiella opuntiae* (Megachilidae) (all three bees specialize on Cactaceae pollen), and *Melissodea tristis* (Apidae), while secondary pollinators are *Apis mellifera*, *Lasioglossum (Dialictus) pruinosiformis*, and *Lasioglossum* spp. (Halictidae) (these other bees visit many different flowers); numerous *Carpophilous* beetles eat the floral parts and mate but do not pollinate, and ants collect pollen but do not pollinate (Pendley 2002). In Florida, *Opuntia humifusa* is visited by 16 species of bees (Deyrum et al. 2002).

*Opuntia phaeacantha* yellow: *Hesperia viridis* 2x.

*Opuntia polyacantha* yellow: *Callophrys gryneus siva*, *Hesperia pahaska* 45x, *Hesperia pahaska martini* 1x, *Hesperia uncas* 8x, *Hesperia viridis*, *Notamblyscirtes simius* (adults crawl into and almost disappear among the stamens [and evidently pollinate the flowers], where many small beetles also occur) 77x (*Opuntia polyacantha* purple had no visits), *Polites (Yvretta) rhesus*, *Stinga morrisoni* 3x. This is self-compatible, unlike *O. phaeacantha*. Both are pollinated by medium to large bees of genera *Diadasia*, *Lithurgis*, *Melissodea*, *Bombus*, *Agapostemon*, and *Megachile* in southern Colorado (Osborn et al. 1988).

## CORNACEAE

Cornaceae in general is pollinated by bees flies and beetles (by wind in *Davidia*) (Judd et al. 2008).

*Cornus sericea=stolonifera* white is unpopular: *Celastrina neglecta* 5x, *Vanessa atalanta* 2x. It is pollinated by long-tongued and short-tongued bees including bumblebees and solitary bees and the specialist pollinator *Andrena fragilis* (that visits only *Cornus*) (Hilty 2013), and probably sometimes by visiting wasps flies beetles and butterflies. Several other *Andrena* bees specialize on *Cornus*.

## HYDRANGEACEAE

Beautiful cultivated *Hydrangea* and *Philadelphus* are rarely visited, but native *Jamesia* is very popular. Hydrangeaceae in general produce nectar and are pollinated by insects (butterflies, moths, flies, bees, wasps, beetles) (Judd et al. 2008).

(*Hydrangea* spp. purple/pink/blue/white are showy and planted in some Denver yards, but are not visited.)

*Jamesia americana* white is very popular: *Aglais milberti* 3x, *Amblyscirtes vialis*, *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) callippe* 10x, *Argynnis (Speyeria) coronis* 4x, *Argynnis (Speyeria) edwardsii* 10x incl. Janet Chu, *Argynnis (Speyeria) hesperis* 3x, *Asterocampa celtis jeffermont* often,

*Callophrys dumetorum homoperplexa*, *Callophrys gryneus siva* 8x, *Celastrina humulus* hop-ecotype 6x, *Celastrina lucia sidara* 24x, *Chlosyne gorgone*, *Chlosyne nycteis* 2x incl. Janet Chu, *Chlosyne palla calydon*, *Epargyreus clarus*, *Erebia epipsodea*, *Erynnis martialis*, *Erynnis pacuvius*, *Erynnis persius* 4x, *Euphydryas anicia capella* 15x, *Euphyes vestris*, *Glaucopsyche piasus*, *Hesperia pahaska*, *Limenitis weidemeyerii* 3x, *Oeneis chryxus*, *Papilio eurymedon* 8x, *Papilio glaucus rutulus*, *Papilio indra* 22x, *Papilio multicaudata*, *Papilio zelicaon* 4x, *Parnassius phoebus smintheus*, *Piruna pirus*, *Plebejus saepiolus*, *Poanes taxiles* 3x, *Polites themistocles*, *Polygonia gracilis zephyrus*, *Thorybes pylades*, *Vanessa atalanta* 4x, *Vanessa cardui* 11x.

*Philadelphus lemoinei* (=Mock Orange) white is not very popular: *Epargyreus clarus*, *Papilio glaucus rutulus* 2x, *Papilio multicaudata*. It can self-pollinate. *Philadelphus pubescens* reportedly attracts pollinators including bees butterflies and hummingbirds. In Maryland the megachilid bee *Chelostoma philadelphia* is a specialist on *Philadelphus* (Sedivy et al. 2008).

#### LOASACEAE

*Mentzelia* are common and have beautiful pale flowers but only open toward evening and are rarely visited by butterflies. Loasaceae in general are pollinated by bees wasps flies butterflies hawkmoths hummingbirds and rodents seeking nectar and/or pollen (Judd et al. 2008). Several bees specialize on Loasaceae in Chile and Argentina.

*Mentzelia* ~yellow: *Satyrium californica*. *Mentzelia decapetala* and *M. laevicaulis* are reportedly pollinated at night by moths and other insects. But *M. oligospora* is pollinated by bees by day (early morning?) and moths at night, which may be the usual pattern. But *M. nuda* has nectar to attract bees (Keeler 1981) and *M. multiflora* is reportedly pollinated by bees. *M. involucrata* has nectar that attracts *Xeralictus* bees, and is mimicked by another plant *Mohavea confertiflora* that lacks nectar and mimics *M. involucrata* (Little 1983).

#### BALSAMINACEAE

(*Impatiens capensis* orange is common in S Minnesota marsh edges but butterflies do not visit it. However in eastern U.S. it is sometimes visited by longer-proboscis butterflies *Papilio troilus* (frequently), *Zerene cesonia*, and *Euphyes conspicua*. *Impatiens capensis* is pollinated by bumblebees *Bombus vagans* and *B. fervidus* and other *Bombus*, by honeybees that rob nectar but still pollinate as well as bumblebees, and sometimes by wasps *Vespula maculifrons*, and hummingbirds [Rust 1977, 1979; Young et al. 2007]. Hummingbirds often visit it. *Impatiens trichocarpa* is pollinated in India usually by honeybees [*Apis florum*, *indica*, *dorsata*], also by hawk moths *Macroglossum variegatum*, butterflies [*Pachlioptera aristolochiae*, *Euploea core* and *Papilio demoleus*], and *Chrysomya megacephala* flies [Kullooli and Sreekala 2009]. *Impatiens cuspidata* in India is pollinated by *Apis cerana* and *Trigona* bees, by *Macroglossum variegatum* and *M. corythus* hawk moths, butterflies, and flies which are poor pollinators [Sreekala et al. 2011]. *Impatiens glandulifera* is pollinated by bumblebees in Britain [Proctor et al. 1996].)

#### POLEMONIACEAE

These flowers are pretty but frequently too long for the butterfly proboscis and are not popular (including cultivated *Eryngium*, *Polemonium*). But *Phlox* with shorter corollas are still not popular, though some *Phlox* elsewhere are reportedly moderately popular. Polemoniaceae in general attract bees flies beetles butterflies and moths (Judd et al. 2008).

*Gilia pinnatifida* white: *Epargyreus clarus*. (*Gilia subnuda* is pollinated by hummingbirds [Grant 1994].) (*Gilia* scarlet had no butterfly visits in several days, including no visits by *Polites peckius* or *P. themistocles*. Red *Gilia* are mostly pollinated by hummingbirds.)

*Ipomopsis* are not very popular, and the flowers are too long. Cary et al. (2011) claim that *Ipomopsis sancti-spiritus* is pollinated by the butterfly *Paratrytone snowi* in New Mexico.

*Ipomopsis aggregata collina* [not *Gilia texana*] red: *Paratrytone snowi*. This is pollinated by hummingbirds (Bauer 1983, Grant 1994). In Colorado it is pollinated mainly by Broad-tailed and Rufous Hummingbirds

because they are the most common visitors, but in some years by bumblebees (superior pollinators when they are present), solitary bees, syrphid flies, long-tongued sphingid moths, and Swallowtail butterflies can be important pollinators (Mayfield et al. 2001; Campbell et al. 1991, Snow et al. 1996).

*Ipomopsis globularis* purplish-white: *Euphydryas anicia brucei*.

*Ipomopsis rubra* "Fuchsia Gilia" red: *Papilio multicaudata* (Jean Morgan photo).

(*Polemonium* spp bluish are fairly common in higher mountains but I have no records. *Polemonium brandegeei* blue and another sp. are pollinated by hummingbirds [Grant 1994] at least in part. *P. viscosum* is pollinated by Muscoid flies, solitary bees, syrphid flies, and bumblebees *Bombus* (in declining importance) in krummholz (upper limit of trees) while *Bombus* is the major pollinator and the others are much less important on alpine tundra (Galen 1996). *Polemonium foliosissimum* is frequently visited and presumably pollinated by *Bombus flavifrons* and less often by *B. bifarius* (Pleasants 1983). The bee *Andrena polemonii* specializes on *Polemonium reptans*.)

*Phlox hoodii canescens* white with yellow centers: *Callophrys gryneus siva*, *Polites (Yvretta) rhesus* 2x, *Strymon melinus*.

*Phlox longifolia* lavender: *Pontia beckerii*.

*Phlox multiflora* [white-pink-blue]: *Boloria improba acrocneuma* (Scott 1982). Some *Phlox* are butterfly pollinated (Reddi and Bai 1984).

*Phlox paniculata* pink: *Papilio glaucus glaucus* (This Old House TV show); *Papilio multicaudata* 2x incl. var. Brigadier 5 min. (even stopped wings from fluttering), *Danaus plexippus* 5x (+2x on white flowers). *Phlox paniculata* and *P. drummondii* are pollinated by butterflies and moths (Grant and Grant 1965; Levin 1985).

*Phlox pilosa* ~pinkish: *Ancyloxypha numitor* 3x (and male 2 sec and 2 sec), *Colias eurytheme*, *Colias philodice?*, *Danaus plexippus*, *Vanessa cardui*. *Phlox pilosa* and *P. glaberrima* place pollen on different places on *Colias* butterflies that pollinate them (Levin and Berube 1972).

*Phlox subulata* var. *nelsonii* pink: *Vanessa cardui*.

*Phlox* white: *Poanes taxiles* 2 sec.

## PRIMULACEAE

Primulaceae (*Androsace*, *Dodecatheon*, *Primula*) are unpopular. Primulaceae in general are pollinated by various insects, and *Dodecatheon* are "buzz-pollinated" (Judd et al. 2008).

(*Androsace septentrionalis* has tiny white flowers and is very common in montane Colorado but is shunned. It is pollinated by flies in Finland.)

(*Dodecatheon* has no records. *Dodecatheon pulchellum* is pollinated by bumblebees (Dodson and Dunmire 2007). *Dodecatheon meadia*, *D. amethystinum*, and *D. conjugens* are buzz-pollinated by worker bumblebees elsewhere in North America for tiny 12.5µm pollen that they shake out of the anthers with 400Hz buzzing [Harder and Barclay 1994]. Some showy species are reportedly buzz-pollinated by bumblebees.)

(*Lysimachia nummularia* is a pretty yellow flower but prefers shade in towns and I have no records on it. In Wisconsin the bee *Macropis nuda* specializes on *Lysimachia* pollen and even has a parasitic bee *Epeoloides pilusula* that lays an egg in its nests [Alan Barbian, www.fs.fed.us]. The *Macropis steironematis* bee also specializes on *Lysimachia*. The European *Lysimachia punctata* is pollinated by the specialist bee *Macropis fulvipes*, and has a parasitic bee *Epeoloides coecutiens* that lays an egg in its nests [Dotterl 2008]; the European *Hoplitis adunca* bee also specializes on *Lysimachia*.)

Primrose small violet: *Euptoieta claudia*, *Junonia coenia*, *Junonia evarete nigrosuffusa*.

(*Primula parryi* reddish-pink and *P. angustifolia* pink are locally common in the alpine zone but are shunned. *P. parryi* is pollinated by bumblebees *Bombus* [predominantly *B. balteatus*], and sometimes by hummingbirds; *P. angustifolia* has the same but fewer pollinators [Miller et al. 1994].)

## ERICACEAE

*Arctostaphylos* is moderately popular, but most genera are not popular and I have no records for *Vaccinium* or *Gaultheria*. *Pyrola* and *Chimaphila* etc. (often placed in Pyrolaceae) have flowers pointed



downward and are not visited by butterflies. Ericaceae in general have nectar and are pollinated by bees and wasps (*Rhododendron* has pollen tetrads that are pulled out of the anther by pollinators) (Judd et al. 2008).

*Arctostaphylos* (manzanita) pink/white: *Callophrys mossii windi*. *A. pringlei* and *A. glandulosa* are pollinated by bees and flies in California (Fulton and Carpenter 1979). They are reportedly “buzz pollinated” by bees. In Ariz. *Arctostaphylos pungens* is mostly visited by 10 bees and 2 flies: it is mostly pollinated by *Osmia ribifloris* (Megachilidae) bees, half as often by *Eucera* bees, and 1/5 as often by *Lasioglossum* bees (which buzz-pollinate the flowers), and honeybees pollinate sometimes; *Bombylius* bee flies are common but poor pollinators, *Volucella avida* flower flies and *Melissodea* and *Anthophora* bees are good pollinators but seldom visit, while *Halictus*, *Nomadia*, and *Augochlorella* bees and small butterflies mostly rob nectar and are less common so seldom pollinate (*Nomadia* are 100% robbers, while all the others can sometimes pollinate); Anna’s Hummingbirds visit sometimes and wreck the flowers while eating thrips (Richardson and Bronstein 2012).

*Arctostaphylos uva-ursi* whitish: *Aglais milberti* 3x, *Callophrys augustinus augustinus* 21x, *Callophrys eryphon* 5x, *Callophrys polios* 18x, *Callophrys sheridani lemberti*, *Callophrys spinetorum* 2x incl. Janet Chu, *Celastrina lucia sidara* 10x, *Erynnis brizo burgessi*, *Erynnis pacuvius*, *Erynnis persius*, *Polygonia faunus*, *Polygonia gracilis zephyrus*, *Stinga morrisoni*, *Vanessa cardui*. There is little information about its pollination, but it is buzz-pollinated by bumblebees for pollen (Willmer 2011; captive bumblebees often visit it, Internicola and Harder 2012), and it can self-pollinate because shrinking corollas press stamens against style; butterfly pollination is evidently possible but probably infrequent. Thrips do 20% of pollination in SW Europe (Garcia-Fayos and Goldarazena 2008) but thrips are not found in Norwegian plants.

*Kalmia polifolia* pink: *Pyrgus centaureae* 3x. Bumblebees are effective pollinators.

(*Linnaea borealis* whitish is uncommon and I have no records. The flowers rarely self and are mostly pollinated by bees (*Bombus* bumblebees, megachilid bees [*Osmia* spp.], halictid bees [three *Lasioglossum* spp.], colletid species [*Hylaeus* spp.], plus two sphecid wasps, sawflies, five syrphid flies, Bombyliid, muscid, and faniid flies, and occasionally by the staphylinid beetle *Eusphalerum* and the skipper butterfly *Euphyes vestris* [Hilty 2013].)

*Rhododendron* (*Azalea*) yellow to red: Part I and Bright and Ogard (2010) note visits in hotter regions than Colorado by the very large butterflies *Papilio glaucus glaucus* on yellow flowers 5x, *P. polyxenes* 3x on yellow, *P. troilus* on orange-red, *P. palamedes*, *P. cressphontes*, *Battus philenor*, *Phoebis sennae* 4x on red to white. *Rhododendrons* are cultivated and scarce in Colorado. *Rhododendron* (*Azalea*) is pollinated by insects especially bumblebees and honeybees, while in mountain areas where bees are scarce ants may be primary pollinators. Beetles flies and butterflies also visit and may occasionally pollinate.

(*Vaccinium* is common in Colorado but the three species *V. cespitosum*, *V. myrtillus oreophilum*, and *V. scoparium* have 3-mm white-to-rose flowers that are not visited by butterflies. *Vaccinium* [blueberries and cranberries] are reportedly “buzz pollinated” by bees. In Europe, *Vaccinium myrtillus* is buzz-pollinated by bumblebees, but the smaller species usually self-pollinate [Proctor et al. 1996] which may apply to all three small Colorado *Vaccinium* listed above including *V. myrtillus oreophilum*. Elsewhere the *Vaccinium* are larger: *Vaccinium macrocarpon* cranberries are pollinated by bumblebees, honeybees [but honeybees cannot buzz-pollinate so Willmer {2011} states they are useless for blueberries and cranberries], and andrenid, halictid, and megachilid bees. The *Anthophora plumipes* bee was imported to pollinate native blueberries [Cane 2003]. The anthophorid bee *Habropoda laboriana* visits mostly *Vaccinium ashei* and *V. corymbosum* in SE U.S., and occasionally visits *Gelsemium*, *Quercus*, and *Cercis*; these bees and *Bombus* bumblebees buzz-pollinate the *Vaccinium* [Cane and Payne 1988]; *V. ashei* is pollinated by honeybees [?], *Osmia ribifloris* bees, and *H. laboriana* [Sampson and Cane 2000]. The bee *Melitta americana* collects pollen from *Vaccinium stamineum* [Hilty 2013], the *Andrena carolina* bee is a specialist on *Vaccinium* blueberries, and the *Osmia ribifloris* bee pollinates some blueberries. *Vaccinium vitis-idaea* is pollinated by various insects.)

BORAGINACEAE (includes some “Hydrophyllaceae”)

*Cryptantha* seems fairly popular, but most plants including *Cynoglossum* are only weakly to moderately popular. *Onosmodium* is doubtfully visited by butterflies. *Eriodictyon*, *Hydrophyllum*, and *Phacelia* were formerly included in Hydrophyllaceae; they are not very popular, except *Eriodictyon* is popular in Calif. Judd et al. (2008) note that Boraginaceae in general are pollinated by bees wasps butterflies flies moths beetles bats and birds. They note that the flowers of *Mertensia Myosotis* and *Cryptantha* rapidly change color after pollination as a signal to pollinators. *Eritrichum aretioides* is pollinated by ants in the Cascade Mts.

*Anchusa azurea* blue is scarce in Denver but moderately popular: *Pieris rapae*, *Vanessa cardui*. *Anchusa* is pollinated by bees.

(*Borago officinalis* blue-purple has few local plants, and I have seen no visits. It is pollinated by honeybees who gather nectar, and by bumblebees that gather nectar and pollen and “buzz pollinate” it to shake out pollen while grabbing toothlike appendages on stamens and the scales [staminodes] with their legs.)

*Cryptantha* is moderately popular. megachilid bees in the *Hoplites proteriades* group visit *Cryptantha* flowers almost exclusively.

*Cryptantha ~thyrsiflora* white: *Piruna pirus*.

*Cryptantha fendleri* white: *Apodemia mormo pueblo*.

*Cryptantha jamesii* white: *Callophrys dumetorum homoperplexa*, *Callophrys eryphon* 2x, *Callophrys gryneus siva* 12x, *Coenonympha tullia*, *Euptoieta claudia* 3x, *Hesperia pahaska* 13x, *Hesperia uncas* 4x, *Hesperia viridis*, *Neominois ridingsii*, *Lycaena arota* 2x, *Notamblyscirtes simius* 15x, *Paratrytone snowi* 1x, *Phyciodes pulchella camillus*, *Poladryas minuta arachne* 4x, *Pontia protodice* 8x, *Pyrgus communis*, *Satyrium titus* 2x.

*Cryptantha minima* white: *Vanessa cardui* 2x.

*Cryptantha virgata* white: *Aglais milberti* tall, *Callophrys gryneus siva* tall, *Erebia epipsodea*, *Erynnis persius*, *Euphydryas anicia capella* 9x, *Euptoieta claudia*, *Glaucopsyche piasus* 2x, *Hesperia nevada*, *Papilio indra*, *Pieris rapae* 50 cm tall, *Polites mystic* 2x, *Vanessa cardui* 2x.

*Cryptantha* white: *Callophrys gryneus nelsoni*, *Papilio zelicaon*, *Pontia beckerii*.

(*Cynoglossum officinale* red-purple is uncommon and unpopular. It is reportedly pollinated by insects mainly bumblebees, also thrips, other bees, and butterflies, and can self-pollinate.)

*Eriodictyon californicum* white to lavender: *Cercyonis sthenele behrii* [?Eriodictyon], *Euphydryas editha editha* 2x, *Hesperia lindseyi* several, *Ochlodes agricola*, *Satyrium saepium* 2x, *Satyrium tetra* 2x.

*Eriodictyon* white to lavender is popular in California: *Adelpha californica*, *Argynnis (Speyeria) callippe callippe*, *Chlosyne palla palla*, *Euphydryas chalcedona chalcedona*, *Junonia coenia*, *Limenitis lorquini*, *Lycaena gorgon*, *Papilio eurymedon*, *Papilio glaucus rutulus*, *Pieris rapae*, *Plebejus acmon*.

*Hackelia floribunda* blue: *Papilio indra*, *Phyciodes cocyta* (bluish-white), *Piruna pirus* [?Hackelia floribunda 1m tall plant with tiny blue flowers], *Polites mystic*. *Hackelia cronquisti* is reportedly pollinated by bees and flies and can self-pollinate. *Hackelia venusta* is pollinated by *Andrena nigrocaerulea* bees, *Protosmia rubifrons* bees, and the fly *Eulonchus* (Recovery Plan for *Hackelia venusta*, [www.fws.gov/pacific](http://www.fws.gov/pacific)).

*Heliotropium curassavicum* “white-blue low scorpioid Borage”: *Pyrgus scriptura*. This is visited by bees and Lepidoptera.

*Hydrophyllum fendleri* white is unpopular: *Vanessa atalanta*. *Hydrophyllum canadense* is pollinated by bees (honeybees, *Bombus pennsylvanicus*, *B. vagans*, *B. griseocollis*, *B. nevadensis*, *Osmia*, *Hoplitis*, *Anthophora*), and flies also visit; the flowers can self-pollinate and they lack odor (Ramstetter and Popp 2001). The bee *Andrena geranii* specializes on *Hydrophyllum*.

*Lappula redowskii* has tiny light-blue flowers: *Oarisma garita* (bluish-white), *Pholisora mejicanus*, *Pyrgus communis* 9x.

*Lithospermum multiflorum* yellow is not popular: *Argynnis (Speyeria) edwardsii*, *Poanes taxiles*. But the butterfly *Poanes hobomok* reportedly is a common visitor to *Lithospermum caroliniense* yellow in Pennsylvania, and *P. hobomok* and the butterfly *Plebejus melissa samuelis* help pollinate it.

(*Mertensia ciliata* is pollinated by bumblebees [Bauer 1983] as are other *Mertensia* [Macior 1978].

*Mertensia brevistyla*=*fusiformis* is pollinated by bumblebees, and by solitary *Osmia* bees [Forrest and Thomson 2010].)

*Mertensia alpina* blue: *Euphydryas anicia brucei* 2x.

*Mertensia lanceolata* blue is common but only moderately popular: *Amblyscirtes vialis* 2x, *Callophrys sheridanii*, *Erynnis martialis* 8x, *Erynnis pacuvius*, *Erynnis persius*, *Erynnis telemachus* 3x, *Euchloe ausonides*, *Euchloe olympia*, *Glaucopsyche lygdamus* 2x, *Hemiargus isola* flower that had lost its petals (intact flowers have petals too long for the short *H. isola* proboscis), *Lycaena phlaeas arctodon*, *Pieris rapae*, *Plebejus icarioides*, *Poladryas minuta arachne*, *Vanessa cardui*. The flowers are pollinated by bees (Dodson and Dunmire 2007).

*Mertensia?* blue: *Pyrgus centaureae*.

(*Myosotis alpestris* blue is in some Denver gardens but I have no records, though it is reportedly pollinated by bees flies moths and butterflies. Most *Myosotis* are reportedly pollinated by flies and bees, and can self-pollinate. *M. colensol* can self but is primarily pollinated by a tachinid fly *Protohystricia huttoni* [Robertson 1989; Robertson and MacNair 1995].)

(*Nemophila menziesii* blue [formerly misplaced in Hydrophyllaceae]. I have seen no butterflies on the single local plant. This is pollinated by bees [90% of visitors], mainly honeybees and two bees *Andrena macrocephala* and *A. crudeni* that are apparently restricted to *N. menziesii* except when flowers are scarce, plus *Andrena torulosa* and megachilid bees; other *Nemophila* have megachilid bees and bionid flies [*Bibio* spp.] as pollinators [Cruden 1972].)

(*Onosmodium occidentale* brownish-red is uncommon and shunned.)

*Phacelia heterophylla* white to pinkish is only moderately popular: *Callophrys dumetorum homoperplexa*, *Callophrys gryneus siva* (white) 2x, *Celastrina humulus* hop-ecotype, *Chlosyne gorgone* (~pinkish) 2x, *Erynnis persius* 3x, *Euphyes vestris* 3x (usually purplish but one white), *Glaucopsyche lygdamus*, *Glaucopsyche piasus* 3x, *Paratrytone snowi*, *Plebejus icarioides* (white) 2x, *Polites themistocles*, *Strymon melinus* (~pinkish), *Vanessa atalanta* (white) probing with proboscis, *Vanessa cardui* (~pinkish). In California, several megachilid bees *Chelostoma californicum* and *C. incisulum* are specialists on *Phacelia*, and two others *C. cockerelli* and *C. marginatum* are specialists on Hydrophyllaceae (Sedivy et al. 2008). The bees *Andrena lamelliterga* and *A. phaceliae* and *Proteriades* specialize on *Phacelia*. *Phacelia campanularia* blue is pollinated by bumblebees *Bombus terrestris* and *B. lucorum* that eat only pollen, and syrphid flies (*Episyrphus balteanus* and *Melanostoma scalare*) and honeybees (Sutherland 2006).

*Phacelia* violet: *Phyciodes orseis herlani*.

## RUBIACEAE

Rubiaceae in general may be pollinated by butterflies moths bees flies birds or bats all seeking nectar, though a few are wind-pollinated (Judd et al. 2008). The Colorado species are not popular, although *Cephalanthus occidentalis* white is very popular in eastern U.S.

*Bouvardia glaberrima* a riparian shrub with red tubular flowers in S Ariz. is popular: *Atrytonopsis cestus* and *Atrytonopsis ovinia edwardsi* evidently on this flower, *Papilio multicaudata*. This is pollinated by hummingbirds (Grant 1994 etc.).

*Galium* is not popular: *Galium* species are pollinated by flies, small bees, beetles, and selfing.

*Galium septentrionale* white: *Argynnis (Speyeria) atlantis sorocko*, *Euphydryas anicia capella*, *Phyciodes pulchella camillus*.

*Galium* ~triflorum whitish: *Euphyes vestris*.

*Galium* whitish: *Lycaena nivalis*, *Lycaena florus*.

## GENTIANACEAE

Gentianaceae such as *Frasera* and *Gentiana* and *Pseumonanthe* and *Swertia* are mostly shunned by butterflies. Judd et al. (2008) state that Gentianaceae in general are pollinated mainly by bees and butterflies seeking nectar, but butterflies shun them in Colorado. *Gentiana* with bell-shaped corollas are

pollinated by bumblebees (Proctor et al. 1996). Some South American species are pollinated by syrphid flies and bees, but most self-pollinate.

(*Frasera speciosa* is shunned. Its large pale-green flowers bloom en-masse about every four years and are pollinated by a wide variety of insects [Beattie et al. 1973] including bumblebees and flies [Dodson and Dunmire 2007]).

Gentian flower: *Callophrys gryneus nelsoni* (courting on flower, maybe nectaring first?).

*Gentianella acuta* "amarella" blue: *Thorybes mexicana* 2x. The European *Gentianella germanica* is self-compatible but usually pollinated by Diptera and solitary bees.

(*Gentianopsis thermalis* bluish-purple is too uncommon for me to note any visits. It is pollinated by large insects [Dodson and Dunmire 2007]).

(*Swertia perennis* blue is unpopular, with no records. Several *Swertia* spp. are known to be bee-pollinated. The Tibetan *Swertia przewalskii* is visited by a variety of insects but the most effective and common pollinators are bumblebees *Bombus keshimirensis* and honeybees [Duan and Liu 2003].)

#### APOCYNACEAE (includes Asclepiaceae)

These are all enormously popular, except *Vinca*. Judd et al. (2008) note that frequent pollinators include various nectar-gathering insects (butterflies moths bees flies).

*Apocynum androsaemifolium* pinkish-white: *Aglais milberti*, *Amblyscirtes aenus*, *Amblyscirtes oslari*, *Amblyscirtes vialis* 3x, *Apodemia nais* 10x, *Argynnis (Speyeria) aphrodite* 29x, *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) callippe* 57x, *Argynnis (Speyeria) coronis* 14x, *Argynnis (Speyeria) edwardsii* 10x + one very brief, *Argynnis (Speyeria) hesperis* 47x, *Atrytone arogos* 3x, *Callophrys dumetorum homoperplexa* 3x, *Callophrys gryneus siva* 16x, *Cercyonis oetus* 3x, *Cercyonis pegala* 5x (male proboscis caught by stamens on one), *Chlosyne gorgone* 2x, *Chlosyne nycteis drusius* 9x, *Chlosyne palla calydon*, *Colias alexandra* 4x, *Colias eurytheme*, *Cupido amyntula*, *Epargyreus clarus* 5x, *Erynnis horatius*, *Erynnis martialis* 9x, *Erynnis pacuvius* 4x, *Erynnis persius* 7x, *Erynnis telemachus*, *Euphydryas anicia capella* 119x (12 were caught by proboscis stuck in stamen column slits, most dead), *Euphyes vestris* 30x, *Euptoieta claudia*, *Leptotes marina*, *Limenitis weidemeyerii* 16x, *Lycaena arota* 21x, *Lycaena dione* 2x, *Lycaena helloides*, *Lycaena heteronea* 6x, *Lycaena hyllus* several, *Lycaena rubidus* 4x, *Ministrymon leda*, *Oarisma edwardsii*, *Oarisma garita* 10x, *Papilio eurymedon* 16x, *Papilio glaucus rutulus* 17x, *Papilio indra*, *Papilio zelicaon* 2x + 1x f. *nitra*, *Paratrytone snowi*, *Parnassius phoebus smintheus*, *Phaeostrymon alcestis*, *Phyciodes cocyta selenis* 59x, *Phyciodes pulchella camillus* 2x (one had proboscis caught by stamens), *Pieris rapae* 3x, *Piruna pirus* 77x, *Plebejus icarioides*, *Poanes taxiles* 6x, *Poladryas minuta arachne* 2x, *Polites mystic* 5x, *Polites origenes* 3x, *Polites themistocles* 3x, *Polygonia gracilis zephyrus* 2x, *Pontia protodice*, *Satyrium acadica*, *Satyrium behrii* 18x, *Satyrium calanus godarti* 7x, *Satyrium californica* 7x, *Satyrium favonius autolytus=violae*, *Satyrium liparops aliparops* 4x, *Satyrium saepium* 17x, *Satyrium sylvinus putnami* 2x, *Satyrium titus* 4x, *Strymon melinus* 6x, *Thorybes pylades* 2x, *Vanessa atalanta* 5x, *Vanessa cardui* 12x, *Vanessa carye*, *Vanessa virginiensis* 3x. This is pollinated by bees including honeybees, the solitary bee *Macropis nuda*, syrphid and muscid flies; the proboscis may get wedged between the two anthers and pick up pollen that goes to another flower. Bumblebees are common visitors to *A. androsaemifolium* (Lavery 1994) and surely pollinate. Waddington (1976) found that about 25% of Lepidoptera visitors sampled (mostly butterflies) carried pollen of *Apocynum sibiricum* on the proboscis tip, but pollinations by Lepidoptera were infrequent.

*Apocynum cannabinum* whitish: *Celastrina humulus* hop-ecotype 4x, *Cercyonis pegala* 8x, *Colias eurytheme* 2x, *Danaus gilippus*, *Epargyreus clarus* 47x, *Erynnis afranius*, *Lycaena dione* 3x, *Lycaena hyllus*, *Lycaena rubidus*, *Pieris rapae* 19x, *Piruna pirus* 50x, *Poanes taxiles* 2x, *Polites mystic* 52x, *Pontia protodice* 3x, *Satyrium acadica*, *Satyrium liparops* 4x, *Vanessa atalanta* 6x, *Vanessa cardui* 10x. In Illinois this is visited by long-tongued and short-tongued bumblebees and bees, sphecid wasps, butterflies and skippers, and six families of flies, but the flies are not very effective pollinators (Hilty 2013).

*Asclepias asperula occidentalis* purple: *Callophrys gryneus siva*, *Hesperia pahaska* (Scott 1973a).

*Asclepias hallii* white: *Hesperia nevada*, *Hesperia uncas tomichi* 5x, *Hesperia pahaska* 5x (purplish flowers).

*Asclepias incarnata* pink to rose-purple: *Ancyloxypha numitor*, *Argynnis* (*Speyeria*) *cybele cybele*, *Atalopedes campestris*, *Colias eurytheme*, *Colias philodice* 2x, *Cupido comyntas* 2x, *Danaus gilippus* 2x, *Danaus plexippus*, *Euphyes bimacula*, *Euphyes conspicua* 3x, *Euphyes dion* 6x, *Euphyes vestris*, *Junonia coenia* 2x, *Lethe eurydice fumosus* 6x including pollinia on leg of 3 adults and pollinia on leg of 2 males (one had 3 pollinia on each middle leg) of *A. incarnata* or *Asclepias syriaca*, *Limenitis archippus*, *Lycaena dione*, *Papilio glaucus glaucus* 2x, *Papilio glaucus rutulus* 2x, *Papilio multicaudata* 3x, *Papilio polyxenes* 4x, *Phyciodes tharos tharos*, *Poanes taxiles* 2x, *Poanes viator* 51x, *Pompeius verna*, *Satyrium calanus falacer*, *Vanessa cardui* 15x.

*Asclepias* pink: *Aguna asander* (pollinia on leg, William McGuire), *Callophrys augustinus*, *Callophrys spinetorum*, *Dione vanillae* (pollinia on leg), *Satyrium auretteum*, *Satyrium californica*, *Satyrium saepium*, *Satyrium sylvinus*.

*Asclepias pumila*: *Atrytone arogos* (white flowers 4x, whitish-green 1x), *Hesperia ottoe* (whitish flower), *Strymon melinus* (white flower).

*Asclepias* red: *Calephelis rawsoni arizonensis*.

*Asclepias* purple: *Ochlodes yuma* (Scott, Shields, and Ellis 1976).

*Asclepias speciosa* pink: *Adelpha californica*, *Amblyscirtes eos*, *Argynnis* (*Speyeria*) *aphrodite* 4x (one has pollinia on leg), *Argynnis* (*Speyeria*) *cybele cybele* pollinia on leg, *Argynnis* (*Speyeria*) *hesperis* pollinia on leg, *Atalopedes campestris* 2x, *Atrytone arogos* ~22x, *Callophrys gryneus siva* 3x, *Cercyonis pegala*, *Colias philodice*, *Danaus gilippus* 4x, *Danaus plexippus* 10x, *Euphydryas anicia capella* (2 pollinia on leg), *Euphyes bimacula* 13x (3 had pollinia on leg), *Euphyes vestris* 10x, *Euptoieta claudia* 1 sec. then 1 sec. (proboscis too short?), *Hesperia lindseyi* 3x, *Hesperia ottoe* 2x, *Hesperia uncas* 2x, *Hesperia viridis* 2x (one has pollinia on leg), *Lethe eurydice*, *Limenitis weidemeyerii* many pollinia on leg, *Lycaena arota* 2x, *Lycaena dione* 32x, *Lycaena hyllus* 9x (incl. pollinia on leg of 4x), *Lycaena rubidus* 5x, *Nymphalis antiopa*, *Oarisma edwardsii* 2x, *Oarisma garita*, *Ochlodes sylvanoides*, *Papilio glaucus rutulus*, *Papilio glaucus rutulus* 19x, *Papilio machaon bairdii* (f. *bairdii* 25x, f. *brucei* 4x), *Papilio multicaudata* 6x, *Papilio polyxenes*, *Pieris rapae* 2x (one had pollinia on leg and the other was dead caught by proboscis with 4 pollinia on legs), *Piruna pirus* 2x, *Plebejus acmon*, *Poanes taxiles* 2x, *Poladryas minuta arachne*, *Polites mystic* 16x (two of these had pollinia on leg; a female was caught between corona and petals by her proboscis), *Polites origenes* (leg had two pollinia), *Polites themistocles* 2x (one caught between corona and petals by proboscis, another had pollinia on leg), *Pontia protodice*, *Satyrium acadica* 27x, *Satyrium behrii* 3x, *Satyrium behrii* *behrii* some, *Satyrium californica* many, *Satyrium liparops* pollinia on leg, *Satyrium saepium* 2x, *Satyrium sylvinus* 24x incl. female captured by flower, *Satyrium sylvinus* *sylvinus*, *Satyrium tetra* 2x, *Satyrium titus* 11x, *Vanessa atalanta* 2x, *Vanessa cardui* 2x.

*Asclepias subverticillata* whitish-cream: *Callophrys eryphon*, *Ochlodes yuma*.

*Asclepias syriaca* pink: *Argynnis* (*Speyeria*) *cybele cybele* 4x, *Argynnis* (*Speyeria*) *idalia*, *Anatrytone logan logan* 2 pollinia on legs of 2 adults, *Ancyloxypha numitor*, *Atalopedes campestris*, *Atrytone arogos* 2x, *Boloria selene nebraskensis* male has pollinia on leg, *Callophrys gryneus gryneus*, *Colias eurytheme* 2x, *Danaus plexippus*, *Epargyreus clarus* 2x, *Euphyes bimacula* 9x (one had pollinia on leg), *Euphyes dion* 4x, *Euphyes vestris* 13x, *Lethe eurydice fumosus* 4x including male with pollinia on leg, *Limenitis archippus*, *Nymphalis antiopa*, *Phyciodes tharos tharos* pollinia on leg, *Pieris rapae* (had pollinia on leg), *Poanes hobomok* pollinia on leg, *Poanes viator* and 1 male pollinia on leg, *Poanes viator* (*A. syriaca/incarnata*) pollinia on leg, *Polites origenes* 3x (one leg had pollinia), *Polygona comma*, *Satyrium acadica*, 2x, *Satyrium calanus falacer* pollinia on leg, *Satyrium edwardsii* ~7x, *Satyrium liparops strigosa*, *Strymon melinus*, *Vanessa atalanta* male had pollinia on leg. *Asclepias syriaca* (and *A. incarnata* and *A. verticillata* in the same area) are visited by many insects including bumblebees (*Bombus* 9 spp.), honeybees, wasps (*Ammobia* 2 sp., *Bembix spinolae*, *Polistes fuscatus*, *Tachytes* 2 sp., *Vespa* 3 sp., *Dolichovespula*, *Chlorion aerarium*, *Myzinum quinguecictum*) (Macior 1965), and various butterflies are primary visitors in daytime, and moths are the primary nocturnal visitors; the flowers produce four times the amount of nectar at night as in daytime, yet nocturnal moths pollinated few flowers compared to diurnal bumblebees (Morse and Fritz 1983). *Asclepias syriaca* is pollinated mostly by Hymenoptera (bumblebees especially *Bombus griseocollis*, honeybees, carpenter bees, Sphecidae and other wasps), and

sometimes by Lepidoptera (Theis et al. 2007). *A. syriaca* is sometimes butterfly-pollinated (Reddi and Bai 1984), but bumblebees are the main pollinators (Morse 1982).

*Asclepias tuberosa* orange is absent in N Colo., but is probably the most popular flower where it occurs eastward and southward (its common name Butterfly Milkweed is very appropriate): *Argynnis* (*Speyeria*) *aphrodite*, *Calephelis nemesis*, *Colias eurytheme*, *Danaus gilippus*, *Danaus plexippus*, *Polites mystic*, *Satyrrium titus*, *Strymon melinus*.

*Asclepias verticillata* whitish: *Polites themistocles*.

*Vinca minor* blue mostly grows in shade, and is not popular: *Vanessa cardui*.

## OLEACEAE

Oleaceae in general are pollinated by nectar-gathering bees butterflies and flies, and by wind in *Fraxinus* and *Forestiera* (Judd et al. 2008).

(*Fraxinus pensylvanica* var. *lanceolata* is common but wind-pollinated and shunned.)

*Syringa reticulata* white: *Papilio glaucus glaucus*.

*Syringa vulgaris* pink-purple is not especially popular, except during migrations of *Vanessa cardui*: *Colias eurytheme*, *Papilio multicaudata* 3x, *Papilio polyxenes* 4x (one only 1 sec.), *Papilio zelicaon*, *Pieris rapae*, *Vanessa atalanta* 2x, *Vanessa cardui* 49x (+ one only 1 sec.) + white form *alba* 1x. *Syringa* is reportedly pollinated by bees and butterflies.

## PLANTAGINACEAE (includes most “Scrophulariaceae”)

(Most of the former genera of Scrophulariaceae have been moved to Plantaginaceae.) Plantaginaceae in general are pollinated by nectar-gathering bees, flies and birds (Judd et al. 2008). Most Plantaginaceae are unpopular, except for *Penstemon* which is very popular especially for long-proboscis Hesperinae.

*Antirrhinum majus* [many colors]: *Pyrgus communis* 2 sec. *Antirrhinum* is pollinated by bumblebees and honeybees.

*Antirrhinum majus* white: *Vanessa cardui* 4x.

*Antirrhinum majus* yellow: *Papilio multicaudata* 1 sec.

(*Besseyia* is not popular. *Besseyia bullii* is visited by many small insects, the most common being halictid bees [*Augochlorella striata* and *Dialictus* spp.], and it sometimes self-pollinates [McKone et al. 1995]).

*Collinsia parviflora* tiny 4 mm blue-white: *Pontia sisymbrii*.

(*Digitalis* is in some gardens, but I have seen no visits. The purple or white flowers of *Digitalis purpurea* are pollinated by bumblebees in Washington [Best and Bierzychudek 1982].)

(*Hippuris* has vestigial flowers that are wind- and water-pollinated, so there are no records.)

*Linaria* is not popular, because it is too hard for butterflies to get into the flowers:

*Linaria canadensis* var. *texana* blue: *Strymon melinus*.

*Linaria genistifolia dalmatica* yellow but red at apex: *Colias philodice*, *Euptoieta claudia* ½ sec, *Hesperia pahaska*, *Ochlodes sylvanoides* (probed several times but did not succeed and flew), *Pieris rapae*.

*Linaria vulgaris* yellow with orange palate: *Colias eurytheme*, *Lycaena arota* 3x (one probed flower base 1-2 min.), *Strymon melinus* 15x by feeding through holes (made by *Bombus terrestris* bumblebees?) in spur (most flowers have such holes and one had 5 holes, a bumblebee fed out of same holes). *Linaria vulgaris* is reportedly pollinated by bumblebees and halictid bees; Proctor et al. (1996) note it is pollinated by strong bees (bumblebees and honeybees). Robertson (1929) found that bumblebees and other long-tongued bees, butterflies, and skippers visit the flowers, but only bumblebees are strong enough to push past the palate and enter the corolla throat, and butterflies and skippers are not effective pollinators.

*Penstemon* are popular mostly with skippers and *Papilio* which have long proboscis. In Arizona 80% of *Penstemon* species are bluish and are pollinated by bees (including honeybees, and some *Osmia* species rely heavily on *Penstemon* in montane western U.S.) and the wasp *Pseudomasaris vespoides* (other common visitors are *Megachile* bees, bumblebees [which often just visit for nectar, or chew a slit and steal the nectar, or buzz-pollinate to get pollen], the bees *Ceratina*, Halictidae [*Lasioglossum*, *Dialictus*, *Halictus*, *Mexalictus*], and *Hylaeus*, long-tongued *Oligodranes* flies, and *Bombylius* flies, while hawkmoths *Hyles lineata* and syrphid flies [*Eulonchus*], and melyrid beetles and butterflies visit

sometimes but are not very effective pollinators); the few reddish species in Arizona are pollinated by hummingbirds and sometimes by bees (flies sometimes visit both kinds) (S. Kimball and P. Wilson 2009). Grant (1994) also notes that some *Penstemon* (usually red flowered) are pollinated by hummingbirds. Most of the pollen of *Penstemon caryi* is gathered by *Anthophora ursina* (Apidae) and the *Penstemon* specialist *Osmia brevis* (Megachilidae) which visits many *Penstemon* in western U.S. (Tepedino et al. 2011). The *Osmia distincta* bee mostly specializes on *Penstemon*. And the wasp *Pseudomasaris occidentalis* specializes on *Penstemon* and helps pollinate it. *Penstemon confertus procerus* is pollinated partially by bumblebees in Montana (Bauer 1983). *Penstemon degeneri* is pollinated by *Bombus* bumblebees and megachilid bees, and also *Pseudomasaris vespoides* a wasp specialist on *Penstemon* (English et al. 2009). But butterflies often visit *Penstemon*:

*Penstemon albidus* white with violet guide lines: *Hesperia uncas*, *Neominois ridingsii*.

“*Penstemon*” ~*albidus* white: *Atrytone arogos*.

*Penstemon alpinus* blue-purplish: *Vanessa virginiensis*.

*Penstemon angustifolius* blue: *Erynnis persius*, *Papilio zelicaon*, *Polites (Yvretta) rhesus*.

*Penstemon barbatus* red: *Phoebis sennae*. Pollinated by hummingbirds (Dodson and Dunmire 2007, Grant 1994).

*Penstemon* blue: *Amblyscirtes aenus*, *Atalopedes campestris* (cultivated), *Atrytonopsis hianna hianna*, *Paratrytone snowi*.

*Penstemon caespitosus* blue: *Paratrytone snowi* 2x.

*Penstemon* ~*calycosus* pink: *Poanes taxiles* 2x.

*Penstemon confertus procerus* tiny blue flowers: *Boloria bellona* 6x, *Oarisma garita*.

*Penstemon cyathophorus* pink-blue: *Hesperia nevada*.

*Penstemon glaber* deep blue or bluish-purple: *Erynnis afranius*.

*Penstemon griffinii* blue: *Paratrytone snowi* 7x.

*Penstemon* large purple: *Paratrytone snowi* 2x.

*Penstemon secundiflorus* purple: *Amblyscirtes oslari* 4x, *Amblyscirtes vialis* 5x, *Argynnis (Speyeria) edwardsii*, *Atrytonopsis hianna hianna*, *Callophrys polios* rear of flower, *Epargyreus clarus*, *Euptoieta claudia* ½ sec, *Eurema mexicana*, *Hesperia pahaska* 80x, *Hesperia uncas*, *Hesperia viridis* 2x, *Notamblyscirtes simius* 95x, *Papilio eurymedon* 4x, *Papilio multicaudata* 5x, *Papilio polyxenes*, *Papilio zelicaon* 3x, *Phoebis sennae*, *Poanes taxiles* 3x, *Polites mystic* 3x, *Polites origenes* 2x, *Stinga morrisoni* 11x, *Vanessa cardui* 6x.

*Penstemon strictus* blue: *Hesperia nevada*, *Pyrgus communis*.

*Penstemon virens* blue is common but not very popular in part because it grows mostly in shade: *Colias eurytheme* 2x, *Erynnis martialis*, *Erynnis persius*, *Euchloe olympia* briefly, *Euphyes vestris*, *Hesperia nevada*, *Oarisma garita* 2x and another only ½ sec, *Papilio eurymedon* 6x, *Papilio polyxenes* 2x, *Papilio zelicaon* 25x, *Oarisma edwardsii* (*P. virens*?), *Plebejus glandon*, *Poanes taxiles*, *Polites draco* 2x, *Polites mystic*, *Thorybes pylades*, *Vanessa cardui* 2x.

*Penstemon virgatus asagrayi* lavender-purple: *Hesperia comma*, *Hesperia pahaska* 7x, *Papilio multicaudata*, *Papilio polyxenes*, *Paratrytone snowi* [not *Penstemon secundiflorus*] 96x, *Poanes taxiles*.

*Plantago lanceolata* white: *Euchloe ausonides ausonides* 15x, *Junonia coenia* 4x, *Papilio zelicaon*, *Pieris rapae*, *Plebejus icarioides*, *Strymon melinus* 2x. *Plantago lanceolata* and *P. major* have tiny wind-pollinated flowers, but are pollinated sometimes by honeybees in Australia.

(*Plantago major* has tiny white wind-pollinated flowers, and has no records.)

*Veronica* ~*americana* blue or nearly white: *Polites themistocles* only 1/3 sec., *Pontia protodice*, *Pyrgus communis* (on prostrate flower ½ sec.). Some *Veronica* spp. are pollinated by Syrphidae flies.

*Veronica catenata* pale-blue or white: *Callophrys gryneus siva*, *Euphyes vestris*, *Pieris rapae*.

*Veronica nutans* blue: *Plebejus saepiolus*.

SCROPHULARIACEAE (now includes *Buddleja*; most previous genera are now placed in Plantaginaceae)

Scrophulariaceae are unpopular, except for *Buddleja* which is very popular (it was placed in Loganiaceae and later in Buddlejaceae). Scrophulariaceae in general are pollinated by a variety of nectar-gathering insects (Judd et al. 2008).

*Buddleja davidii* (pink to pink-purple to purple to violet) is very popular in towns: *Argynnis* (*Speyeria*) *cybele cybele*, *Argynnis* (*Speyeria*) *edwardsii*, *Chlosyne gorgone*, *Colias eurytheme*, *Danaus plexippus* 7x, *Limnitis weidemeyerii*, *Papilio multicaudata* 2x, *Papilio polyxenes*, *Pieris rapae* 10x, *Polites peckius* 27x, *Polites themistocles* 2x, *Strymon melinus* 2x, *Vanessa cardui* 38x, *Vanessa virginiensis*. *Buddleja davidii* has fragrant nectariferous flowers that attract mainly butterfly visitors (Ebeling et al. 2012); Andersson (2003) studied those floral compounds in *Buddleja* that attract butterflies. *Buddleja lindleyana* often self-pollinates, while some South American species with long red flowers are pollinated by hummingbirds.

*Buddleja davidii* white is much less popular: *Argynnis* (*Speyeria*) *aphrodite* 3x, *Argynnis* (*Speyeria*) *hesperis*, *Danaus plexippus* 6x, *Pieris rapae* 2x, *Vanessa atalanta*, *Vanessa cardui* 61x.

(*Diascia ~rigescens* [short spurs] pink is unpopular as no butterflies including no *Polites peckius* or *P. themistocles* visited it in several days.)

*Scrophularia macrantha* red is unpopular: *Papilio multicaudata*. *Scrophularia macrantha* is pollinated by hummingbirds in its native range in New Mexico (Lightfoot and Sivinski 1994), while *Scrophularia vernalis* with yellow-green flowers and *S. nodosa* and *S. umbrosa* are primarily pollinated by wasps. British *Scrophularia* spp. including *S. nodosa* are pollinated by the wasp *Vespula germanica* and *V. vulgaris* and honeybees (Proctor et al. 1996). Five Spanish *Scrophularia* are pollinated by bumblebees, wasps, and small bees.

*Verbascum thapsus* yellow is unpopular: *Strymon melinus* 2x, *Vanessa cardui* only ½ sec. Bumblebees are the most important pollinators; many insects visit the flowers including bees, halictid bees, syrphid and other flies, and butterflies, but only bees accomplish pollination; after one day the flowers self-pollinate.

#### PHRYMACEAE (*Mimulus* was in Scrophulariaceae)

*Mimulus ?guttatus* yellow with red spots: *Callophrys gryneus nelsoni*, *Euphydryas editha rubicunda*. *M. guttatus* is pollinated by bumblebees (Proctor et al. 1996; Dodson and Dunmire 2007), *M. lewisii* by bumblebees (Macior 1995), *M. eastwoodiae* and *M. cardinalis* red by hummingbirds (Grant 1994).

#### LAMIACEAE=LABIATAE

Many Lamiaceae genera are very popular; *Monarda* is one of the most popular flowers. Lamiaceae in general are pollinated by bees wasps butterflies moths flies beetles and birds (Judd et al. 2008).

*Agastache rupestris* red is not popular in cultivation: *Pyrgus communis* 2x, *Strymon melinus*, (*Polites peckius* and *Polites themistocles* and other butterflies did not visit it during several days). It is pollinated by hummingbirds, bees, and other insects.

*Agastache urticifolia* mostly pinkish (white to rose to violet) is popular in western Colorado: *Argynnis* (*Speyeria*) *atlantis sorocko*, *Argynnis* (*Speyeria*) *callippe* 2x, *Argynnis* (*Speyeria*) *cybele charlottii*, *Argynnis* (*Speyeria*) *egleis* (on whitish flowers), *Argynnis* (*Speyeria*) *hesperis electa*, *Argynnis* (*Speyeria*) *zerene* 3x, *Euphyes vestris*, *Papilio glaucus rutulus*. (*Agastache pallidiflora* whitish is pollinated by bees [Dodson and Dunmire 2007] and honeybees).

*Ajuga reptans* blue: *Vanessa cardui*. This is pollinated by bumblebees and other long-tongued bees, sometimes by other insects. It is pollinated by bumblebees and *Rhingia campestris* hoverflies and *Bomblylius* bee flies in Europe (Proctor et al. 1996, who mistakenly list it as butterfly pollinated on their table 4.2).

Lamiaceae many undetermined species (Lamiaceae are popular, but microscope work is needed to identify most): *Argynnis* (*Speyeria*) *callippe*, *Argynnis* (*Speyeria*) *callippe near-callippe*, *Argynnis* (*Speyeria*) *callippe shasta*, *Argynnis* (*Speyeria*) *coronis coronis*, *Argynnis* (*Speyeria*) *egleis near egleis*, *Argynnis* (*Speyeria*) *hesperis cottlei*, *Argynnis* (*Speyeria*) *hesperis irene*, *Argynnis* (*Speyeria*) *hydaspe near-rhodope* some, *Argynnis* (*Speyeria*) *zerene gunderi* some, *Argynnis* (*Speyeria*) *zerene near-zerene* several, *Cercyonis oetus oetus*, *Erynnis tristis tristis*, *Euphydryas chalcedona ~mcglashani*, *Euphydryas*



*chalcedona olancha*, *Hesperia comma*, *Hesperia lindseyi* several, *Ochlodes agricola*, *Parnassius clodius* 3x, *Satyrium behrii behrii* abundant, *Satyrium californica*, *Satyrium californica* many, *Satyrium saepium* 5x, *Satyrium tetra*, *Satyrium titus immaculosus* some.

Lamiaceae white: *Amblyscirtes exotera*, *Apyrrothrix araxes* 3x, *Thorybes pylades*.

Lamiaceae red: *Dione vanillae*.

Lamiaceae purple: *Polites sonora sonora*, *Euphydryas chalcedona sierra*.

Lamiaceae blue: *Argynnis (Speyeria) nokomis*, *Codattractus valeriana* small sp., *Leptidea sinapis*, *Ochlodes yuma*.

Lamiaceae violet: *Junonia coenia* 2x, *Lycaena hyllus* (pale violet, small).

(*Lamium amplexicaule* pink weeds are now superabundant in Denver but I have no records.)

*Lavandula angustifolia* light-purple: *Hemiargus isola* 3x, *Pieris rapae* 13x, *Poanes taxiles* 3x (plus two only ½ sec.), *Polites peckius* 3x, *Pontia protodice*, *Vanessa cardui* 2x. Honeybees pollinate it. *Lavandula latifolia* is pollinated by small bees and occasionally by flies and butterflies in Europe (Herrera 1987, whose visitors are copied on table 11.7 of Willmer 2011).

*Marrubium vulgare* cream is only moderately popular except *Pieris rapae* frequents it: *Erynnis afranius*, *Euphyes vestris*, *Hesperia viridis*, *Pieris rapae* 23x, *Satyrium californica*, *Strymon melinus* 2x. This is evidently pollinated mostly by bees; in Illinois it is visited by honeybees and the long-tongued bees *Bombus* (*B. griseocallis*, *B. pensylvanica*) and Anthophoridae (*Ceratina dupla*) and Megachilidae (*Megachile brevis*), short-tongued bees Halictidae (*Nomia nortoni*), bombyliid flies (*Bombylius atriceps*), and butterflies (*Pieris protodice*) (Hilty 2013).

*Mentha arvensis* pink: *Cercyonis oetus* 10x, *Cercyonis pegala* 4x, *Lycaena helloides*, *Ochlodes sylvanoides*, *Pieris rapae* 4x, *Plebejus icarioides*, *Polites mystic*, *Strymon melinus*. Bees pollinate *Mentha arvensis*, *Mentha pulegia* (including honeybees), and *Mentha Xpiperita* (butterflies may sometimes pollinate this also—Proctor et al. [1996 table 4.2] list *Mentha* with small tubular flowers as butterfly pollinated).

*Mentha spicata* pink-white: *Colias eurytheme*, *Plebejus icarioides* [*Mentha spicata* or *Nepeta cataria*] white.

*Monarda fistulosa* rose-purple is very popular: *Amblyscirtes oslari*, *Anatrytone logan lagus* 23x, *Argynnis (Speyeria) aphrodite* 608x, *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) callippe* 22x, *Argynnis (Speyeria) coronis* 5x, *Argynnis (Speyeria) edwardsii* 8x, *Argynnis (Speyeria) hesperis* 118x incl. Anne U. White and Janet Chu, *Argynnis (Speyeria) hesperis* near *lurana* several, *Asterocampa celtis jeffermont* 2x, *Atrytone arogos* 32x, *Cercyonis oetus* (proboscis must be too small for this) only once, *Cercyonis pegala* 89x, *Chlosyne gorgone*, *Epargyreus clarus* 22x, *Erynnis afranius*, *Euphyes vestris* 106x incl. Anne U. White, *Euptoieta claudia* (hanging below flower maybe caught by predator), *Hesperia ottoe* 22x, *Hesperia pahaska* 4x, *Hesperia uncas*, *Hesperia viridis* 11x, *Limenitis weidemeyerii* 3x, *Ochlodes sylvanoides* 6x [this flower blooms mostly earlier], *Papilio multicaudata*, *Papilio polyxenes* 4x, *Paratrytone snowi* 40x, *Parnassius phoebus smintheus*, *Phyciodes coccyta* 2x, *Pieris marginalis mcdunnoughii* (for this *Monarda*?), *Pieris rapae* 1 sec. then flew, *Piruna pirus* 3x, *Poanes taxiles* 247x incl. Anne U. White and Janet Chu, *Polites mystic* 40x, *Polites origenes* 118x, *Polites themistocles* 2x, *Polites vibex* 2x, *Polygonia interrogationis*, *Satyrium behrii* 3x, *Satyrium liparops* 3x, *Satyrium saepium* 2x + 3x only 1-2 sec. (maybe proboscis too short), *Satyrium titus* 2x, *Vanessa atalanta* 4x, *Vanessa cardui* 12x, *Vanessa virginiensis* 2x. Internet search indicates that bees such as *Bombus* and *Anthophora* and others visit this species. Dodson and Dunmire 2007 wrote that long mouthparts are required to pollinate it, on some bees, moths, butterflies, and hummingbirds. Hummingbirds (Grant 1994) and honeybees also help pollinate it. The bee *Dufourea monardae* specializes on *Monarda* (and possibly *Agastache*).

*Monarda fistulosa* red cultivated var.: *Poanes taxiles*.

*Monarda* rose-purple: *Argynnis (Speyeria) cybele leto*, *Aglais milberti*, *Papilio zelicaon* (Scott and Scott 1978), *Paratrytone snowi*.

*Nepeta cataria* white is popular especially for *Pieris rapae*: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) cybele charlottii*, *Argynnis (Speyeria) hesperis* 12x, *Atalopedes campestris*, *Cercyonis pegala* 8x, *Lycaena arota*, *Ochlodes sylvanoides*, *Papilio glaucus rutulus*, *Papilio polyxenes*, *Pieris rapae* 93x (+7x only a few sec. on old flowers lacking nectar), *Polygonia*

*interrogationis*, *Pyrgus communis*, *Vanessa atalanta*. The most important pollinators are honeybees, solitary halictid bees, and bumblebees, and it can self-pollinate (Sih and Baltus 1987).

*Nepeta Xfaassenii=mussinii* violet is fairly popular, often frequented *Pieris rapae*: *Hemiargus isola* 4x, *Pieris rapae* (blue 30x, pink-violet 29x, white 1x), *Poanes taxiles* 2x, *Polites peckius* 2x, *Pontia protodice*, *Pyrgus communis* 7x, *Vanessa cardui*.

(*Ocimum basilicum* has tiny whitish flowers that are not visited. They are pollinated by bees.)

*Origanum vulgare* purplish-pink grew in my yard for a decade but is unpopular: *Pieris rapae* 4x. An internet photo shows *Aglais urticae* feeding on it in Britain. It is reportedly pollinated by bees including honeybees, moths, and butterflies.

*Perovskia atriplicifolia* blue (an Asian plant now abundant in gardens) is not very popular: *Pieris rapae* 4x, *Hemiargus isola* (Michael S. Fisher), *Pyrgus communis* 3x, *Vanessa cardui*, *Vanessa carye* likes it. (No butterflies and no *Polites peckius* or *P. themistocles* visited it in several days.) This is pollinated by bumblebees and honeybees.

*Physostegia virginiana* rosy-cream (sometimes white) is not popular: *Polites peckius* 1 visit to rosy-cream flower. No more visits by this or *P. themistocles* or other butterflies were seen in about 5 days.

*Prunella vulgaris* blue: *Poanes taxiles*. Reportedly pollinated by bumblebees *Bombus vagans*.

*Pycnanthemum tenuifolium* white is extremely popular in eastern U.S. (one of the most popular flowers studied by Robertson 1929): *Junonia coenia*. This is pollinated by honeybees. It is visited by many Hymenoptera and some Lepidoptera in New Jersey, most often by sweat bees *Lasioglossum* and *Halictus* which are probably the major pollinators there.

*Salvia* species are mostly pollinated by bees including honeybees (and some especially the shrubby red-flowered species by hummingbirds, Grant 1994). *Salvia pratensis* blue and *S. glutinosa* yellow are pollinated by bees in Europe (Proctor et al. 1996). In Britain cultivated red *Salvia splendens* are pollinated by bumblebees *Bombus pascuorum* and short-tongued bees that have to crawl down the long corolla; *S. splendens* is pollinated by hummingbirds in its native Brazil (Proctor et al. 1996).

*Salvia sclarea* pink has a powerful scent but is not popular: *Papilio multicaudata* 3x (but two only 1 sec. and several sec.), *Pieris rapae* (<1 sec.).

*Salvia farinacea* purple to seldom white is moderately popular: *Colias eurytheme* 2x, *Euptoieta claudia*, *Polites peckius* purple-blue 53x +violet-blue 13x +white 1x, *Polites themistocles* purple-blue 44x + white 4x (preferred over *Gomphrena*) (*S. farinacea* is not as popular as *Verbena* and *Zinnia* to both *Polites*), *Vanessa cardui* violet-blue “Blue Bedder”. This is pollinated by two species of stingless bees and by honeybees.

*Salvia nemorosa* “East Friesland” blue is moderately popular: *Pieris rapae* 3x, *Polites peckius* 8x, *Pontia protodice*, *Vanessa cardui* (“Mainacht” purple) 4x, *Vanessa carye* (“Mainacht” purple) 2x.

*Salvia ~officinalis* blue: *Polites themistocles* 5x.

(*Salvia* “like *Gilia*” red had no visits by butterflies and no *Polites peckius* or *P. themistocles* during several days.)

*Scutellaria brittonii* deep-violet-blue is not very popular: *Amblyscirtes vialis*, *Atrytonopsis hianna hianna*, *Papilio indra*, *Parnassius phoebus smintheus*, *Poanes taxiles*, *Polites* (*Yvretta*) *rhesus* long time. Other *Scutellaria* spp. are reportedly pollinated by long-tongued bees (bumblebees and *Anthophora*) and wasps; they are visited by short-tongued bees and syrphid flies and occasionally by butterflies but those are too small or weak to be effective pollinators.

*Stachys olympica* pinkish is unpopular: *Pieris rapae* ½ sec. (blue flower), *Vanessa atalanta*, *Vanessa cardui*.

*Stachys tenuifolia* lavender is primarily pollinated by long-tongued bees for nectar, and short-tongued bees sometimes collect pollen, while flower flies feed on the pollen but are not very effective pollinators; occasional butterflies and skippers visit but are not very effective pollinators either (Hilty 2013). *Stachys sylvatica* is pollinated by *Bombus pascuorum* in Europe (Proctor et al. 1996). Three species of *Stachys* are pollinated by hummingbirds (Grant 1994).

*Stachys palustris* pink: *Papilio polyxenes* a little.

*Teucrium chamaedrys* red-purple is fairly popular: *Atalopedes campestris* 7x, *Pieris rapae*, *Polites peckius* 6x. This is pollinated by bees, and sometimes by self-pollination. *Teucrium scorodonia* is pollinated by

bumblebee *Bombus lapidarius* in Europe (Proctor et al. 1996, who mistakenly list it as butterfly pollinated on their table 4.2).

OROBANCHACEAE (includes many genera formerly placed in Scrophulariaceae, including *Agalinis*, *Castilleja*, *Cordylanthus*, *Orthocarpus*, *Pedicularis*)

These flowers are unpopular. The small parasitic *Orobanche* have *Penstemon*-like flowers that are often dull brown and are evidently rarely visited by butterflies. *Castilleja* are beautiful but are mostly shunned (and the colorful bracts are too large for the butterfly to get any nectar). Orobanchaceae in general are pollinated by bees wasps flies and birds (Judd et al. 2008).

(*Agalinis tenuifolia* had no visits on the few flowers I found in Wheatridge Colo.)

*Castilleja integra* crimson: *Papilio machaon bairdii* [briefly?], *Papilio polyxenes* 2x. Most *Castilleja* including this *C. integra*, *C. affinis*, *C. chromosa*, *C. foliolosa*, *C. lanata*, and *C. miniata* are pollinated by hummingbirds (Grant 1994). Elsewhere, *Castilleja linariifolia* is pollinated by hummingbirds, *Castilleja pulchella* by bumblebees (Bauer 1983), *Castilleja sulphurea* is regularly visited by bumblebees, a Peruvian *Castilleja* is pollinated by bees, and *Castilleja cryptantha* self-pollinates.

*Castilleja rhexifolia* lavender: *Boloria eunomia* ½ sec. This is pollinated by hummingbirds (Grant 1994) (*Castilleja sessiliflora* is common on the plains but is shunned. It is pollinated only by *Bombus fervidus* bumblebees in Wisconsin.)

(*Orthocarpus luteus* yellow: I have seen few flowers and no visits. Most *Orthocarpus* are pollinated by native bees and honeybees. But *Orthocarpus campestris* may self-pollinate, and *O. pusillis* resembles prostrate moss and is pollinated by ants.)

*Pedicularis groenlandica* reddish-purple to dark-rose is unpopular: *Boloria frigga*. *Pedicularis* is sometimes “buzz-pollinated” (Macior 1983). *P. groenlandica* and most other summer pinkish *Pedicularis* lack nectar and are pollinated by worker bumblebees (Dodson and Dunmire 2007, Macior 1978, 1995, Aluri and Robart 1991) and sometimes by cuckoo bees *Psithyrus*. But spring species with yellow flowers such as *P. canadensis* and *P. palustris* have nectar and are pollinated by queen bumblebees (Proctor et al. 1996), and *Pedicularis procera* has much nectar and is pollinated by hummingbirds and bumblebees (Macior 1995). *Pedicularis densiflora* is pollinated by hummingbirds (Grant 1994).

*Pedicularis*? blue elephant flower: *Thorybes pylades* S Ariz.

## VERBENACEAE

*Lantana* and *Verbena* are very popular. *Verbena* spp. are some of the best butterfly-attracting flowers in Denver in late summer. Verbenaceae in general are pollinated by nectar-gathering bees wasps and flies (Judd et al. 2008).

*Caryopteris clandonensis* blue: *Atalopedes campestris* [on “Longwood Blue”], *Pieris rapae* 3x, [*Polites peckius* did not feed on it during several days]. This is sometimes visited by butterflies but is probably usually pollinated by the numerous honeybees and bumblebees that visit.

*Lantana camara* yellow (turning reddish with age): *Amblyscirtes nysa*, *Copaeodes aurantiaca*, *Hylephila phyleus*, *Junonia evarete nigrosuffusa* (~*Lantana*-type yellow flower with legume leaves), *Lerodea eufala*, *Strymon bazochii* common. *Lantana* is used in butterfly greenhouses, it is so popular. In the usual variety, only the yellow flowers have nectar, and they turn reddish and nectarless in three days. Butterflies are the main pollinators in America and India (Andersson 2006, Schemske 1976, Thakur and Mattu 2010) (*Trigona fulviventris* bees are nectar robbers, Barrows 1976), and most prefer the nectariferous yellow flowers (Dronamraju 1960) though some butterflies prefer orange. In Tanzania the flowers favor long-tongued insects, and butterflies are the most frequent pollinators (62%, compared to bees 14%, flies 7%, moths 7%, and others 10%) (Muthoka and Mananze 1976). Thrips pollinate *L. camara* regularly in India (Mohan Ram and Mathur 1984), and they also prefer the yellow flowers. In Australia it is pollinated by honeybees, and butterflies and moths visit it for nectar.

*Phyla*=*Lippia cuneifolia* white: *Phyciodes pulchella camillus* 5x, *Pyrgus communis* 2x. Honeybees are the only major pollinators of Australian *Lippia*, and Mexican *Lippia graveolens* is evidently pollinated by

honeybees *Apis mellifera* and *Apis mandacaiia*. Other *Lippia* are visited by a sphingid moth etc., and some can self-pollinate.

*Phyla*=*Lippia lanceolata* bluish-white: *Nathalis iole* 4x.

*Verbena* is pollinated by honeybees, but is very popular with butterflies.

*Verbena bipinnatifida* purple to rosy to white: *Polites peckius* lavender 2x + purple 1x, *Polites themistocles* purple 5x + lavender 1x + rosy 4x + pink 1x + rosy-white 1x + white 1x.

*Verbena bracteata* bluish-purple: *Argynnis* (*Speyeria*) *edwardsii*, *Pholisora mejicanus* 7x, *Pieris rapae*, *Pyrgus communis*, *Pyrgus communis*, *Pyrgus scriptura*.

*Verbena hastata* purplish-blue: *Ancyloxypha numitor* 13x, *Atalopedes campestris* 15x, *Boloria selene nebraskensis*, *Celastrina neglecta*, *Cercyonis pegala*, *Colias eurytheme* 13x, *Colias philodice* 2x, *Danaus plexippus* 3x, *Hylephila phyleus* 5x, *Lycaena dione*, *Lycaena hyllus*, *Nathalis iole*, *Ochlodes sylvanoides* 7x, *Papilio glaucus rutulus*, *Papilio polyxenes*, *Phyciodes cocyta*, *Phyciodes tharos orantain* 2x, *Pieris rapae* 7x, *Plebejus melissa*, *Polites peckius* 3x, *Pontia protodice*, *Pyrgus communis*, *Strymon melinus* 2x. This is pollinated by long-tongued bees (esp. bumblebees) and short-tongued bees, Epoline cuckoo bees, Eucerine miner bees, halictid bees, the specialist *Verbena* Bee (*Calliopsis verbenae*); other visitors that may sometimes pollinate are a thread-waisted wasp, bee flies, thick-headed flies, the golden soldier beetle, and butterflies. It sometimes self-pollinates, and some other *Verbena* do so frequently. Other *Verbena* are visited by numerous pollinating bees, many flies, and some wasps and butterflies.

*Verbena Xhybrida* “Imagination” purple: *Atalopedes campestris* 18x, *Pieris rapae* 2x, *Poanes taxiles* 2x, *Vanessa cardui* 10x.

*Verbena nervosa* purple or purplish-blue: *Phoebis sennae*? 4x, *Vanessa cardui* 7x, *Pyrgus communis* (near-venosa, “Purple Top”), *Vanessa cardui* “Purple Top” 17x, *Danaus plexippus* “Purple Top”, *Strymon melinus* “Purple Top”.

*Verbena rigida* purple/bluish-purple: *Polites peckius*, *Vanessa cardui*.

*Verbena stricta* purplish-blue: *Amblyscirtes vialis* 4x, *Anatrytone logan logan*, *Argynnis* (*Speyeria*) *aphrodite* 5x, *Argynnis* (*Speyeria*) *coronis* 3x, *Argynnis* (*Speyeria*) *edwardsii* 5x, *Boloria selene sabulocollis*, *Cercyonis pegala*, *Colias philodice* 7x, *Erynnis afranius* 2x, *Euphyes vestris* 13x, *Euptoieta claudia*, *Papilio machaon brucei*, *Pieris rapae*, *Plebejus melissa*, *Poanes taxiles* 3x, *Polites origenes* 12x, *Polites peckius*, *Strymon melinus*. Visited by numerous bees including bumblebees, the *Verbena* Bee (*Calliopsis verbenae*), flies, some wasps, and butterflies that may pollinate.

*Verbena* purple and purplish-blue: *Argynnis* (*Speyeria*) (probably *aphrodite* and *edwardsii*) Janet Chu, *Atrytonopsis pittacus* ~13x, *Atrytonopsis vierecki*, *Erynnis ?tristis*, *Euptoieta claudia*, *Eurema nicippe*, *Hylephila phyleus*, *Lerodea eufala*, *Pieris rapae*, *Strymon melinus* Janet Chu, *Vanessa cardui*, *Vanessa carye*, *Vanessa virginiana*, *Vanessa virginiana* 11x, *Zerene cesonia*.

?*Verbena* tall 1m blue flower: *Atalopedes campestris*.

## BIGNONIACEAE

Bignoniaceae in general are pollinated by bees, wasps, butterflies, hawk moths, birds, and bats (Judd et al. 2008). Colorado species are cultivated and are not visited.

(*Catalpa bignonioides* trees have large very showy white flowers but are shunned and I have no records.

However there are records of 4 *Battus philenor* visiting it in Iowa. *Catalpa speciosa* is reportedly pollinated by bumblebees [*Bombus* spp.], the large carpenter bee *Xylocopa virginica*, and various nocturnal moths [Geometridae, Ctenuchidae, Noctuidae, Lasiocampidae, Sphingidae], while other nectar-seeking visitors are honeybees, skipper butterflies, ants, and flies that are less effective at cross-pollination.)

(*Campsis radicans* red has no records, although *Asterocampa clyton* sucks nectar? from fallen flowers [Bright and Ogard 2010]. Their giant flowers are pollinated by hummingbirds.)

## CONVOLVULACEAE (includes Cuscutaceae)

Convolvulaceae are unpopular flowers, including the cultivated *Ipomoea* etc., except some Hesperinae skippers like *Convolvulus sepium*. Convolvulaceae in general are pollinated by various insects (Judd et al. 2008).

- Convolvulus (Calystegia) sepium angulata* white 4 cm flowers: *Poanes taxiles* 9x (5x crawled inside 5 cm corolla tube, and female crawled completely into flower and extended proboscis to feed); *Polites mystic* crawled into flower tube. Bright and Ogard (2010) have a photo of *Phoebis sennae* in the tube. This is pollinated by bees (including *Bombus pascuorum*) and hoverflies (and probably not by sphingid moths) in Europe (Baker 1957; Stace 1965). *Systropha* bees are known to use *Convolvulus* pollen.
- Convolvulus arvensis* whitish is very common but unpopular: *Colias eurytheme* 7x (plus 1 sec. for another and <1 sec. for 2x), *Colias philodice* 4x (+ briefly 3x so an unpopular flower), *Erynnis afranius*, *Euptoieta claudia* 3x (+ 2x briefly), *Oarisma garita* 2x, *Pieris rapae* 12x (+ one only 30 sec., one 6 sec., others 1 sec.), *Poanes taxiles* 2x, *Polites themistocles* 7x (another only 1 sec.), *Pontia protodice* 5x (3x only briefly), *Pyrgus communis* 3x, *Vanessa cardui* 2x. In Europe this is pollinated by various insects, primarily bees and a variety of flies (Proctor et al. 1996) including the syrphid fly *Rhingia*.
- (*Cuscuta epithimum* pale-pink [formerly in Cuscutaceae] is uncommon, but I have never seen a butterfly on it. It is reportedly pollinated by ants, while bees, wasps and flies visit and could pollinate, and it self-pollinates.)
- (*Ipomoea* has no records. Elsewhere, *Ipomoea coccinea* is pollinated by hummingbirds [Grant 1994], as are *I. quamoclit* and *I. hederifolia* even though 80% of visits are by Coliadae butterflies, which also make some visits to *I. hederacea* and *I. trichocarpa* which are pollinated by bees (Wolfe and Sowell 2006). *Melitoma* bees [Anthophoridae] [including *M. taurea*] and the bee *Cemolobus ipomoeae* are specialists and visit only *Ipomoea* flowers.)

## SOLANACEAE

- These flowers are showy but are usually shunned. Solanaceae in general are pollinated by bees wasps flies butterflies and moths; *Solanum* has no nectar and is pollinated by bees and flies seeking pollen (bumbees can buzz-pollinate it); *Cestrum* and *Datura* have nectar and attract insects (Judd et al. 2008).
- (*Capsicum frutescens* [conical chilies] have pretty whitish flowers but are not visited. It can self-pollinate, and is pollinated by 16 sp. of native bees in *Hylaeus* [Colletidae], *Dialictus*, *Halictus*, *Augochlora*, *Augochloropsis* and *Ceratalictus* [all Halictidae], *Exomalopsis* and *Bombus* [Apidae], and no other insects visited [Raw 2000], while syrphid flies *Eristalis tenax*, *Bombus impatiens* bumblebees [which buzz-pollinate them], honeybees, *Osmia cornifrons* bees, *Melipona subnitida* bees, even thrips and ants sometimes, are known to pollinate elsewhere. *Capsicum chinense* [Habanero chilis] are pollinated by *Nannotrigona perilampoides*.)
- (*Datura stramonium* has giant white flowers that are shunned. *Datura meteloides* is visited by the sphingid moth *Manduca sexta* [Baker 1961], and *Datura wrightii* is claimed to be pollinated by moths.)
- Lycium barbarum halimifolium* violet is a popular flower elsewhere but is rare in Colo.: *Hesperia leonardus pawnee* 3 sec, *Pieris rapae* 4x a long time. It is evidently usually pollinated by bees, and sometimes by syrphid and other flies and perhaps sometimes by butterflies, and it can self-pollinate.
- Petunia hybrida* pink or rosy or purple or red or white are large cultivated flowers that are seldom visited, by large Papilionidae butterflies: *Papilio multicaudata* pink 10 sec+ in area with few flowers (others flew over it and did not land), *Vanessa cardui* pink 1 sec., and photos show *Battus philenor* (on P. Allan Smith TV show) and *Papilio glaucus* on pink *Petunia* (no butterflies and no *Polites peckius* or *P. themistocles* or *Pieris rapae* visited colored flowers or white flowers on several days) Elsewhere, this is probably pollinated by nocturnal moths as it has few daytime visitors in Britain, and *Petunia axillaris* white is pollinated by the sphingid moth *Manduca sexta* drawn to its odor, while *Petunia exserta* red lacks a scent and is pollinated by bumblebees attracted to its red color (Klahre et al. 2011). Smaller native species including *Petunia integrifolia* pink and Brazilian *Petunia* spp. are pollinated by bees.
- (*Physalis hederifolia* and *P. virginiana* etc. yellowish are fairly common on prairies but are shunned. Colorado *P. heterophylla* and *P. virginiana* outcross, but *Physalis* elsewhere with tiny flowers [P.

*angulata*, *P. pubescens*, and *P. grisea*] self-pollinate. The bees *Colletes latitarsis* and *C. willistoni* and *Perdita halictoides* are specialists that gather pollen and usually nectar only from *Physalis* flowers.) (*Physalis ixocarpa* yellow with brown spots [tomatillo] is in gardens but is shunned. Some *Colletes* bees buzz-pollinate it.)

(*Physalis melongena* [eggplant] violet is in gardens but is shunned. Bumblebees buzz-pollinate it.)

*Solanum dulcamara* violet with green spots: *Pteris rapae*. This is pollinated by bumblebees by “buzz pollination” to shake tiny 14µm pollen out of the anther tips, as the flowers lack nectar (Proctor et al. 1996; and others); the colletid bee *Ptiloglossa* also sonicates (buzz-pollinates) it. Other *Solanum* (*S. melongena*, *S. violaceum*, and *S. carolinense* [pollinated by bees *Bombus impatiens* and sometimes by *Augochloropsis metallica* or *Lasioglossum*]) are also buzz-pollinated (Quesada-Aguilar 2007).

*Solanum* yellow: *Eurema proterpia*.

(*Solanum melongena* var. *esculentum* violet and *Solanum tuberosum* white to bluish are also not visited in gardens. They are buzz-pollinated the same way as *Solanum lycopersicum* discussed below.)

(*Solanum lycopersicum*=*Lycopersicon esculentum* [tomato] yellow is common in my garden, but I have never seen a butterfly visit. It is self-fertile, and is pollinated by bumblebees [*Bombus terrestris*] in greenhouses. It is buzz-pollinated [the anther has a hole from which pollen must be shaken, so bees grab it and “buzz-pollinate” it to shake the pollen onto their bodies]. Some *Anthophora* bees are important pollinators in southwest U.S., and halictid bees in Peru. In Europe it is buzz-pollinated by bumblebees *Bombus posovororum*, *B. terrestris*, *B. lapidarius*, *B. sylvarum*, and *Megachile willoughbiella*, and by smaller bees *Hylaeus gibbus*, and by *Lasioglossum* bees including *L. morio* and *L. politum* that buzz then scrape the pollen from their bodies into the leg storage [Teppner 2005].)

#### CAMPANULACEAE (includes Lobeliaceae)

*Campanula* is not popular, but *Lobelia* is very popular. Campanulaceae in general are pollinated especially by bees and birds (Judd et al. 2008).

(*Campanula carpatica* blue had no butterfly visits in several days, including no *Polites peckius* or *P. themistocles*. In eastern U.S. *Campanula* [*Campanulastrum*] *americana* is pollinated principally by long-tongued bees, including bumblebees *Bombus* and large leaf-cutting megachilid bees [including the Campanulaceae specialist bee *Megachile campanulae*], much less efficiently by halictid bees, while syrphid flies may get nectar but are not effective pollinators, and butterflies and skippers occasionally visit [Hilty 2013]. Other *Campanula* are pollinated by honeybees etc. Ten species of bees specialize on *Campanula* flowers in Europe [Naylor 2006], and three of those [*Chelostoma campanularum*; *C. fuliginatum*, and *Lithurgus chrysurus*] have been introduced to the U.S. [Cane 2003].)

*Campanula rapunculoides* blue is a common yard weed, not popular: *Papilio glaucus rutulus*, *Poanes taxiles*, (*Polites peckius* did not visit it).

*Campanula rotundifolia* blue: *Amblyscirtes phylace*, *Erynnis afranius*, *Hesperia comma* briefly, *Oarisma garita*, *Papilio multicaudata* 2 sec., *Pontia protodice* briefly. This is pollinated by bees (Proctor et al. 1996).

*Lobelia siphilitica* violet-blue is very popular: *Amblyscirtes eos* 2x, *Ancyloxypha numitor*, *Argynnis* (*Speyeria*) *idalia*, *Atalopedes campestris*, *Atalopedes campestris*, *Atrytone arogos* 2x, *Battus philenor*, *Cercyonis pegala* 2x, *Colias edwardsii altiplano*, *Colias eurytheme*, *Euptoieta claudia* 12x, *Hesperia ottoe* 3x, *Lerodea eufala*, *Papilio polyxenes* blue, *Polites peckius*, *Polites themistocles* 2x, *Pyrgus communis* 4x, *Vanessa cardui* 3x, *Vanessa virginiensis*, *Wallengrenia egeremet* 2x. It is pollinated by bumblebees (*Bombus*) (Caruso et al. 2003), and hummingbirds and butterflies also visit and may pollinate sometimes (halictid bees gather pollen only and are non-pollinating).

(*Lobelia cardinalis* is rare in Colorado so I have no observations. Its red flowers are pollinated by hummingbirds [Caruso et al. 2003].)

(*Platycodon grandiflorum* blue had no *Polites peckius* or *P. themistocles* or other butterfly visits during 4-5 days. It often self-pollinates.)

#### ASTERACEAE=COMPOSITAE

These are mostly quite popular and are reportedly butterfly-pollinated. The most popular genera are: *Achillea*, *Agoseris*, *Anaphalis*, *Antennaria*, *Arctium*, *Arnica*, *Aster*, *Bidens*, *Carduus*, *Centaurea*, *Chrysothamnus*, *Cirsium*, *Echinacea*, *Erigeron*, *Eupatorium*, *Gaillardia*, *Grindelia*, *Haplopappus*, *Helianthus* [not very popular], *Heliopsis*, *Heterotheca*, *Hymenopappus*, *Hymenoxys*, *Liatris*, *Machaeranthera*, *Onopordum*, *Pericome*, *Rudbeckia*, *Senecio*, *Solidago*, *Tagetes*, *Taraxacum*, *Tetradymia*, *Verbesina*, *Viguiera*, *Zinnia*. Some genera seem to be only moderately popular: *Ageratum* (unpopular), *Anthemis*, *Brickellia*, *Chaenactis*, *Chrysanthemum*, *Cichorium*, *Conyza*, *Coreopsis*, *Cosmos*, *Crepis*, *Dyssodia*, *Gutierrezia*, *Lactuca*, *Lygodesmia*, *Podospermum*, *Ratibida*, *Sonchus*, *Stephanomeria*, *Tanacetum*, *Tragopogon*. *Gnaphalium* has small ugly flowers that are seldom visited. *Ambrosia*, *Artemisia*, *Iva*, *Xanthium*, and some *Baccharis* also have small ugly flowers and are wind-pollinated, so they are not visited. Judd et al. (2008) state that Asteraceae in general are pollinated by a wide variety of generalist pollinators (butterflies bees flies beetles), and pollination by bees is especially frequent, while a few genera and *Baccharis* are wind-pollinated. Actually *Baccharis* is partly wind-pollinated but must be insect pollinated at least in part because some species are frequently visited by insects and are popular with butterflies (see below). The bees *Osmia californica* and *Eumegachile* (*Sayapis*) *pugnata* and dozens of *Melissodea* spp. are specialist pollinators of Asteraceae flowers. *Andrena* (*Callandrena*) bees specialize on one of the four subtribes of Asteraceae. *Artemisia* (including *Seriphidium*) is wind-pollinated. (The various new genera that Weber and Wittmann [2012] use to split *Aster*, *Centaurea*, *Haplopappus*, *Senecio*, *Solidago* etc., are lumped here as subgenera.)

*Achillea filipendulina* “Gold Plate” yellow: *Hemiargus isola*.

*Achillea millefolium* wild variety “lanulosa” white is abundant so there are many records, though it is not as popular as many other flowers: *Aglais milberti*, *Boloria titania helena*, *Argynnis* (*Speyeria*) *aphrodite* 2x, *Argynnis* (*Speyeria*) *atlantis sorocko*, *Argynnis* (*Speyeria*) *callippe*, *Argynnis* (*Speyeria*) *hesperis* 2x, *Argynnis* (*Speyeria*) *mormonia* 2x, *Callophrys gryneus nelsoni* ~18x, *Callophrys gryneus siva* 2x, *Cercyonis meadii* 2x (+ once only ½ sec.), *Cercyonis oetus* 4x, *Chlosyne leanira leanira* 6x, *Chlosyne palla australomontana* some, *Coenonympha haydenii*, *Coenonympha tullia californica* 5x, *Coenonympha tullia inornata*, *Colias meadii*, *Colias scudderii* 2x, *Danaus plexippus*, *Erebia callias*, *Erebia epipsodea* 2x, *Erebia stubbendorffii* “theano” *ethela* 4x, *Euchloe ausonides ausonides* 8x, *Euphydryas anicia capella* 2x, *Euphydryas editha editha*, *Hesperia comma* 2x, *Hesperia viridis*, *Junonia coenia* 9x, *Lycaena arota*, *Lycaena florus* 26x (frequently), *Lycaena gorgon*, *Lycaena heteronea* 4x, *Lycaena rubidus* 8x, *Lycaena xanthoides* “*editha*” *vurali* 7x, *Nathalis iole*, *Neominois ridingsii* 2x, *Neophasia menapia* 1x and another only ½ sec., *Oarisma garita*, *Ochlodes sylvanoides* 2x, *Oeneis calais altacordillera* 3x (+ others only 1/3, 1/3, 2 sec.), *Paratrytone snowi*, *Parnassius clodius*, *Parnassius phoebus smintheus* 1x, *Phyciodes batesii apsaalooke*, *Phyciodes pulchella camillus camillus* 2x, *Pieris marginalis mcdunnoughii* 3x, *Piruna pirus*, *Plebejus glandon rustica* 8x, *Plebejus icarioides* (mostly ssp. *lycea*), *Plebejus alupini lutzi*, *Plebejus melissa*, *Plebejus saepiolus*, *Poladryas minuta monache* 9x, *Polites draco*, *Polites origenes*, *Polites peckius surllano*, *Polygonia faunus* (mostly ssp. *hylas*), *Pontia callidice occidentalis*, *Pontia protodice*, *Pyrgus communis*, *Satyrium behrii crossi* 3x, *Satyrium californica*, *Satyrium saepium* 3x, *Strymon melinus*, *Vanessa cardui* 4x (+ one only ½ sec.). This is self-incompatible and pollinated by numerous insects such as solitary bees and Hemiptera and syrphid and tachinid flies. In Illinois the flower nectar attracts flies (bee flies, syrphid flies including drone flies, thick-headed flies, Tachinid flies, flesh flies, Anthomyiid flies, and others) and wasps, while halictid bees and other short-tongued bees occasionally visit for nectar and pollen; mordellid beetles are sometimes found on flower heads (Hilty 2013).

*Achillea millefolium* (cultivated var. *millefolium*) white (some rosy ones were not visited): *Colias eurytheme* 1 sec., *Strymon melinus*, *Polites peckius* (unpopular flower, 2x rested on it but did not feed, and none visited it other days), *Pyrgus communis* ½ sec.; (*Polites themistocles* never visited this during several days).

*Ageratum houstonianum* blue (or pink or purple or white): butterflies ignored the blue flowers of dwarf plants in my yard and local gardens. It is known to be partly self-pollinating, and even thrips going from one flower to another can pollinate *Ageratum conyzoides*. However the blue flowers of taller more open-

inflorescence *Ageratum* varieties are much more popular, as internet photos show visiting butterflies (*Zerene cesonia*, 5 *Danaus gilippus*, *Danaus plexippus*, *Heliconius ismenius*, *Vanessa virginiensis*, *Junonia coenia*, *Urbanus proteus*, plus honeybees and 2 syrphid flies and a bombyliid fly.)

*Agoseris aurantiaca* orange: *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) hesperis*, *Argynnis (Speyeria) mormonia* 4x, *Parnassius phoebus smintheus*.

*Agoseris glauca dasycephala* yellow: *Erebia callias*.

*Agoseris glauca* var. *parviflora* yellow: *Colias scudderii*.

*Agoseris glauca* yellow: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) atlantis sorocko* 19x, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) hesperis* 8x, *Argynnis (Speyeria) mormonia* 5x and var. *parviflora* 1x, *Boloria titania*, *Chlosyne gorgone* (gray thistle-like leaf), *Colias meadii*, *Erebia epipsodea* 2x, *Euptoieta claudia*, *Hesperia uncas* 2x, *Papilio polyxenes*, *Parnassius phoebus smintheus* 3x (one male caught by foreleg in slit of flower, the petal or stamen wound around his leg), *Plebejus glandon*, *Vanessa virginiensis*. This is pollinated by various insects.

(*Ambrosia* is very common but has no records; the tiny ugly flowers are wind-pollinated.)

*Anaphalis margaritacea* whitish is popular, and cultivated flowers are also popular: *Aglais milberti*, *Argynnis (Speyeria) hesperis* 2x, *Cercyonis oetus*, *Euchloe olympia*, *Euphydryas anicia capella* 2x, *Lycaena florus* 20x, *Lycaena heteronea* 3x, *Lycaena nivalis browni*, *Lycaena rubidus* 4x, *Lycaena xanthoides "editha" vurali* 4x, *Polygonia gracilis zephyrus* 4x, *Plebejus saepiolus*, *Satyrium saepium*. Outcrossing is maintained by all-male and mostly-female plants, that are reportedly pollinated by insects including butterflies and moths.

*Antennaria* is moderately popular despite its modest appearance. *Antennaria* is pollinated by small bees and flies in Illinois prairies.

*Antennaria parvifolia* whitish: *Callophrys dumetorum homoperplexa*, *Callophrys spinetorum* Janet Chu, *Celastrina lucia sidara* 2x, *Chlosyne gorgone*, *Coenonympha tullia ochracea* 8x, *Erynnis icelus*, *Erynnis pacuvius*, *Erynnis persius*, *Erynnis telemachus*, *Euphydryas anicia capella*, *Lycaena florus*, *Lycaena nivalis browni*, *Oeneis calais altacordillera* 5 sec., *Oeneis chryxus*, *Parnassius phoebus smintheus*, *Phyciodes pulchella camillus* 11x, *Plebejus glandon* 4x and 1 sec., *Plebejus saepiolus* (1x, and another probing seedy dry head), *Polites draco* ½ sec., *Polygonia gracilis zephyrus* 4x, *Pyrgus xanthus* 2x.

*Antennaria rosea* rosy-whitish: *Lycaena florus* 7x, *Pyrgus xanthus*.

*Arctium minus* rose or rose-purple: *Argynnis (Speyeria) aphrodite* 7x, *Argynnis (Speyeria) hesperis* 42x, *Argynnis (Speyeria) nokomis* 2x, *Colias philodice*, *Erynnis horatius*, *Euptoieta claudia*, *Hesperia comma* 12x, *Lycaena arota*, *Ochlodes sylvanoides* 23x, *Ochlodes yuma*, *Pholisora catullus*, *Pieris marginalis mcdunnoughii*, *Pieris rapae* 20x, *Piruna pirus*, *Papilio troilus* and *Polites themistocles* (photos), *Polygonia satyrus* 3x, *Pontia protodice*, *Pyrgus communis* (photo), *Strymon melinus*. In Illinois this is visited by numerous long-tongued bees including honeybees and bumblebees and Anthophoridae and Megachilidae, by short-tongued halictid bees, and by syrphid and bombyliid flies and butterflies, most of which probably pollinate it (Hilty 2013).

*Arnica cordifolia* yellow is popular and would be even more so if it did not prefer partial shade: *Aglais milberti*, *Argynnis (Speyeria) mormonia* 3x, *Boloria freija*, *Boloria eunomia*, *Boloria titania* 3x, *Colias meadii* 2x, *Colias scudderii* 2x, *Erebia callias*, *Erebia epipsodea* 3x, *Euchloe ausonides* 2x, *Lycaena cupreus snowi*, *Oeneis calais altacordillera* 3x, *Pieris marginalis mcdunnoughii* 5x, *Plebejus glandon* 3x, *Plebejus saepiolus*, *Polygonia gracilis zephyrus* 4x, *Pyrgus centaureae* 7x, *Vanessa cardui*. *Arnica cordifolia* usually self-pollinates so most plants are clones, but it is occasionally pollinated by bees and flies etc.

*Arnica [cordifolia or fulgens]* yellow: *Euptoieta claudia* 2x Anne U. White and Janet Chu.

*Arnica fulgens* yellow: *Chlosyne gorgone*. This is reportedly pollinated by bees flies and butterflies.

*Arnica mollis* yellow (some of these records could actually be *Arnica rydbergii* yellow): *Aglais milberti* 15x, *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) callippe calgariana*, *Argynnis (Speyeria) hesperis lurana*, *Argynnis (Speyeria) mormonia* 74x, *Argynnis (Speyeria) zerene* 6x, *Boloria eunomia* 3x, *Boloria titania* 73x, *Cercyonis oetus* ~20x, *Colias eurytheme*, *Colias meadii* 6x, *Colias scudderii* 6x, *Erebia callias*, *Erebia epipsodea* (incl. 2 form *brucei*) 21x, *Euphydryas bernadetta bernadetta* small,



*Hesperia comma colorado*, *Lycaena cupreus snowi*, *Lycaena xanthoides* “*editha*” *vurali*, *Oarisma garita*, *Oeneis chryxus*, *Oeneis jutta* sucking it from below, *Parnassius phoebus smintheus* 5x, *Parnassius phoebus hermodur*, *Phyciodes cocyta* 2x, *Phyciodes pulchella camillus* 4x, *Piruna pirus*, *Plebejus glandon* 2x, *Plebejus saepiolus*, *Plebejus shasta pitkinensis*, *Polites draco*, *Polygonia gracilis zephyrus* 2x, *Pontia protodice* 2x, *Pyrgus centaureae* 2x, *Satyrium fuliginosum semiluna* ~10x, *Vanessa atalanta* 7x, *Vanessa cardui* 28x, *Vanessa carye* 2x. This is pollinated by insects, probably mostly by bees and flies but surely sometimes by butterflies.

*Arnica parryi* (rayless) yellow: *Argynnis* (*Speyeria*) *mormonia* 2x, *Lycaena florus* 7x + 1 sec.

*Arnica rydbergii* yellow: *Aglais milberti* 29x, *Argynnis* (*Speyeria*) *mormonia* 14x, *Boloria titania* 3x, *Chlosyne whitneyi damoetas* 4x, *Coenonympha tullia*, *Colias meadii* 17x, *Colias scudderii* 4x, *Erebia epiptodea* 9x, *Hesperia nevada*, *Lycaena cupreus snowi*, *Lycaena florus* 2x, *Oeneis calais altacordillera* 2x, *Parnassius phoebus hermodur* 5x, *Polites draco*, *Satyrium behrii*, *Vanessa cardui*.

*Artemisia frigida* pale greenish: *Paratrytone snowi* 4x. *Artemisia* are wind-pollinated [the pollen blows long distances], sometimes self-pollinated, and evidently only occasionally pollinated by insects.)

(*Artemisia ludoviciana* greenish is wind-pollinated.)

(*Artemisia* (*Oligosporus*) including *A. dracunculus* greenish is wind-pollinated.)

(*Artemisia* (*Seriphidium*) including *A. tridentata* grayish is wind-pollinated; its pollen is prominent in soils throughout its range.)

*Aster* spp. are reportedly pollinated by *Colletes* bees, though they are also popular with butterflies. The bees *Andrena asteris* and *A. asteroides* specialize on *Aster*, and the bees *Andrena hirticincta*, *A. nubecula*, *A. simplex*, *A. solidaginis*, and *A. simulans armata* specialize on *Aster* and *Solidago* (including *Euthamia* and *Oligoneuron*), while *A. placata* specializes on *Solidago* (incl. *Oligoneuron*). (The splitting-orgy names *Almutaster*, *Brachyactis*, *Eucephalus*, *Herrickia*, *Symphyotrichum*, *Virgulaster*, and *Virgulus* are included as subgenera of *Aster* here, while *Leucelene* is a genus treated below.)

*Aster ascendens* bluish: *Argynnis* (*Speyeria*) *hesperis electa*, *Cercyonis oetus* 4x, *Cercyonis pegala*, *Colias eurytheme*, *Colias philodice* 2x, *Hesperia comma* 5x, *Hesperia comma colorado* 2x, *Lycaena florus*, *Lycaena rubidus*, *Oarisma garita*, *Ochlodes sylvanoides* 4x, *Papilio polyxenes*, *Phyciodes pulchella camillus* 15x, *Pieris marginalis mcdunnoughii*, *Plebejus melissa* 3x, *Poladryas minuta arachne* 6x, *Polites sabuleti*, *Polites sonora utahensis* 2x, *Polygonia gracilis zephyrus*, *Pyrgus communis*.

(*Aster brachyactis*=*Brachyactis ciliata* has tiny flowers and is evidently rarely visited by butterflies.)

*Aster chilensis* bluish: *Atalopedes campestris*, *Junonia coenia*, *Lerodea eufala*, *Ochlodes yuma* several, *Phyciodes pulchella deltarufa* some, *Polites sabuleti*.

*Aster* blue: *Atalopedes campestris*, *Hesperia comma*, *Hesperia leonardus pawnee* several (Paul A. Opler), *Hesperia uncas*, *Hesperia woodgatei*, *Lycaena heteronea* some, *Ochlodes sylvanoides*, *Ochlodes yuma* 2x (Scott, Shields, and Ellis 1976), *Polygonia faunus* some, *Satyrium sylvinus nootka*.

*Aster campestris* lavender: *Hesperia comma*.

*Aster ericoides* var. *falcatus* white: *Cercyonis oetus*, *Junonia coenia*, *Plebejus alupini texanus*.

*Aster ericoides* white: *Atalopedes campestris* 3x, *Cercyonis pegala*, *Colias eurytheme* 27x + var. *falcatus* 2x, *Colias philodice* 49x, *Danaus plexippus*, *Euptoieta claudia*, *Hemiargus isola* (6x + var. *ericoides* 4x + var. *falcatus* 1x), *Hesperia comma* 2x, *Hesperia leonardus pawnee* 2x, *Hesperia uncas* 2x incl. var. *ericoides*, *Lycaena helloides* 10x, *Lycaena hyllus*, *Ochlodes sylvanoides* 2x, *Phyciodes cocyta* 2x, *Phyciodes picta*, *Phyciodes pulchella camillus* 68x + var. *ericoides* 1x + var. *falcatus* 28x, *Phyciodes tharos orantain* 12x, *Phyciodes tharos tharos* ~5x, *Pieris rapae* (10x and var. *falcatus* 3x), *Plebejus melissa* 22x + var. *ericoides* 1x + var. *falcatus* 5x, *Polites peckius*, *Polites sabuleti* 26x, *Pontia callidice occidentalis* 4x + var. *falcatus* 1x, *Pontia protodice* 12x + var. *falcatus* 4x, *Pyrgus communis* 11x + var. *falcatus* 2x, *Strymon melinus* 6x, *Vanessa cardui* 9x, *Vanessa carye* 2x.

*Aster* white: *Atrytonopsis pittacus* 11x, *Atrytonopsis vierecki*, *Calephelis rawsoni arizonensis* 2x, *Euphilotes glaucon centralis*, *Hesperia leonardus* ssp. occasionally (Scott and Stanford 1981), *Lycaena helloides*.

*Aster fendleri* blue-violet: *Brephidium exilis*, *Phyciodes pulchella camillus*, *Polites peckius* (white flowers of *Aster* ~*fendleri*), *Strymon melinus*.

*Aster foliaceus* purple: *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) hesperis electa*, *Argynnis (Speyeria) zerene*, *Ochlodes sylvanoides* 15x, *Polygonia faunus* [for form *silvius*].

*Aster foliaceus* var. *apricus* blue-violet sometimes purple: *Argynnis (Speyeria) mormonia* 2x, *Boloria titania*, *Colias meadii* 4x, *Colias scudderii* 2x, *Erebia epipsodea* form *brucei* 2x, *Lycaena florus* 3x, *Lycaena rubidus*, *Plebejus glandon* 10x, *Plebejus saepiolus*, *Polites draco* 2x.

*Aster (Eucephalus) glaucodes* white to violet: *Argynnis (Speyeria) callippe* 3x, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) hydaspe rhodope* 2x, *Colias philodice*, *Euphydryas bernadetta rorina* 2x, *Hesperia comma*, *Lycaena helloides*, *Lycaena rubidus*, *Oarisma garita*, *Ochlodes sylvanoides*, *Phyciodes batesii anasazi* 2x, *Phyciodes batesii apsaalooke*, *Phyciodes pulchella camillus*, *Pieris marginalis mcdunnoughii*, *Polygonia gracilis zephyrus*, *Pontia callidice occidentalis* 2x, *Satyrium behrii*.

*Aster laevis* var. *geyeri* blue: *Argynnis (Speyeria) aphrodite* 11x, *Argynnis (Speyeria) coronis* 2x, *Argynnis (Speyeria) hesperis* 29x, *Argynnis (Speyeria) mormonia*, *Cercyonis oetus* 23x incl. Janet Chu, *Cercyonis pegala* 4x, *Colias eurytheme* 3x, *Colias philodice* 3x, *Danaus gilippus*, *Hemiargus isola*, *Hesperia comma* 44x, *Limnitis weidemeyerii* 2x, *Lycaena arota* 5x, *Lycaena florus* common, *Neophasia menapia* 9x, *Oarisma edwardsii* big, *Ochlodes sylvanoides* 68x incl. Janet Chu, *Phyciodes cocyta*, *Phyciodes pulchella camillus* 4x, *Phyciodes tharos orantain* 2x, *Piruna pirus*, *Plebejus melissa*, *Polites themistocles*, *Polygonia faunus* 3x, *Polygonia gracilis zephyrus*, *Satyrium saepium* 2x, *Satyrium titus*, *Strymon melinus* 5x incl. Janet Chu, *Vanessa atalanta* 2x, *Vanessa virginiensis*, *Zerene cesonia*.

*Aster lanceolatus hesperius* bluish-white: *Cercyonis pegala*, *Chlosyne gorgone*, *Colias eurytheme* 67x (they prefer this to *A. ericoides*), *Colias philodice* 145x, *Colias philodice*X*eurytheme*, *Danaus plexippus* 2x, *Euptoieta claudia*, *Hesperia comma* 6x, *Hesperia leonardus montana* 2x, *Lycaena helloides* 24x, *Lycaena hyllus* 2x, *Ochlodes sylvanoides* 53x, *Phyciodes pulchella camillus* 24x, *Phyciodes tharos orantain* 6x, *Pieris rapae* 33x, *Plebejus alupini texanus*, *Plebejus melissa* 3x, *Polites sabuleti* 8x, *Polites themistocles* 10x, *Pontia callidice occidentalis* 3x, *Pontia protodice* 5x, *Pyrgus communis*, *Strymon melinus*, *Vanessa carye* 7x.

*Aster novae-angliae* purple: *Argynnis (Speyeria) nokomis* 3x, *Colias eurytheme* 4x, *Danaus plexippus*, *Danaus plexippus*, *Ochlodes sylvanoides* 9x, *Papilio polyxenes*, *Pieris rapae* 6x, *Vanessa atalanta* 2x, *Vanessa cardui* 4x. This is pollinated by bees, flies, beetles, Lepidoptera including moths, and by selfing.

*Aster novi-belgii* purple: *Atalopedes campestris*, *Vanessa cardui* (+ white-flowered variety 10x).

*Aster* “Pixie Park” purple: *Vanessa cardui* 2x.

*Aster pauciflorus* blue-violet: *Colias philodice*, *Colias eurytheme* 3x.

*Aster porteri* white: *Argynnis (Speyeria) aphrodite* 3x, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) hesperis* 3x, *Colias philodice*, *Cupido amyntula*, *Cercyonis meadii* 34x, *Cercyonis oetus* 50x, *Cercyonis pegala* 5x, *Colias eurytheme* 7x, *Euptoieta claudia* 2x, *Hemiargus isola* 4x, *Hesperia comma* 48x, *Hesperia juba*, *Hesperia leonardus montana* 3x, *Hesperia leonardus pawnee* 2x, *Lycaena arota* 9x, *Lycaena heteronea*, *Lycaena rubidus*, *Neophasia menapia* 3x, *Ochlodes sylvanoides* 64x, *Phyciodes pulchella camillus* 112x, *Pieris rapae* 5x, *Plebejus alupini texanus*, *Plebejus melissa* 5x, *Polygonia gracilis zephyrus*, *Pontia protodice* 5x, *Pyrgus communis* 4x, *Satyrium saepium* 6x, *Satyrium titus*, *Strymon melinus* 4x, *Vanessa atalanta*.

*Aster simplex* whitish: *Celastrina neglecta*, *Colias eurytheme* 4x, *Colias philodice*, *Danaus plexippus* 8x, *Phyciodes tharos tharos*, *Pieris rapae* 5x.

“Aster” sunflower with wavy leaves yellow: *Chlosyne whitneyi whitneyi*.

Asteraceae blue: *Junonia coenia* 1x.

Asteraceae (rayless) with long heads of flowers on bush: *Lymnas cephise cephise* and many other species.

Asteraceae shrub yellow: *Asterocampa leilia*, *Cercyonis meadii* 6x, *Coenonympha tullia californica*, *Danaus gilippus*, *Junonia coenia* 3x, *Leptotes marina*, *Libythea carinenta larvata*, *Microtia dymas*, *Ministrymon leda*, *Ochlodes sylvanoides* 4x, *Phyciodes texana*, *Plebejus acmon* 6x, *Pyrgus communis*, *Satyrium sylvinus megapallidum*, *Satyrium titus*, *Strymon melinus* 3x.

Asteraceae shrub white: *Chlosyne leanira fulvia* many.

Asteraceae yellow species: *Apodemia virgulti duryi*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) egleis oweni*, *Chlosyne definita*, *Chlosyne gorgone* 2x, *Chlosyne leanira fulvia* 6x, *Chlosyne leanira leanira*,

*Coenonympha tullia californica* common, *Colias behrii*, *Colias philodice* abundant, *Erynnis tristis tatus*, *Euphydryas editha lehmani* (body covered with Asteraceae yellow pollen), *Euphydryas editha rubicunda*, *Hesperia pahaska*, *Hesperia uncas*, *Hylephila phyleus* 2x, *Lerodea eufala*, *Lycaena cupreus snowi* 2x, *Lycaena florus* several, *Nathalis iole*, *Oeneis calais ivallda* male covered with yellow pollen evidently from Asteraceae, *Parnassius phoebus smintheus*, *Philotiella speciosa* small (pressed), *Phyciodes pulchella pulchella*, *Plebejus shasta pitkinensis* usually, *Poladryas minuta arachne*, *Poladryas minuta near-minuta* 8x, *Polygonia faunus* many (preferred), *Polygonia gracilis zephyrus* 2x, *Pyrgus communis*, *Satyrium titus*, *Strymon melinus*, *Vanessa virginiensis* several.

*Baccharis salicifolia*=*viminea* whitish: *Adelpha californica*, *Atlides halesus* 3x, *Brephidium exilis*, *Hylephila phyleus* 2x, *Junonia coenia* 10x, *Lycaena helloides*, *Phyciodes mylitta*, *Plebejus acmon* 30x, *Satyrium saepium* many. Elsewhere, *Baccharis* spp. are pollinated by ants, parasitic Hymenoptera, and honeybees (Steffan 1997). Megachilid bees gather pollen from *Baccharis emoryi* and pack it among long hairs on the underside of their abdomen.

~*Baccharis sarothroides* whitish: *Calephelis nemesis*, *Emesis zela*, *Danaus gilippus* 4x, *Libythea carinenta larvata* very common, *Ministrymon leda* 7x, *Phyciodes texana* many, *Strymon melinus*.

*Baccharis* whitish: *Amblyscirtes elissa*, *Apodemia palmerii*, *Apyrrothrix araxes arizonae* ~47x, *Atlides halesus*, *Autochton cellus* 2x.

*Baccharis*: *Battus philenor*, *Calephelis rawsoni arizonensis*, *Callophrys gryneus siva*, *Codatractus arizonensis* 3x, *Copaeodes aurantiaca*, *Danaus gilippus*, *Emesis zela cleis* 3x, *Hesperia pahaska*, *Leptotes marina*, *Libythea carinenta larvata*, *Microtia dymas* 20x, *Microtia (Texola) elada* 30x, *Ministrymon leda* 2x, *Papilio polyxenes*, *Staphylus ceos*, *Strymon melinus*.

*Bahia dissecta* yellow: *Euptoieta claudia*.

(*Balsamorhiza sagittata* was insufficiently observed. In Utah, *Osmia californica* and *O. montana* bees prefer the larger *B. macrophylla* over *B. sagittata* and mostly specialize on *Balsamorhiza* but also visit *Taraxacum officinale* and *Wyethia amplexicaulis* [Cane 2011]).

*Bidens cernua* yellowish: *Atalopedes campestris* 2x, *Chlosyne gorgone*, *Colias eurytheme*, *Euptoieta claudia* 2x, *Limenitis archippus*, *Lycaena helloides* 5x, *Phyciodes cocyta*, *Phyciodes pulchella camillus*, *Phyciodes tharos orantain* 4x, *Pieris rapae* 3x, *Polites themistocles*, *Strymon melinus* 4x, *Vanessa virginiensis*. (Some *Bidens* are pollinated by bumblebees [Aluri and Robart 1991])

*Bidens frondosa* yellowish: *Colias eurytheme* 5x, *Lycaena helloides* 35x, *Lycaena hyllus* 8x, *Nathalis iole* 11x, *Phyciodes cocyta*, *Pieris rapae* 2x, *Pontia protodice* 2x.

*Boltonia asteroides* white: *Libythea carinenta bachmanii*. The bee *Perdita boltoniae* specializes on *Boltonia asteroides* and possibly other *Boltonia* spp.

*Brickellia californica* greenish-white: *Pieris rapae*. These flowers are fragrant at night so may be pollinated by moths.

*Carduus nutans* rose-purple [nearly all my “*Cirsium vulgare*” records up to 1988 were actually *Carduus nutans* so were corrected]: *Anatrytone logan lagus* 3x, *Argynnis (Speyeria) aphrodite* 73x, *Argynnis (Speyeria) callippe* 18x, *Argynnis (Speyeria) coronis* 29x, *Argynnis (Speyeria) cybele cybele* 3x, *Argynnis (Speyeria) edwardsii* 47x, *Argynnis (Speyeria) hesperis* 28x, *Argynnis (Speyeria) hesperis nausicaa*, *Argynnis (Speyeria) idalia* often, *Argynnis (Speyeria) mormonia*, *Argynnis (Speyeria) nokomis* 34x, *Atrytone arogos* 11x, *Atrytone arogos* 62, *Callophrys gryneus siva*, *Cercyonis oetus*, *Cercyonis pegala* 4x, *Cercyonis pegala* 16x, *Colias alexandra*, *Colias eurytheme* 32x, *Colias philodice* 5x, *Danaus gilippus*, *Danaus plexippus* 2x, *Danaus plexippus* 5x, *Epargyreus clarus*, *Epargyreus clarus*, *Erynnis horatius*, *Euphydryas chalcedona chalcedona* several, *Euphyes vestris* 8x, *Euptoieta claudia* 5x, *Hesperia comma* 51x, *Hesperia comma*, *Hesperia dacotae* 41x, *Hesperia leonardus montana* 86x, *Hesperia leonardus pawnee* 6x (incl. Paul A. Opler), *Hesperia ottoe* 167x, *Hesperia pahaska* 3x, *Hesperia uncas* 17x, *Hesperia viridis* 7x, *Limenitis weidemeyerii* 2x, *Lycaena dione* 4x, *Lycaena hyllus*, *Neophasia menapia*, *Oarisma garita* 2x, *Oarisma powesheik* “*Cirsium vulgare*” surely, *Ochlodes sylvanoides* 70x, *Papilio eurymedon* 4x, *Papilio glaucus rutulus* 9x, *Papilio indra*, *Papilio machaon bairdii* (f. *bairdii* and f. *brucei*), *Papilio multicaudata* 25x, *Papilio polyxenes* 14x, *Pieris rapae* 3x (another only hovered over), *Poanes taxiles* 8x, *Polites mystic* 9x, *Polites origenes* 21x, *Polites peckius* 2x, *Polites sabuleti*, *Polites*

*themistocles* 20x, *Satyrrium sylvinus*, *Strymon melinus*, *Vanessa cardui* 42x, *Vanessa carye*, *Vanessa virginiensis*, *Zerene cesonia* 3x. *Carduus nutans* can self-pollinate sometimes, contributing to its invasive spread across the world. In Illinois it is pollinated primarily by bumblebees, and often by other long-tongued bees, butterflies, and skippers (Hilty 2013). In New Zealand introduced *Carduus nutans* is visited by honeybees and bumblebees, ants, wasps, many flies, Hemiptera, Coleoptera, moths and several butterflies (*Vanessa gonerilla* and *V. itea*), even a few Psocoptera and Dermaptera (Jessep 1990).

*Centaurea americana* white and pink: *Asterocampa celtis* *Celtis*.

*Centaurea cyanus* blue: *Polites themistocles* 3x, *Pyrgus communis*.

*Centaurea dealbata* pinkish or purple: *Papilio multicaudata* 5 sec., *Polites themistocles*.

*Centaurea diffusa* lavender: *Argynnis (Speyeria) aphrodite* 6x, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) hesperis* 10x (+ two <1/2 sec.), *Cercyonis pegala* 5x, *Colias eurytheme* 7x, *Colias philodice* 2x, *Lycaena rubidus*, *Ochlodes sylvanoides* 8x, *Phyciodes pulchella camillus* 4x, *Plebejus melissa* 1x, *Pontia protodice*, *Satyrrium sylvinus*, *Vanessa cardui* 10x. The flowers outcross and are visited by *Bombus* bumblebees, honeybees, solitary bees, *Anthophora* and *Megachile* bees, which all visit both the purple and white flowers. The bee *Megachile apicaulis* is a specialist on *Centaurea*.

*Centaurea diffusa* white: *Argynnis (Speyeria) aphrodite* 2x, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) coronis* 2x, *Argynnis (Speyeria) hesperis* 27x, *Cercyonis oetus* 31x, *Cercyonis pegala* 8x, *Colias eurytheme* 17x, *Colias philodice* 13x, *Cupido amyntula*, *Euptoieta claudia*, *Hesperia comma* 4x, *Neophasia menapia* 7x, *Ochlodes sylvanoides* 19x, *Phyciodes pulchella camillus* 7x, *Pieris rapae* 14x, *Plebejus melissa* 8x, *Polygonia gracilis zephyrus*, *Pyrgus communis* 8x, *Satyrrium calanus*, *Strymon melinus*, *Vanessa atalanta*, *Vanessa cardui* 67x, *Vanessa virginiensis*.

*Centaurea maculosa* lavender is very popular: *Colias eurytheme* 2x, *Colias philodice* 3x, *Euptoieta claudia* 2x, *Hesperia comma* 55x, *Ochlodes sylvanoides*, *Plebejus melissa*, *Pyrgus communis* 15x, *Vanessa cardui* 6x.

*Centaurea near ruthenica* white: *Papilio multicaudata* 3x (one only 3 sec.).

*Centaurea repens* blue: *Hesperia comma*, *Hesperopsis libya lena* 4x, *Ochlodes sylvanoides*, *Pontia beckerii*.

*Centaurea scabiosa* blue: *Pontia protodice*, *Vanessa cardui*. This is pollinated by bumblebees (*Bombus lapidarius*) and honeybees.

*Chaenactis alpina* white: *Euptoieta claudia*. Bee visitors that probably pollinate are *Halictus ligatus*, green sweat bees (*Agapostemon* sp.), bumblebees (*Bombus huntii*), mason bees (*Osmia* sp.), *Micranthophora flexipes*, and honeybees ([www.plants.usda.gov/plantguide](http://www.plants.usda.gov/plantguide)).

?*Chaenactis douglasii* white: *Strymon melinus*.

*Chrysanthemum leucanthemum* white: *Chlosyne gorgone*, *Ochlodes sylvanoides* 2x, *Pieris rapae*, *Plebejus glandon rustica*. *Chrysanthemum* is pollinated by honeybees.

*Chrysanthemum Xsuperbum*=*maximum* white: *Atalopedes campestris* 1x (and once on “white sunflower” [*C. Xsuperbum*?, *Gerbera*?]), *Colias eurytheme* 2x (+ another only 4 sec.), *Nathalis iole*, *Ochlodes sylvanoides*, *Pieris rapae*, *Polites themistocles* 3x, *Pyrgus communis*, *Strymon melinus* 1x (another several times but flew after sipping for a few sec.), *Vanessa cardui* 5x.

*Chrysanthemum morifolium* (cultivated “mums”): *Danaus plexippus* [~white], *Vanessa cardui* [1x “Corinne” white, 1x “Megan” purple, 1x “Melanic” ?white, 6x yellow, yellow with orange center 1x, yellowish 2x], *Polygonia comma* [hybrid, ~white], *Pontia protodice* [orange], *Pyrgus communis* 1 sec., *Vanessa carye* [yellow].

*Chrysanthemum parthenium* white (yellow center): *Polites peckius* 2x, *Vanessa carye*.

*Chrysothamnus nauseosus* yellow is very popular: *Aglais milberti* 23x, *Apodemia mormo mormo*, *Argynnis (Speyeria) aphrodite* 45x, *Argynnis (Speyeria) coronis* 19x, *Argynnis (Speyeria) edwardsii* 21x, *Argynnis (Speyeria) hesperis*, *Argynnis (Speyeria) mormonia* 2x, *Argynnis (Speyeria) nokomis* 11x, *Argynnis (Speyeria) zerene* 4x, *Argynnis (Speyeria) zerene gunderi* 2x, *Argynnis (Speyeria) zerene malcolmi* 2x, *Atalopedes campestris* ~9x, *Brephidium exilis* 2x, *Callophrys gryneus siva* 14x, *Cercyonis meadii* 4x, *Cercyonis meadii alamosa* 29x, *Cercyonis oetus* 32x, *Cercyonis pegala* 15x, *Cercyonis sthenele masoni* 12x, *Coenonympha tullia*, *Colias edwardsii edwardsii*, *Colias eurytheme* 324x, *Colias philodice* 98x, *Danaus gilippus*, *Danaus plexippus* 67x, *Euphilotes ancilla ancilla* 4x, *Euptoieta claudia* 25x,

*Glaucopsyche piasus* 3x, *Hemiargus isola* 6x, *Hesperia comma* 295x, *Hesperia juba* 161x, *Hesperia leonardus pawnee* 59x, *Hesperia uncas* 8x, *Junonia coenia* 2x, *Leptotes marina*, *Limenitis weidemeyerii*, *Lycaena arota* 28x, *Lycaena florus*, *Lycaena helloides* 3x, *Lycaena heteronea* 16x (a dozen had pollen on thorax uns), *Lycaena rubidus*, *Lycaena xanthoides* "editha" vurali 4x, *Nathalis iole* several, *Neominois ridingsii* 3x, *Neominois ridingsii wyomingo* 5x, *Nymphalis antiopa* 10x, *Ochlodes sylvanoides* 36x, *Ochlodes yuma* 5x (Scott, Shields, and Ellis 1976), *Papilio polyxenes* 4x, *Parnassius phoebus smintheus* 1x, *Phyciodes pulchella camillus* 35x, *Pieris rapae* 23x, *Plebejus alupini lutzi* 10x, *Plebejus alupini texanus*, *Plebejus melissa* 28x, *Polygonia faunus* 10x [incl. form silvius], *Polygonia gracilis zephyrus* 194x, *Polygonia interrogationis*, *Polygonia oreas satellow* popular (Scott 1984), *Polygonia satyrus*, *Pontia beckerii*, *Pontia callidice occidentalis* 2x, *Pontia protodice* 14x, *Pyrgus communis* 23x, *Satyrium titus* 2x, *Strymon melinus* 39x, *Vanessa atalanta* 35x, *Vanessa cardui* 1062x, *Vanessa carye* 33x, *Vanessa virginiensis* 17x.

*Chrysothamnus viscidiflorus* yellow: *Colias edwardsii altiplano*.

*Cichorium endivia* blue: *Pyrgus communis*.

*Cichorium intybus* blue: *Colias philodice*, *Ochlodes sylvanoides*, *Hesperia comma* 2x. This is reportedly pollinated mostly by bees (megachilids, Halictids) and syrphid flies including *Eristalis tenax* also visit, and it also self-pollinates.

*Cirsium ~arizonica* big reddish: *Atrytonopsis cestus*, *Atrytonopsis hianna deva*, *Atrytonopsis ovinia edwardsi*.

*Cirsium arvense* purple: *Aglais milberti* (1x, and var. *incanum*), *Amblyscirtes oslari*, *Anatrytone logan lagus* 2x, *Ancyloxypha numitor* 5x, *Asterocampa celtis jeffermont* several, *Argynnis (Speyeria) aphrodite* 12x (+ var. *incanum* 4x), *Argynnis (Speyeria) callippe* 5x, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) edwardsii* M. Fisher, *Argynnis (Speyeria) hesperis* 21x (+ var. *incanum* 11x), *Argynnis (Speyeria) hesperis electa=nikias* 2x, *Argynnis (Speyeria) hesperis nausicaa* (small blue head ?*arvense*), *Argynnis (Speyeria) mormonia luski* (small blue head ?*arvense*), *Argynnis (Speyeria) zerene* 2x, *Atalopedes campestris* 3x, *Atrytone arogos* ~129x, *Callophrys gryneus siva* 4x, *Cercyonis meadii* (1x, var. *incanum* 1x), *Cercyonis oetus* (purple 16x, white 1x, var. *incanum* purple 3x), *Cercyonis pegala* 34x, *Cercyonis pegala* var. *incanum* 5x, *Chlosyne gorgone* (var. *incanum*), *Chlosyne nycteis*, *Colias eurytheme* 15x (+ var. *incanum* 23x), *Colias philodice* (3x + var. *incanum* 4x), *Cupido comyntas* (var. *incanum*), *Danaus gilippus*, *Danaus plexippus* 10x, *Epargyreus clarus* 12x, *Erynnis afranius* 7x (+ var. *incanum* 2x), *Euchloe ausonides ausonides* 8x [does not visit *Cirsium arvense* in Colo.], *Euphyes bimacula* 3x, *Euphyes vestris* 4x, *Euptoieta claudia* 8x, *Hemiargus isola* 2x, *Hesperia comma* 3x (+ var. *incanum* 2x), *Hesperia ottoe* 2x, *Hesperia pahaska* 17x, *Hesperia uncas* 5x, *Hesperia viridis* 22x, *Junonia coenia* 48x, *Leptotes marina*, *Lethe eurydice* (var. *incanum* 6x), *Lycaena dione* 24x (+ var. *incanum* 1x), *Lycaena florus*, *Lycaena helloides* 3x (+ var. *incanum* 1x), *Lycaena heteronea* >102x, *Lycaena hyllus* 3x, *Lycaena rubidus* 8x, *Neophasia menapia* 7x, *Notamblyscirtes simius* 1x, *Nymphalis antiopa*, *Oarisma garita* 7x (and var. *incanum* 2x), *Ochlodes sylvanoides* 21x (+ var. *incanum* 18x), *Ochlodes yuma*, *Papilio glaucus rutulus* 2x (+ var. *incanum* 1x), *Papilio machaon bairdii*, *Papilio multicaudata*, *Papilio polyxenes* 9x (+ var. *incanum* 1x), *Papilio zelicaon* (blue), *Pholisora mejicanus*, *Phyciodes batesii anasazi* 3x, *Phyciodes cocyta*, *Phyciodes picta* (var. *incanum*), *Phyciodes pulchella camillus* 2x, *Phyciodes pulchella pulchella* blue, *Phyciodes tharos orantain* (var. *incanum*), *Phyciodes tharos tharos*, *Pieris rapae* 60x (+ var. *incanum* 10x), *Piruna pirus* 39x (+ var. *incanum* 2x), *Plebejus acmon* 1x, *Plebejus melissa* (var. *incanum* 3x), *Poanes taxiles* 18x (+ var. *incanum* 1x), *Poladryas minuta arachne*, *Polites mystic* 8x (+ var. *incanum* 2x), *Polites peckius* 11x, *Polites sabuleti*, *Polites sonora* ~8x, *Polites themistocles* 6x, *Polygonia comma*, *Polygonia faunus* 2x, *Polygonia gracilis zephyrus* 2x, *Polygonia satyrus* 1x (+ var. *incanum* 1x), *Pontia protodice* 12x (+ var. *incanum* 1x), *Pyrgus communis* 3x, *Satyrium acadica* 3x, *Satyrium behrii* 3x, *Satyrium calanus*, *Satyrium calanus falacer*, *Satyrium californica* 5x, *Satyrium liparops* 4x, *Satyrium saepium* 5x (+ var. *incanum* 2x), *Satyrium sylvinus* 5x, *Satyrium titus* 3x, *Strymon melinus* 18x, *Thymelicus lineola* 150x, *Vanessa atalanta* 26x (+ var. *incanum* 78x), *Vanessa cardui* 32x (+ var. *incanum* 10x), *Vanessa carye* 2x, *Vanessa virginiensis* 4x (+ var. *incanum* 1x), *Wallengrenia egeremet*. *Cirsium arvense* is pollinated mostly by honeybees, has high visitation by other bees (*Halictus* and

*Lasioglossum*), and other pollinators include Syrphidae and common butterflies *Vanessa atalanta* and *Pieris rapae* (Theis, 2006). The bee *Melissodea desponsa* specializes on *Cirsium* (and possibly *Arctium*). Andersson (2003) studied the floral scent compounds in *Cirsium arvense* that attract butterflies.

*Cirsium canescens* whitish: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) coronis* 2x, *Argynnis (Speyeria) edwardsii* 4x, *Argynnis (Speyeria) hesperis chitone* several, *Argynnis (Speyeria) nokomis* 6x, *Danaus plexippus*, *Euphydryas chalcedona chalcedona*, *Hesperia leonardus montana*, *Hesperia pahaska*, *Hesperia uncas* 2x, *Papilio eurymedon*, *Papilio glaucus rutulus*, *Papilio multicaudata*, *Papilio polyxenes*, *Papilio zelicaon*, *Poanes melane*, *Paratrytone snowi* 2x, *Parnassius phoebus smintheus* 2x, *Phyciodes mylitta*, *Plebejus acmon*, *Poanes taxiles*.

*Cirsium centaureae* yellowish-white: *Argynnis (Speyeria) aphrodite byblis*, *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) callippe calgariana*, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) cybele charlottii*, *Colias alexandra*, *Colias scudderii*, *Lycaena florus*, *Lycaena xanthoides "editha" vurali*, *Ochlodes sylvanoides* 2x, *Papilio machaon brucei*.

*Cirsium discolor* pinkish-violet: *Atalopedes campestris* 3x, *Colias eurytheme* 3x, *Colias philodice* 4x, *Danaus plexippus* 14x, *Papilio glaucus glaucus*, *Papilio polyxenes* 45x, *Polites peckius* 2x, *Vanessa cardui* 95x.

*Cirsium eatonii tweedyi* purplish: *Vanessa cardui*.

*Cirsium neomexicanum* ~pink or ~pink-cream: *Argynnis (Speyeria) cybele leto*, *Papilio multicaudata*.

*Cirsium ochrocentrum* rose-purple (some lavender-white): *Amblyscirtes aenus* 2x, *Amblyscirtes oslari* [on "Cirsium probably"], *Anatrytone logan lagus*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) edwardsii* 3x, *Atrytone arogos*, *Colias eurytheme*, *Danaus plexippus*, *Hesperia ottoe*, *Hesperia pahaska* 4x, *Hesperia uncas* 2x, *Hesperia viridis* several, *Oarisma garita*, *Papilio glaucus rutulus*, *Papilio multicaudata*, *Papilio zelicaon*, *Paratrytone snowi* purple-violet 2x, *Poanes taxiles* 3x, *Polites mystic* 3x, *Polites origenes* purple-violet 5x, *Vanessa atalanta*.

*Cirsium parryi* yellow: *Vanessa cardui*, *Danaus plexippus*.

*Cirsium scariosum*=*coloradense* whitish or lavender-white: *Aglais milberti*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) zerene*, *Colias scudderii*, *Euphydryas anicia brucei*, *Plebejus saepiolus* 2x, *Polites mystic?*, *Polites sonora* (on "Cirsium 2'-tall whitish-blue"), *Vanessa cardui*.

*Cirsium scariosum* (=coloradense=drummondii) var. *acaulescens* whitish: *Polites sonora utahensis* 71x (its favorite flower), *Hesperia uncas*.

*Cirsium scopulorum* yellowish-white: *Boloria titania*, *Vanessa cardui*, *Polygonia gracilis zephyrus*.

*Cirsium undulatum* rose-purple (some lavender): *Anatrytone logan logan* 3x, *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) cybele charlottii*, *Argynnis (Speyeria) edwardsii* 2x, *Argynnis (Speyeria) idalia* 6x, *Atrytone arogos*, *Atrytonopsis python*, *Atrytonopsis vierecki* several, *Cercyonis pegala*, *Hesperia dacotae*, *Hesperia leonardus montana* [for "Cirsium pink"], *Hesperia ottoe* 3x, *Hesperia pahaska* 3x, *Hesperia uncas*, *Hesperia viridis*, *Papilio multicaudata* 2x, *Papilio polyxenes* 2x, *Paratrytone snowi* [lavender] 3x, *Poanes taxiles*, *Polites mystic*, *Polites origenes*, *Pontia protodice*, *Vanessa cardui*.

*Cirsium* spp. rose-purple or sometimes purple: *Aglais milberti*, *Argynnis (Speyeria) hesperis* near *dorothea*, *Argynnis (Speyeria) hydaspae*, *Argynnis (Speyeria) nokomis*, *Argynnis (Speyeria) nokomis* [tall whitish-blue], *Argynnis (Speyeria) nokomis* near-*apacheana* 2x, *Argynnis (Speyeria) zerene gunderi*, *Atrytonopsis hianna deva* 3x, *Atrytonopsis python*, *Atrytonopsis vierecki* 2x, *Danaus plexippus*, *Hesperia comma* 3x, *Hesperia leonardus pawnee* (Paul A. Opler), *Hesperia leonardus* ssp. occasionally (Scott and Stanford 1981), *Hesperia pahaska*, *Hesperia viridis* 3x, *Lycaena rubidus*, *Notamblyscirtes simius*, *Ochlodes sylvanoides*, *Ochlodes yuma* (Scott, Shields, and Ellis 1976), *Papilio machaon bairdii* 2x, *Papilio polyxenes*, *Polites origenes*, *Polites sonora*, *Thorybes pylades* 3x, *Vanessa cardui*.

*Cirsium vulgare* rose-purple: *Anatrytone logan lagus*, *Ancyloxypha numitor*, *Argynnis (Speyeria) aphrodite* 5x, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) hesperis*, *Argynnis (Speyeria) nokomis* 64x, *Asterocampa celtis jeffermont* Janet Chu, *Atalopedes campestris*, *Atrytone arogos* 3x, *Cercyonis pegala*, *Colias eurytheme*, *Colias philodice* 2x, *Danaus plexippus* 5x, *Dione vanillae*, *Hesperia comma* 3x,

*Hesperia pahaska* blue 16x, *Hesperia uncas*, *Ochlodes sylvanoides* 6x, *Ochlodes yuma*, *Ochlodes yuma anasazi* 54x, *Papilio glaucus rutulus*, *Papilio machaon bairdii* (f. *bairdii* 21x, f. *brucei* 20x), *Papilio machaon bairdii* and *brucei* 4x, *Papilio multicaudata* 4x, *Papilio polyxenes* 3x, *Pieris rapae* 2x, *Poanes taxiles* blue 2x, *Polites peckius*, *Polites sabuleti*, *Pontia protodice*, *Vanessa cardui* 3x. *C. vulgare* is reported to be pollinated by long-tongued bees, hummingbirds, and self-pollination.

*Conyza canadensis* whitish: *Pieris rapae*, *Strymon melinus*. This is self-pollinated and also pollinated by long-tongued and short-tongued bees, wasps, and flies (Hilty 2002, Weaver 2001).

*Coreopsis* annual ~yellow: *Atalopedes campestris*. The bee *Melissodea coreopsis* specializes on *Coreopsis palmata* and probably other *Coreopsis*.

*Coreopsis grandiflora* yellow: *Colias eurytheme*, *Papilio glaucus rutulus* (avidly). (*Coreopsis grandiflora* is reportedly visited by small bees which evidently pollinate it, as it is not visited much by butterflies.)

*Coreopsis* orange: *Polites themistocles*?

*Coreopsis tinctoria* yellow (like sunflower with *Achillea* leaves): *Oarisma garita*.

*Coreopsis verticillata* var. "Moonbeam" yellow: *Cupido comyntas*, *Nathalis iole* 10x, *Pyrgus communis*.

*Cosmos bipinnatus* (filiform leaves, 2m plants): *Atalopedes campestris* (orange flower), *Colias philodice* (?white), *Danaus plexippus*, *Pontia protodice* (white), *Pyrgus communis* (white with yellow center), *Vanessa cardui* (purple flower 3x, orange 8x, white/pink flower 1x, white 1x, briefly 1x). It is visited by bumblebees, bees, lacewings, flower flies and butterflies that may pollinate it.

*Cosmos sulphureus* coppery: *Euptoieta claudia*.

*Crepis (Psilochenia) atribarba* yellow: *Chlosyne gorgone*, *Euphydryas anicia capella*, *Phyciodes cocyta* briefly. Honeybees and *Osmia* bees help pollinate this. Some *Crepis* can self-pollinate.

*Crepis acuminata* yellow: *Argynnis (Speyeria) callippe*, *Oarisma garita*.

*Crepis occidentalis* yellow: *Oarisma garita*. *Crepis occidentalis* is visited by *Bombus bifarius* and *B. ?huntii* in Utah.

*Dahlia X"Karma"* rose: *Vanessa carye* 1 sec.

*Dimorphotheca sinuata=aurantiaca* orange: *Colias philodice*.

*Echinacea angustifolia* (native) purple: *Anatrytone logan logan*, *Argynnis (Speyeria) idalia* 2x, *Atrytone arogos* 7x, *Cercyonis pegala*, *Danaus plexippus*, *Hesperia dacotae* 12x, *Hesperia ottoe* 6x, *Limnitis archippus*, *Oarisma powesheik* 9x, *Phyciodes tharos tharos*, *Polites origenes*, *Polites themistocles* 2x, *Vanessa cardui* 11x. This is pollinated efficiently by bumblebees and uncommon honeybees and other bees (Leuszler et al. 1996), while bee flies *Systoechus vulgaris* were common but inefficient, *Epicauta ferruginea* beetles were efficient but preferred other yellow flowers, and pierid butterflies [obviously *Colias philodice* and its yellow or white females based on their descriptions] were regular visitors and efficient pollinators (*Vanessa cardui* also visited) (Wist 2005).

*Echinacea purpurea* (cultivated) purple: *Argynnis (Speyeria) aphrodite* 2x, *Argynnis (Speyeria) cybele cybele*, *Atalopedes campestris* 2x, *Colias eurytheme* 5x, pink 1x for albino, *Danaus plexippus* 4x, *Euptoieta claudia* 3x, *Papilio glaucus rutulus* 2x, *Papilio multicaudata* 31x (but three were 1-2 sec./brief), *Papilio polyxenes* 8x, *Poanes taxiles*, *Polites peckius* 7x, *Polites themistocles* 3x, *Pontia protodice*, *Pyrgus communis*, *Strymon melinus* 3x, *Vanessa atalanta*, *Vanessa cardui* 188x, *Vanessa carye*. This is reportedly pollinated by honeybees, and butterflies; it is visited by dozens of bee species in Illinois (Robertson 1929). The bee *Andrena helianthiformis* specializes on *Echinacea*.

*Erigeron* species are pollinated by bumblebees (Aluri and Robart 1991) and reportedly by bees, wasps, flies, and butterflies.

*Erigeron canus* blue-white: *Hesperia pahaska* 2x.

*Erigeron compositus*: A) blue to pinkish or white: *Chlosyne whitneyi whitneyi*; B) white: *Plebejus glandon* 2x; C) white to rose-blue: *Polygonia gracilis zephyrus*, *Euphydryas anicia capella* 2x, *Vanessa cardui* 3x.

*Erigeron coulteri* white: *Argynnis (Speyeria) mormonia*, *Pieris marginalis mcdunnoughii*, *Plebejus glandon* 2x.

*Erigeron divergens*: A) blue: *Pyrgus communis*; B) rose-purple to white: *Coenonympha tullia* 2x, *Euphyes vestris*, *Phyciodes pulchella camillus* 2x; *Pontia protodice*; C) white: *Oarisma garita* *Erigeron divergens* 2x.

*Erigeron elatior*: A) pink-purple: *Argynnis (Speyeria) mormonia* 3x, *Boloria titania* 8x, *Colias meadii*, *Colias eurytheme*, *Lycaena florus* 8x, *Lycaena rubidus* 8x, *Phyciodes pulchella camillus*, *Pieris marginalis mcdunnoughii* 2x, *Plebejus glandon* 26x, *Plebejus saepiolus* 2x, *Polites draco*; B) bluish-white (some lavender): *Lycaena arota* 11x (not on *Aster novae-angliae*).

*Erigeron flagellaris* white: *Phyciodes pallida*.

*Erigeron formosissimus* lavender: *Phyciodes cocyta*.

*Erigeron ~glabellus* blue hairy: *Cercyonis oetus*, *Oarisma garita*.

*Erigeron leiomeris* blue: *Chlosyne whitneyi damoetas* 5x.

*Erigeron melanocephalus* (black phyllaries) white (or pinkish): *Erebia callias*, *Hesperia comma colorado*.

*Erigeron philadelphicus* white: *Ancyloxypha numitor* 2x, *Cupido comyntas*, *Phyciodes diminutor* 14x, *Polites peckius*.

*Erigeron pinnatisectus* blue/purple yellow-centered: *Chlosyne whitneyi damoetas*; *Colias meadii* 11x, *Erebia callias* 3x, *Euphydryas anicia brucei*, *Hesperia comma colorado* [violet], *Plebejus alupini cotundra*, *Plebejus glandon* 2x, *Plebejus shasta pitkinensis*[violet] 4x.

*Erigeron pumilus* whitish/bluish-white: *Argynnis (Speyeria) callippe*, *Cercyonis oetus*, *Chlosyne gorgone* 5x, *Coenonympha tullia* 10x, *Colias edwardsii altiplano*, *Colias philodice*, *Erebia epipsodea* 1x, *Erynnis icelus*, *Erynnis persius* 8x, *Euphydryas anicia capella*, *Euptoieta claudia* 5x, *Glaucopsyche lygdamus* 5x, *Glaucopsyche piasus*, *Hesperia juba* 5x, *Hesperia nevada* 5x, *Hesperia pahaska* 4x, *Hesperia uncas* 3x, *Hesperia viridis*, *Hesperopsis alpheus* 10x, *Lycaena arota*, *Notamblyscirtes simius* 13x, *Oarisma garita* 11x, *Parnassius phoebus smintheus* 24x, *Phyciodes pulchella camillus* 104x, *Plebejus alupini texanus*, *Plebejus glandon* 1x, *Plebejus icarioides*, *Plebejus melissa* 8x, *Plebejus saepiolus* 5x, *Poladryas minuta arachne* 19x, *Polites (Yvretta) rhesus*, *Polites draco* 9x, *Polites sabuleti*, *Polites themistocles*, *Pontia callidice occidentalis*, *Pontia protodice* 3x, *Pyrgus communis* 5x, *Strymon melinus*.

*Erigeron sp.* white: *Parnassius phoebus smintheus* 7x.

*Erigeron pygmaeus* blue/purple: *Chlosyne whitneyi damoetas*.

*Erigeron simplex* blue: *Argynnis (Speyeria) mormonia*, *Boloria improba harryi*, *Boloria titania* (violet), *Chlosyne whitneyi damoetas* (violet), *Colias meadii* 2x, *Erebia magdalena*, *Lycaena cupreus snowi* (purple), *Parnassius phoebus smintheus* 2x, *Plebejus glandon* 2x, *Pontia protodice* (violet), *Pyrgus centaureae* 2x.

*Erigeron speciosus* blue: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) atlantis sorocko* 2x, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) cybele charlottii*, *Argynnis (Speyeria) hesperis* 5x, *Argynnis (Speyeria) hesperis electa* 2x, *Argynnis (Speyeria) mormonia* 16x, *Argynnis (Speyeria) zerene* 4x, *Boloria titania*, *Cercyonis oetus* 34x, *Cercyonis pegala* 4x, *Chlosyne palla calydon*, *Chlosyne palla flavula*, *Colias alexandra* 1x, *Colias eurytheme* 3x, *Colias philodice*, *Emesis zela*, *Euphyes vestris*, *Hesperia comma* 7x, *Hesperia leonardus montana?*, *Lycaena arota* common, *Lycaena florus* (frequently, Scott 1978), *Lycaena florus* 34x, *Lycaena heteronea* 6x, *Lycaena rubidus* 2x, *Nathalis iole*, *Neophasia menapia* 5x, *Oarisma garita* 3x, *Ochlodes sylvanoides* 13x, *Phyciodes batesii anasazi* 2x, *Phyciodes cocyta* 4x, *Phyciodes pulchella camillus* 7x, *Pieris rapae*, *Plebejus glandon* 2x, *Plebejus saepiolus*, [*Polites peckius* none seen on], *Polygonia faunus*, *Pontia callidice occidentalis*, *Pontia protodice*-pink 2x, *Satyrium saepium* 2x, *Strymon melinus*, *Vanessa atalanta*, *Vanessa cardui* 3x, *Vanessa virginiensis*.

*Erigeron ursinus* blue-purplish/blue is one of the most popular subalpine flowers: *Aglais milberti* 4x, *Argynnis (Speyeria) hesperis electa*, *Argynnis (Speyeria) mormonia* 69x, *Boloria eunomia* 14x, *Boloria improba acrocneema*, *Boloria alaskensis halli* sometimes, *Boloria selene tollandensis*, *Boloria titania* 79x, *Cercyonis oetus*, *Colias meadii* 21x, *Colias philodice* 2x, *Colias scudderii* 35x, *Erebia callias*, *Erebia epipsodea* 14x (including f. *brucei* 5x), *Erynnis funeralis*, *Euphydryas anicia brucei* 2x, *Euptoieta claudia*, *Hesperia comma blue* 2x, *Hesperia comma colorado* 3x, *Lycaena florus* (some violet) 76x, *Lycaena heteronea* 19x, *Lycaena phlaeas arctodon* "Aster", *Lycaena rubidus* 11x, *Lycaena xanthoides "editha"* *vurali* 8x, *Oarisma garita* 5x, *Oeneis calais altacordillera* 4x, *Parnassius phoebus smintheus*, *Phyciodes pulchella camillus* 7x, *Pieris marginalis mcdunnoughii* 9x, *Plebejus glandon* 93x, *Plebejus melissa pseudosamuelis*, *Plebejus saepiolus* 13x, *Plebejus shasta*, *Poladryas minuta arachne* 2x, *Polites draco* 5x, *Polites peckius peckius*, *Polites sonora* 4x, *Polites sonora* 5x, *Polygonia gracilis zephyrus*,



*Pontia callidice occidentalis*, *Pontia protodice* 2x, *Pyrgus centaureae* 18x, *Pyrgus communis*, *Pyrgus xanthus*, *Thorybes mexicana*, *Vanessa cardui* 7x.

*Erigeron* ~blue: *Colias eurytheme*, *Poladryas minuta arachne*, *Hesperia comma* 2x, *Lycaena florus*, *Lycaena rubidus*, *Plebejus glandon* 2x, *Pontia protodice* Janet Chu.

probably *Erigeron* “Aster” blue: *Hesperia miriamae*; *Boloria titania*.

Some *Eupatorium* including *E. solidaginifolium*, *E. solidaginoides*, *E. monanthum* etc. are wind-pollinated and 11 species have short-spined pollen that blows away better than long-spined pollen (Grashoff and Beaman 1970), and the Chinese *E. adenophorum* only self-pollinates (Lutt et al. 2008). But *Eupatorium cannabium* is pollinated by bees and visited and perhaps pollinated by flies, a beetle, Lepidoptera (Proctor et al. 1996 table 4.2 lists it as butterfly pollinated), and selfing. The following species are popular and are pollinated by insects:

*Eupatorium maculatum* reddish: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) edwardsii* 2x, *Phyciodes pulchella camillus* (blue flower), *Danaus plexippus* 5x. This is reportedly pollinated by honeybees, bumblebees, long-tongued moths, green bottle flies, butterflies, and stink bugs, even hummingbirds.

*Eupatorium perfoliatum* white: *Euphyes conspicua* 2x, *Vanessa cardui*. Reportedly visited by long-tongued moths, etc.

*Eupatorium purpureum* pink-purplish: *Atrytone arogos*, *Hesperia leonardus* ssp. occasionally [includes “bonehead” meaning Boneset] (Scott and Stanford 1981), *Strymon melinus*. This is reportedly pollinated by bees and butterflies, and it self-pollinates.

*Eupatorium rugosum* white: *Danaus plexippus* 2x, *Pieris rapae*.

*Euryops pectinatus* “viridis” yellow is evidently popular but I have seen few of these garden plants: *Pontia protodice*, *Vanessa cardui*. It is reportedly pollinated by bees including honeybees, and visited by beetles and flies.

*Gaillardia aristata Xgrandiflora* petals red with yellow tips: *Colias eurytheme*.

*Gaillardia aristata* yellow with red-purple base: *Argynnis (Speyeria) aphrodite* 19x, *Argynnis (Speyeria) callippe* 14x, *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) edwardsii* 2x, *Argynnis (Speyeria) hesperis* 25x (incl. 1x ray bases orange then yellow beyond and 10x red-centered), *Argynnis (Speyeria) mormonia*, *Atalopedes campestris* 2x, *Atrytone arogos*, *Cercyonis pegala*, *Chlosyne gorgone* 3x, *Chlosyne nycteis*, *Colias alexandra* 7x, *Colias edwardsii altiplano*, *Colias eurytheme* 10x, *Colias philodice* 2x, *Euphydryas anicia capella* 38x (6 had yellow thorax due to *Gaillardia* pollen), *Euptoieta claudia* 11x incl. Janet Chu, *Hesperia viridis*, *Oarisma garita* 4x incl. Janet Chu, *Parnassius phoebus smintheus* 4x, *Phyciodes cocyta* 2x, *Phyciodes tharos orantain*, *Poladryas minuta near-minuta* (yellow with orange base), *Polites mystic*.

*Gaillardia pulchella* reddish with yellow apex (cultivated): *Colias eurytheme* 2x, *Colias philodice*, *Polites mystic* (long pink center and pink petals) 6x, [*Polites peckius* none seen on it], *Pyrgus communis*. Reportedly pollinated by bees, other insects, and butterflies.

*Gazania longiscapa* yellow with uv center: *Vanessa cardui*. Whitish flower: *Pyrgus communis*. Orange-yellow flower: *Pieris rapae* landed on and flew (poor nectar). *Gazania krebsiana* is reportedly pollinated by bees, bee flies, beetles, butterflies, and ants, so at least the bees surely pollinate.

(*Gnaphalium palustre* white is uncommon and unpopular, with no records. *Gnaphalium uliginosum* is pollinated by insects in Europe. *Gnaphalium [Pseudognaphalium] canescens* is pollinated by many small bees and other insects. *Gnaphalium [Pseudognaphalium] obtusifolium* nectar attracts primarily short-tongued bees (mainly Halictidae), wasps [Eumenids, Crabronids, paper wasps, spider wasps, cuckoo wasps, weevil wasps, and many others], and flies [Hilty 2013].)

*Grindelia squarrosa* yellow: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) edwardsii* 2x, *Argynnis (Speyeria) hesperis*, *Atrytone arogos* 2x, *Cercyonis meadii* (two for only 1 sec.), *Cercyonis oetus* Janet Chu, *Colias eurytheme* 3x, *Colias philodice* 21x, *Erynnis afranius*, *Euphyes vestris*, *Euptoieta claudia* 6x incl. Janet Chu (but one approached it but did not land), *Hesperia comma* 80x, *Hesperia leonardus pawnee* 4x, *Hesperia uncas* 4x, *Lycaena helloides*, *Neophasia menapia* 2x, *Ochlodes sylvanoides* 29x, *Papilio indra*, *Phyciodes batesii apsaalooke*, *Phyciodes cocyta*, *Phyciodes*

*pallida*, *Phyciodes pulchella camillus* 4x, *Pieris rapae* 11x, *Piruna pirus*, *Plebejus melissa* 2x, *Poanes taxiles*, *Polites sabuleti*, *Pontia protodice* 4x, *Pyrgus communis* 9x, *Vanessa cardui*.

*Grindelia stricta* yellow: *Lycaena xanthoides nigromaculata* ~135x, *Junonia coenia* yellow 3x.

*Grindelia subalpina* yellow: *Poladryas minuta arachne*.

*Grindelia* yellow: *Ochloides yuma* (Scott, Shields, and Ellis 1976).

*Gutierrezia sarothrae* yellow is much less popular than *Chrysothamnus*: [*Poladryas minuta* near-*minuta* not on or maybe once], *Cercyonis oetus*, *Colias eurytheme* 4x, *Colias philodice* 4x, *Euptoieta claudia* 4x, *Hemiargus isola*?, *Hesperia comma* 3x, *Hesperia leonardus pawnee* 5x, *Nathalis iole*?, *Parnassius phoebus smintheus* (not *Chrysothamnus viscidiflorus*), *Phyciodes mylitta*, *Phyciodes pulchella camillus*, *Plebejus alupini texanus* 2x, *Plebejus melissa* 5x, *Pyrgus communis* 4x, *Strymon melinus* 4x, *Vanessa atalanta*, *Vanessa cardui* (1x + another only 1 sec.). It is pollinated by various insects.

*Haplopappus (Oreochrysum) parryi* yellow is popular: *Argynnis (Speyeria) hesperis electa*, *Argynnis (Speyeria) mormonia* 20x, *Hesperia comma colorado*, *Lycaena florus* 51x, *Lycaena heteronea*, *Plebejus glandon* 3x.

*Haplopappus (Pyrrcoma) lanceolata* yellow: *Colias scudderii*, *Hesperia comma colorado* [? *Haplopappus lanceolata*], *Polites sabuleti*.

*Haplopappus (Tonestus) lyallii* yellow: *Argynnis (Speyeria) mormonia*, *Chlosyne whitneyi damoetas*, *Lycaena cupreus snowi*.

*Haplopappus (Tonestus) pygmaeus* yellow: *Colias meadii* 3x, *Erebia magdalena*, *Euphydryas anicia brucei*, *Hesperia comma colorado*, *Lycaena cupreus snowi*, *Oeneis polixenes*, *Parnassius phoebus smintheus*, *Plebejus glandon*, *Plebejus shasta pitkinensis* 2x, *Vanessa cardui*.

*Helenium autumnale* yellow: *Phyciodes tharos tharos* 4x, *Polites sabuleti*.

~*Helianthella uniflora* yellow: *Vanessa cardui*. *Helianthella* is reportedly pollinated in part by *Osmia montana* bees. *H. quinquenervis* is surely pollinated by bumblebees *Bombus bifarius* and *B. flavifrons* in Colorado (Pleasants 1983).

*Helianthus* is not a very popular flower despite its abundance. In Illinois long-tongued bees are the most important pollinators of *Helianthus* spp., including honeybees, bumblebees *Bombus*, digger bees (*Melissodea*) and leaf-cutter bees (*Megachile*), short-tongued bees including halictid bees, alkali bees, and some andrenid bees; specialist bees that visit only *Helianthus* (*Andrena accepta*, *A. helianthi*, [*A. aliciae* elsewhere], *Dufourea marginatus*, *Melissodea agilis*, and *Pseudopanurgus rugosus*) also pollinate it; visitors of lesser importance include bee flies, butterflies, skippers, and *Chauliognathus pennsylvanicus* beetles (Hilty 2013). The bee *Eumegachile (Sayapis) pugnata* specializes on Asteraceae and helps pollinate *Helianthus* (Frolich and Parker 1983).

*Helianthus annuus* yellow: *Argynnis (Speyeria) nokomis* 2x, *Chlosyne gorgone* 2x, *Colias edwardsii altiplano* 2x, *Colias philodice*, *Danaus plexippus* 2x, *Hesperia leonardus pawnee* 2x (incl. Paul A. Opler), *Papilio multicaudata* briefly, *Phyciodes tharos tharos* 2x, *Vanessa cardui*. In Texas it is pollinated by specialist and generalist bees; large bees are more effective than small ones, and wild bees and specialist bees are more effective pollinators than honeybees and bumblebees (Neff and Simpson 1990; Parker 1981).

*Helianthus divaricatus* yellow: *Ancyloxypha numitor* [not *Hel. tuberosus*?], *Boloria selene nebraskensis*, *Colias eurytheme*, *Colias philodice* 4x, *Colias philodice Xeurytheme*, *Phyciodes diminutor*.

*Helianthus nuttallii* yellow: *Lycaena hyllus*, *Strymon melinus*, *Vanessa cardui*, *Zerene cesonia*, *Chlosyne chinatiensis* 2x.

*Helianthus petiolaris* yellow: *Argynnis (Speyeria) callippe* ~10x, *Argynnis (Speyeria) cybele charlottii*, *Chlosyne gorgone* 2x, *Colias eurytheme* 6x, *Colias philodice* 3x and 1x only ½ sec., *Hemiargus isola* 1 sec., *Hesperia comma* 3x, *Hesperia leonardus pawnee* 2x, *Limnitis weidemeyerii*?, *Lycaena rubidus* 4x, *Phyciodes pulchella camillus*, *Plebejus icarioides*, *Pyrgus communis* ½ sec., *Vanessa cardui*, *Wallengrenia egeremet*. The bee *Martinapis* visits this.

*Helianthus pumilus* yellow: *Argynnis (Speyeria) callippe*, *Asterocampa celtis jeffermont* 3x, *Atrytone arogos* 11x, *Chlosyne gorgone* 5x, *Chlosyne palla calydon*, *Colias eurytheme*, *Colias philodice*, *Erebia epiroidea*, *Euphydryas anicia capella* 15x, *Euptoieta claudia* 6x, *Hemiargus isola*, *Hesperia comma*,

*Hesperia viridis* 4x, *Lycaena arota* 5x, *Neominois ridingsii* 3x, *Ochlodes sylvanoides*, *Oeneis chryxus* 3x, *Papilio glaucus rutulus*, *Papilio indra*, *Papilio polyxenes* 1x + 2 sec., *Papilio zelicaon*, *Pholisora catullus*, *Phyciodes cocyta*, *Phyciodes mylitta arizonensis* (like *Helianthus pumilus* yellow but leaves hairless), *Phyciodes pulchella camillus*, *Piruna pirus*, *Plebejus icarioides*, *Polites origenes* 6x, *Pontia protodice* 2x.

*Helianthus tuberosus* yellow: *Ancyloxypha numitor* 6x, *Colias eurytheme* 23x, *Colias philodice* 4x, *Danaus plexippus* 3x, *Euptoieta claudia* 3x, *Lycaena hyllus* 2x, *Papilio polyxenes*, *Phyciodes diminutor*, *Phyciodes tharos tharos* 31x, *Pontia protodice* 2x, *Vanessa atalanta*, *Vanessa cardui* 8x, *Vanessa virginiensis*.

*Helianthus* yellow: *Colias eurytheme*, *Ochlodes yuma* (Scott, Shields, and Ellis 1976).

*Helianthus?* yellow: *Coenonympha tullia*, *Hesperia uncas* 2x, *Parnassius phoebus smintheus*.

*Heliopsis helianthoides* yellow: *Ancyloxypha numitor*, *Atrytone arogos*, *Colias eurytheme*, *Lycaena hyllus*, *Nathalis iole* 2x, *Phyciodes diminutor* 47x.

*Heterotheca* yellow is one of the best butterfly flowers in Colorado, as it is very abundant almost everywhere and is popular. (There may just be one species instead of the three *Heterotheca* “species” listed below.) *H. subaxillaris* [in Colorado as *H. latifolia*] is visited by numerous bees that pollinate it, notably the specialist colletid bee *Colletes mandibularis* (which evidently visits only Asteraceae), and occasionally by *Hesperia* butterflies in Texas; 97% of visits are bees, by that *Colletis mandibularis* specialist, plus Andrenidae (*Andrena reflexa*), Halictidae (*Dialictus*, *Augochloropsis mandibularis metallica*), Megachilidae (*Heriades variolosa*, *Megachile albitarsus*), Apidae (*Apis mellifera* honeybees, *Ceratina diodonta*, *Bombus pennsylvanicus* bumblebees), and Xylocopidae (*Xylocopa micans*) (Olsen 1997).

*Heterotheca canescens* yellow: *Amblyscirtes eos*, *Atalopedes campestris* ~17x, *Chlosyne gorgone*, *Colias eurytheme* 4x, *Colias philodice* 5x, *Euptoieta claudia* 2x, *Hemiargus isola*, *Hesperia comma* 2x, *Hesperia ottoe*, *Lerodea eufala* 12x, *Nathalis iole* ~20x, *Nathalis iole* 2x, *Phyciodes tharos orantain*, *Phyciodes tharos tharos*, *Pieris rapae*, *Plebejus alupini texanus* 5x, *Polites sabuleti*, *Pontia protodice* 2x, *Pyrgus communis* 5x, *Strymon melinus*.

*Heterotheca pumila* yellow: *Argynnis (Speyeria) mormonia* 32x, *Colias meadii* 5x, *Erebia callias*, *Erynnis funeralis*, *Euptoieta claudia*, *Hesperia comma colorado* 18x, *Lycaena florus* 39x, *Lycaena heteronea* 16x, *Oeneis calais altacordillera* 2x, *Parnassius phoebus smintheus* 3x, *Parnassius phoebus hermodur* 6x, *Pieris rapae*, *Plebejus glandon* 12x, *Plebejus saepiolus* 2x, *Polites draco* 2x, *Pontia callidice occidentalis* 3x, *Vanessa cardui*.

*Heterotheca villosa* yellow is extremely common and also popular: *Aglais milberti*, *Amblyscirtes vialis*, *Anatrytone logan lagus*, *Apodemia mormo pueblo* 2x, *Apodemia nais* several, *Argynnis (Speyeria) aphrodite* 5x, *Argynnis (Speyeria) atlantis sorocko*, *Argynnis (Speyeria) callippe* 21x, *Argynnis (Speyeria) coronis* 3x, *Argynnis (Speyeria) edwardsii* 3x, *Argynnis (Speyeria) hesperis* 14x + 1x briefly, *Argynnis (Speyeria) hydaspe*, *Argynnis (Speyeria) zerene*, *Argynnis (Speyeria) coronis carolae* several, *Atrytone arogos* 9x, *Callophrys dumetorum homoperplexa*, *Callophrys gryneus siva* 4x, *Cercyonis meadii* 350x, *Cercyonis oetus* 148x (they prefer *Aster porteri* white), *Cercyonis pegala* 2x, *Chlosyne gorgone* 7x, *Chlosyne leanira fulvia* several, *Coenonympha tullia* 5x, *Colias alexandra* 3x, *Colias edwardsii altiplano*, *Colias eurytheme* 36x, *Colias meadii* 2x, *Colias philodice* ~32x, *Erynnis afranius* 4x, *Erynnis martialis*, *Erynnis martialis*, *Erynnis pacuvius*, *Erynnis persius* 3x, *Euchloe ausonides*, *Euphilotes ancilla barnesi* 3x, *Euphydryas anicia capella* 25x, *Euphyes vestris* 8x, *Euptoieta claudia* 20x incl. Janet Chu, *Hemiargus isola* 2x, *Hesperia comma* 203x, *Hesperia comma colorado* 15x, *Hesperia juba* 3x, *Hesperia leonardus montana* 11x, *Hesperia leonardus pawnee* 4x (incl. Paul A. Opler), *Hesperia pahaska* 1x, *Hesperia uncas* 6x, *Hesperia viridis* 9x, *Lycaena arota* 17x, *Lycaena florus*, *Lycaena heteronea?* 15x, *Lycaena rubidus* 9x, *Lycaena xanthoides “editha” vurali*, *Neominois ridingsii* 5x, *Neominois ridingsii wyomingo*, *Neophasia menapia* 6x, *Oarisma garita* 7x, *Ochlodes sylvanoides* 54x, *Papilio polyxenes*, *Papilio polyxenes rudkini*, *Papilio zelicaon*, *Parnassius phoebus smintheus* 4x, *Pholisora catullus* 2x, *Phyciodes cocyta* 7x, *Phyciodes pallida* 2x, *Phyciodes picta* 4x, *Phyciodes pulchella camillus* 37x, *Pieris rapae* 3x, *Piruna pirus* 2x, *Plebejus alupini texanus* 3x, *Plebejus glandon*, *Plebejus icarioides* 2x incl. Janet Chu, *Plebejus melissa* 14x, *Plebejus shasta minnehaha* ~5x, *Poanes taxiles* 2x, *Poladryas minuta arachne* 91x,

*Poladryas minuta* near-*minuta*, *Polites mystic*, *Polites origenes* 3x, *Polygonia gracilis zephyrus?*, *Pontia callidice occidentalis* 3x, *Pontia protodice* 11x incl. Janet Chu, *Pyrgus communis* 12x, *Pyrgus scriptura* 4x, *Satyrium behrii* 4x, *Satyrium saepium* 5x, *Satyrium titus* 3x, *Strymon melinus* 7x, *Vanessa cardui* 11x.

*Hymenopappus filifolius* yellow: *Callophrys eryphon*, *Callophrys gryneus siva* 3x, *Coenonympha tullia* 3x, *Euptoieta claudia* 2x, *Eurema nise* female on, *Glaucopsyche lygdamus*, *Hemiargus isola*, *Hesperia pahaska* 2x, *Hesperia uncas* 4x, *Neominois ridingsii* 4x, *Notamblyscirtes simius* 1x, *Phyciodes pulchella camillus* 2x, *Plebejus melissa*, *Poladryas minuta arachne* 4x, *Pontia protodice* 3x, *Pyrgus communis* 1x, *Satyrium californica*.

*Hymenoxys (Tetraneuris) acaulis* yellow: *Callophrys eryphon*, *Erynnis afranius* 3x, *Glaucopsyche lygdamus*, *Hemiargus isola*, *Neominois ridingsii* male, *Phyciodes pulchella camillus*, *Plebejus melissa* 2x, *Poladryas minuta arachne*, *Polites (Yvretta) rhesus* 3x, *Pontia callidice occidentalis*, *Pyrgus communis*.

*Hymenoxys (Tetraneuris) brevifolia* yellow: *Argynnis (Speyeria) mormonia*, *Euphydryas anicia brucei*, *Papilio zelicaon*, *Parnassius phoebus hermodur*.

*Hymenoxys grandiflora* yellow: *Boloria improba acrocneuma* (Scott 1982), *Argynnis (Speyeria) mormonia* 2x, *Boloria titania*, *Colias meadii* 2x, *Erebia callias* 2x (one male of these covered with pollen), *Euphydryas anicia brucei* 7x (and male thorax uns covered with its pollen), *Euphydryas anicia capella*, *Hesperia comma colorado*, *Parnassius phoebus smintheus* 2x, *Plebejus glandon*, *Polites draco*, *Pyrgus centaureae*, *Vanessa cardui*. This is pollinated by bumblebees (*Bombus appositus*, *B. flavifrons*, *B. huntii*, *B. melanopygus*) and the syrphid fly *Eristalis hirta* (Rocky Mountain Biological Lab, Gothic Colorado), and surely by *Euphydryas anicia* sometimes.

*Hymenoxys richardsoni* yellow: *Lycaena arota* (pollinating it, covered with the pollen), *Paratrytone snowi* [not *Hymenopappus filifolius*] 4x, *Vanessa cardui*.

(*Iva xanthifolia* has small ugly flowers and is not visited. It is wind-pollinated and the pollen is a major cause of hay fever.)

(*Krigia* is very rare in Colorado so I have no records. The bee *Andrena krigiana* specializes on it.)

*Kuhnia eupatoroides* white: *Plebejus melissa*. This is insect-pollinated.

*Lactuca serriola* yellow is not popular: *Pholisora catullus*, *Pieris rapae* 4x. This (and *Lactuca sativa* the domesticated version of *L. serriola*) self-pollinate most of the time, but are also pollinated by visiting generalist insects, mostly Hymenoptera and flies. A bee *Andrena humilis* specializes on the Lactuceae subgroup of Asteraceae in Europe (Franzen and Larsson 2007).

(*Lepidotheca suaveolens* weeds in my yard have tiny yellow flowers that are not visited.)

*Leucelene ericoides*=*Aster arenosus* white: *Chlosyne leanira alma*, *Hesperia pahaska*, *Pontia callidice occidentalis*.

*Liatris* is surely pollinated in part by butterflies. *Liatris ohlingae* is reportedly pollinated by butterflies. *Liatris cylindracea* is visited by long-tongued bees, butterflies, skippers, and bee flies (short-tongued bees visit but are not effective pollinators); and *Liatris aspera* pollinator visitors are primarily long-tongued bees (honeybees, bumblebees, little carpenter bees, miner bees, leaf-cutting bees), butterflies (*Danaus plexippus*, *Vanessa cardui*, *Papilio polyxenes*), skippers, and bee flies, while green metallic bees also visit and Halictine bees collect mostly pollen but are not effective pollinators (Hilty 2013). In Florida, *Liatris pauciflora* (and the closely-related *Carphephorus corymbosus*) are pollinated by butterflies and their flower heads bend to face upward favoring butterflies, while *Liatris gracilis*, *L. tenuifolia*, and *L. laevigata* are pollinated mostly by bees (Lopera-Blair 2011).

*Liatris ligulistylis* purplish: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) hesperis* 10x, *Hesperia leonardus* ssp. occasionally on this and other *Liatris* species (Scott and Stanford 1981).

*Liatris punctata* purplish is very popular: *Amblyscirtes eos* 6x, *Argynnis (Speyeria) aphrodite* 54x, *Argynnis (Speyeria) coronis* 3x, *Argynnis (Speyeria) edwardsii* 9x, *Atalopedes campestris* 4x, *Atrytone arogos* 15x, *Battus philenor* 4x, *Cercyonis pegala* 18x, *Colias edwardsii altiplano* 8x, *Colias eurytheme* 28x, *Colias philodice* 14x, *Danaus plexippus* 3x, *Erynnis horatius*, *Euptoieta claudia* 15x, *Hemiargus isola*, *Hesperia attalus*, *Hesperia comma* 274x, *Hesperia juba* 2x, *Hesperia leonardus leonardus* many (Steve Spomer and Tim Warwick), *Hesperia leonardus montana* 595x, *Hesperia leonardus pawnee* 256x (main flower, Scott and Scott 1978), *Hesperia leonardus* ssp. abundant on in Colo., Neb., Minn., Mich., N.J. (Scott and

Stanford 1981), *Hesperia uncas* 5x, *Hesperia viridis*, *Lerodea eufala* 2x, *Ochlodes sylvanoides* 22x, *Papilio glaucus rutulus*, *Papilio machaon brucei*, *Papilio multicaudata* very briefly, *Papilio polyxenes* 11x (one for f. *pseudoamericanus*), *Phoebis agarithe*, *Phyciodes pulchella camillus*, *Pieris rapae*, *Plebejus melissa* 3x, *Polites peckius* 59x, *Polites themistocles* 9x, *Pyrgus communis* 10x, *Strymon melinus* 10x, *Vanessa cardui* 21x, *Vanessa virginiensis*.

*Lygodesmia juncea* pink: *Hesperia uncas tomichi* 1 sec., *Notamblyscirtes simius*, *Plebejus melissa*, *Pontia protodice*. This is pollinated by many insects including bees and perhaps even beetles.

*Machaeranthera bigelovii* purple/violet: *Danaus plexippus* [? *Machaeranthera bigelovii*, blue], *Hesperia comma* 2x, *Hesperia pahaska* 2x, *Neophasia menapia* [“Aster” prob. *M. bigelovii*], *Polygonia faunus* 3x, *Vanessa carye*.

*Machaeranthera canescens* deep blue/purple: *Colias eurytheme* 32x, *Colias philodice* 151x (and var. *rubrotinctus* 1x blue), *Hesperia comma* 3x, *Lycaena helloides* 15x, *Ochlodes sylvanoides*, *Phyciodes pulchella camillus* blue 2x and var. *rubrotinctus* blue 2x, *Phyciodes tharos orantain*, *Pieris rapae*, *Polites sabuleti* 2x, *Pontia protodice*, *Pyrgus communis* 3x, *Argynnis (Speyeria) aphrodite*. Reportedly pollinated by honeybees, bee flies *Bombyliidae*, and the butterfly *Pieris rapae*.

*Machaeranthera grindelioides* yellow: *Phyciodes batesii anasazi*.

*Machaeranthera pattersoni* purple/violet: *Argynnis (Speyeria) aphrodite*, *Colias eurytheme* blue 19x, *Colias philodice* blue 55x, *Euptoieta claudia*, *Hesperia comma* 55x, *Hesperia leonardus montana* blue 13x, *Lycaena helloides* blue 9x, *Nathalis iole*, *Neophasia menapia* 3x, *Ochlodes sylvanoides* 12x (+2x for *M. “pattersoni/canescens”*), *Phyciodes pulchella camillus* 17x, *Pieris rapae* blue 5x, *Plebejus glandon*, *Poladryas minuta arachne* 1 sec., *Pontia callidice occidentalis* 2x, *Pontia protodice*, *Pyrgus communis* 7x, *Vanessa atalanta*, *Vanessa cardui* 4x.

*Machaeranthera annua=phyllocephala* yellow: *Colias eurytheme*, *Pieris rapae*, *Pyrgus communis* 3x.

*Machaeranthera pinnatifida=Haplopappus spinulosus* yellow: *Euphydryas anicia wecoet*, *Notamblyscirtes simius*, *Phyciodes pulchella camillus*, *Plebejus melissa*, *Pyrgus communis* 3x. Cuckoo bees (*Anthophorinae*) and megachilid bees (*Anthidium*) and other bees visit this.

*Machaeranthera tanacetifolia* blue-purple: *Colias eurytheme*, *Colias philodice*, *Pontia protodice*, *Pyrgus communis*.

*Matricaria inodora* white: *Pieris rapae*.

*Onopordum acanthium* rose-purple is spreading and still uncommon but popular: *Argynnis (Speyeria) edwardsii*, *Vanessa cardui*. Reportedly pollinated by bumblebees and probably some other bees.

*Osteospermum* near “Buttermilk” whitish petals lavender at base: *Vanessa cardui*. *Osteospermum* is pollinated by honeybees and other bees, and butterflies and flies also visit.

?*Pectis angustifolia* (doubtfully *Dyssodia papposa* which has dissected leaves) yellow tiny Asteraceae 10 cm tall with filamentous leaves: *Nathalis iole* 2x.

*Pericome caudata* yellow: *Cercyonis pegala* 4x, *Hesperia viridis*, *Lycaena arota* 130x, *Ochlodes yuma anasazi* 12x, *Vanessa cardui* 3x.

(*Podospermum laciniatum* yellow weeds near my yard are not visited.)

*Psilostrophe sparsiflora* yellow: *Euptoieta claudia* 5x, *Eurema nicippe*.

*Ratibida columnifera* yellow: *Atrytone arogos* 2x, *Colias eurytheme* 2x, *Danaus plexippus*, *Lycaena dione*, *Polites origenes* (purple flower), *Vanessa atalanta*. The most frequent pollinator in Kansas is the bee *Andrena rudbeckiae* ([www.fs.fed.us/database](http://www.fs.fed.us/database)) (which is a specialist pollinator of *Rudbeckia* and *Ratibida*), and honeybees pollinate garden varieties; numerous bees species visit it in Illinois (Robertson 1929).

*Ratibida pinnata* yellow: *Colias philodice* 2x, *Euptoieta claudia*.

*Rudbeckia hirta* yellow: *Apodemia nais*, *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) atlantis sorocko* 31x, *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) hesperis* 40x, *Argynnis (Speyeria) hesperis nausicaa*, *Argynnis (Speyeria) mormonia* 2x, *Argynnis (Speyeria) mormonia luski*, *Argynnis (Speyeria) nokomis*, *Atrytone arogos*, *Callophrys dumetorum homoperplexa*, *Callophrys gryneus siva*, *Cercyonis oetus* 12x, *Cercyonis pegala* 2x, *Chlosyne gorgone* 3x, *Chlosyne nycteis* 9x, *Chlosyne palla calydon* 3x, *Colias alexandra* 3x, *Colias eurytheme* 6x, *Danaus gilippus*, *Euphydryas anicia capella* 4x, *Euptoieta*

*claudia*, *Limenitis weidemeyerii*, *Lycaena florus* 15x, *Lycaena nivalis*, *Lycaena rubidus*, *Lycaena xanthoides* “*editha*” *vurali*, *Neophasia menapia*, *Oarisma garita* 3x, *Oeneis chryxus* 4x, *Papilio glaucus rutulus* 2x, *Papilio zelicaon*, *Phyciodes cocyta* 41x, *Phyciodes pallida* 4x, *Phyciodes pulchella camillus* 3x, *Phyciodes tharos tharos* 2x (This Old House TV show), *Pieris rapae* (usually ignores it), *Plebejus glandon* 3x, *Polites peckius peckius* Ariz., *Polites peckius surllano* 2x, *Polites sonora*, *Polites themistocles* 5x (it is not popular for either *P. peckius* or *P. themistocles*), *Polygonia faunus*, *Pyrgus communis* 4x, *Satyrrium calanus* 2x, *Satyrrium sylvinus*, *Satyrrium titus*, *Strymon melinus*, *Vanessa atalanta*, *Vanessa cardui* 4x, *Vanessa carye* 2x, *Vanessa virginiensis* 5x. *Rudbeckia auriculata* “most likely” pollinators are native bees in particular *Andrena aliciae* and halictid bees (Diamond et al. 2006). In Illinois *Rudbeckia triloba* attracts bumblebees, numerous bees (*Ceratina*, *Melissodea*, *Triepeolus*, *Coeloxys*, *Megachile*, *Andrena*, *Heterosarus*, and halictid bees including green metallic bees, plus *Andrena rudbeckiae* which is a specialist pollinator of *Rudbeckia* and *Ratibida* flowers; it also attracts sphecid and vespid wasps, many flies (syrphids, bee flies, thick-headed flies, Tachinidae) plus butterflies, and *Chauliognathus pennsylvanicus* beetles (Hilty 2013). Butterflies and honeybees also visit *Rudbeckia fulgida*. The bee *Heterosarus rudbeckiae* specializes on *Rudbeckia*.

*Rudbeckia laciniata ampla* yellow: *Apodemia nais*, *Argynnis (Speyeria) aphrodite* 9x, *Argynnis (Speyeria) atlantis sorocko* 6x, *Argynnis (Speyeria) callippe* 33x, *Argynnis (Speyeria) edwardsii* (~*Rudbeckia laciniata hortensis* yellow with yellowish centers), *Argynnis (Speyeria) hesperis* 134x (favorite), *Argynnis (Speyeria) hesperis ratonensis* 21x, *Argynnis (Speyeria) nokomis*, *Argynnis (Speyeria) zerene* 8x, *Cercyonis oetus* 40x, *Cercyonis pegala*, *Chlosyne nycteis* 23x, *Colias alexandra*, *Epargyreus clarus*, *Euphyes vestris*, *Euptoieta claudia*, *Hesperia comma*, *Lycaena arota* 11x, *Lycaena heteronea*, *Neophasia menapia* 6x, *Ochlodes sylvanoides* 5x, *Oeneis chryxus*, *Papilio glaucus rutulus*, *Parnassius phoebus smintheus*, *Phyciodes batesii anasazi* 11x, *Phyciodes pallida*, *Piruna pirus* 2x, *Polygonia faunus*, *Polygonia gracilis zephyrus* 4x, *Pyrgus communis*, *Satyrrium behrii*, *Satyrrium calanus* 5x, *Satyrrium californica* 6x, *Satyrrium saepium* 2x, *Satyrrium sylvinus* white uns 4x, *Vanessa atalanta* 6x, *Vanessa cardui* 4x, *Vanessa virginiensis* 3x.

(*Rudbeckia occidentalis montana* is frequently visited by bumblebees *Bombus bifarius* and *B. fravifrons* in Colorado, which surely pollinate it.

*Senecio* are common and very popular flowers, except that subgenus/genus *Ligularia* is not visited because the flowers droop downward and evidently attract other insects (Dodson and Dunmire 2007 claims that the nodding species *Senecio [Ligularia] bigelovii* is pollinated by “flies, beetles, butterflies and moths”, but I have no records of butterflies visiting the nodding species even where *Senecio [Ligularia] amplexans* is common, although Schmitt [1980] saw them [see below]). *Senecio* are reportedly pollinated by butterflies, but also by bees as the bee *Andrena gardineri* specializes on *Senecio*. The three *Senecio* species that Schmitt (1980) studied in Colorado (noted below) were visited by bumblebees also, so bumblebees were surely the most important pollinators, although butterflies dispersed the genes (pollen) farther than bumblebees.

(*Senecio [Ligularia] amplexans* yellow was studied by Schmitt [1980], who observed visits by *Bombus silvicola* bumblebees and the butterflies *Parnassius*, *Colias*, and *Argynnis [Speyeria]*.)

*Senecio atratus* yellow: *Argynnis (Speyeria) mormonia* 13x, *Boloria titania*, *Colias meadii*, *Lycaena florus* 21x, *Lycaena heteronea* 9x, *Lycaena rubidus* 2x, *Vanessa cardui* 2x, *Erebia epipsodea* 1x + form *brucei* 1x, *Oeneis calais altacordillera* 5x, *Parnassius phoebus hermodur* ½ sec., *Pieris marginalis mcdunnoughii*, *Plebejus glandon* 11x, *Plebejus saepiolus*.

*Senecio aureus* yellow: *Phyciodes diminutor*.

*Senecio (Packera) canus* yellow: *Aglais milberti* 2x, *Argynnis (Speyeria) callippe* 2x, *Argynnis (Speyeria) mormonia*, *Boloria eunomia*, *Callophrys dumetorum homoperplexa* 2x, *Callophrys augustinus*, *Callophrys eryphon*, *Callophrys gryneus siva* 2x, *Celastrina lucia sidara*, *Chlosyne gorgone* 22x, *Coenonympha tullia* 2x (plus one only ½ sec.), *Colias eurytheme* 2x, *Colias philodice* 2x, *Erebia callias*, *Erebia epipsodea* 2x, *Erynnis brizo* 2x, *Erynnis martialis* 5x, *Erynnis pacuvius* 11x, *Erynnis persius* 16x, *Erynnis telemachus* 4x, *Euchloe ausonides* 2x, *Euphydryas anicia brucei*, *Euphydryas anicia capella* 14x, *Euphydryas bernadetta bernadetta* 5x, *Euptoieta claudia* 2x, *Hesperia juba* 2x, *Hesperia nevada* (another

left after ¼ sec.), *Oarisma garita*, *Oeneis chryxus* 3x, *Papilio polyxenes* 2x, *Papilio zelicaon* 7x, *Parnassius phoebus smintheus* 30x, *Parnassius phoebus hermodur* 3x, *Phyciodes pallida*, *Phyciodes pulchella camillus* 19x, *Plebejus saepiolus*, *Poladryas minuta arachne* 2x, *Polites draco*, *Polygonia gracilis zephyrus* 13x (one male had yellow pollen on uns), *Pontia callidice occidentalis*, *Pyrgus communis*, *Stinga morrisoni*, *Strymon melinus* 2x.

*Senecio crassulus* yellow: *Aglais milberti*, *Argynnis (Speyeria) mormonia* 9x, *Boloria eunomia*, *Boloria titania* (orange or yellow-orange) 7x, *Colias eurytheme*, *Colias meadii* 21x, *Colias scudderii* 24x, *Erebia epipsodea* 32x (incl. form *brucei* 2x), *Euchloe ausonides*, *Euphydryas anicia brucei* 2x, *Oeneis calais altacordillera* 2x, *Pieris marginalis mcdunnoughii* 8x, *Plebejus glandon*, *Plebejus saepiolus* 2x, *Plebejus saepiolus* 4x, *Polites draco* 2x, *Pontia callidice occidentalis*, *Pyrgus centaureae* 5x, *Vanessa atalanta*, *Vanessa cardui* 34x, *Vanessa carye*. Schmitt (1980) saw *Bombus frigidus*, *B. flavifrons*, *B. kirbevellis*, and *B. silvicola* bumblebees, and the butterflies *Parnassius*, *Colias*, *Pieris*, *Vanessa*, and *Argynnis (Speyeria)* visit it.

*Senecio (Packera) crocatus* orange-red to yellow: *Boloria titania*.

*Senecio (Packera) dimorphophyllus* yellow: *Argynnis (Speyeria) mormonia* 3x, *Boloria eunomia*, *Boloria titania* 11x, *Coenonympha tullia*, *Colias meadii* 3x, *Colias scudderii* 2x, *Erebia epipsodea* 2x, *Erebia stubbendorffii* "theano" *demmia*, *Lycaena cupreus snowi* 3x, *Parnassius phoebus hermodur*, *Plebejus saepiolus*, *Pyrgus centaureae* 6x, *Vanessa cardui*.

*Senecio eremophilus kingi* pinnate yellow: *Argynnis (Speyeria) zerene platina*.

*Senecio (Packera) fendleri* yellow: *Aglais milberti*, *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) callippe* 5x (incl. much pollen on body), *Argynnis (Speyeria) coronis* 2x, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) hesperis*, *Callophrys dumetorum homoperplexa* 4x, *Callophrys gryneus siva* 9x, *Celastrina lucia sidara*, *Chlosyne gorgone* 51x, *Chlosyne palla calydon* 2x, *Coenonympha tullia* 15x, *Colias eurytheme* 4x, *Colias philodice*, *Erebia epipsodea*, *Erynnis afranius* 2x (plus one ½ sec.), *Erynnis brizo (Senecio fendleri X canus)* yellow, *Erynnis icelus*, *Erynnis martialis*, *Erynnis pacuvius* 6x, *Erynnis persius* 22x, *Erynnis telemachus* 2x, *Euchloe ausonides*, *Euphydryas anicia capella* 63x, *Euphydryas editha*, *Euptoieta claudia* 9x, *Glaucopsyche lygdamus*, *Hesperia pahaska*, *Hesperia uncas*, *Oarisma garita* 4x, *Oeneis chryxus* 4x, *Oeneis uhleri* 3x, *Papilio indra*, *Papilio polyxenes*, *Papilio zelicaon*, *Parnassius phoebus smintheus* 43x (a male has much pollen from it, a female covered with its pollen, so they must pollinate it) and *Parnassius phoebus smintheus* [probably *Senecio fendleri* or *S. canus*] 97x (one pollinating it covered with yellow pollen), *Phyciodes cocyta* 5x, *Phyciodes pallida*, *Phyciodes pulchella camillus* 53x, *Plebejus alupini texanus* 4x, *Plebejus glandon* 2x, *Plebejus icarioides* 6x, *Plebejus melissa* 2x, *Pyrgus communis* 2x, *Poladryas minuta arachne* 16x, *Polites (Yvretta) rhesus*, *Pontia callidice occidentalis* 3x, *Pontia protodice* 7x, *Stinga morrisoni*, *Vanessa cardui* 17x.

*Senecio fremontii* var. *blitoides* yellow: *Argynnis (Speyeria) mormonia* 2x, *Boloria eunomia*, *Boloria titania* 3x, *Chlosyne whitneyi damoetas* 5x, *Colias scudderii* 4x, *Erebia epipsodea* 4x (incl. form *brucei* 1x), *Lycaena cupreus snowi* 14x, *Parnassius phoebus smintheus*, *Plebejus glandon*, *Pyrgus centaureae*.

*Senecio integerrimus* yellow: *Aglais milberti*, *Argynnis (Speyeria) hydaspae* 2x, *Argynnis (Speyeria) mormonia* 19x, *Argynnis (Speyeria) zerene* 3x, *Boloria selene tollandensis* 2x, *Boloria titania*, *Chlosyne gorgone* 5x, *Colias edwardsii altiplano*, *Erebia epipsodea*, *Erynnis persius* 5x, *Euchloe ausonides*, *Euphydryas anicia capella* 2x, *Glaucopsyche piasus*, *Papilio zelicaon*, *Parnassius phoebus smintheus*, *Phyciodes pulchella camillus* 2x, *Plebejus saepiolus*, *Poladryas minuta arachne*, *Polygonia gracilis zephyrus*, *Pyrgus centaureae* 2x, *Stinga morrisoni*, *Vanessa cardui* 3x. Schmitt (1980) saw *Bombus bifarius* bumblebees, and observed the butterflies *Colias*, *Pieris*, *Erebia [epipsodea]*, *Papilio*, *Danaus*, *Euphydryas*, *Coenonympha [tullia]*, and *Vanessa* visiting it.

*Senecio ~pauperculus* yellow, leaves coarsely serrate: *Danaus plexippus*.

*Senecio (Packera) plattensis* yellow: *Plebejus icarioides*, *Plebejus melissa*, *Polites (Yvretta) rhesus* 2x.

*Senecio (Packera) pseudoreus* orange-red: *Argynnis (Speyeria) mormonia*, *Phyciodes cocyta selenis* (yellow flowers).

*Senecio spartioides* yellow: *Apyrrothrix araxes (~S. spartioides)*, *Cercyonis meadii* 1x, but ignored it 3x, *Cercyonis meadii*, *Chlosyne gorgone*, *Colias eurytheme*, *Colias eurytheme* 7x, *Colias philodice* 5x,

*Danaus plexippus* 4x, *Euptoieta claudia*, *Hesperia comma* 5x, *Hesperia leonardus pawnee* 3x, *Libythea carinenta bachmannii*, *Limenitis weidemeyerii*, *Lycaena helloides* 2x, *Phyciodes pulchella camillus* 2x, *Phyciodes tharos orantain* 2x, *Pieris rapae* 3x, *Poladryas minuta near-minuta*, *Pontia protodice*, *Pyrgus communis* 3x, *Satyrium titus*, *Strymon cestri* (~*S. spartioides*), *Vanessa atalanta*.

*Senecio* (*Packera*) *streptanthifolius* yellow: *Coenonympha tullia*.

*Senecio triangularis* yellow: *Aglais milberti* 2x, *Argynnis* (*Speyeria*) *atlantis sorocko* ~4x, *Argynnis* (*Speyeria*) *callippe*, *Argynnis* (*Speyeria*) *coronis*, *Argynnis* (*Speyeria*) *hesperis electa* ~2x, *Argynnis* (*Speyeria*) *mormonia* 27x, *Argynnis* (*Speyeria*) *zerene* 10x, *Boloria bellona*, *Boloria eunomia* 5x, *Boloria titania* 22x, *Chlosyne nycteis* 10x, *Chlosyne palla calydon* several, *Chlosyne palla flavula* 4x, *Colias pelidne skinneri*, *Colias scudderii* 3x, *Erebia epipsodea* 4x (incl. form *brucei* 1x), *Limenitis weidemeyerii*, *Lycaena rubidus* 2x, *Oarisma garita*, *Phyciodes cocyta* 2x, *Pieris marginalis mcdunnoughii* ~15x, *Plebejus glandon* 2x, *Plebejus saepiolus*, *Polygonia faunus cenveray*, *Polygonia gracilis zephyrus* 2x, *Vanessa cardui* 4x, *Vanessa carye*.

*Senecio* (*Packera*) *tridenticulatus* yellow: *Hesperia uncas*, *Phyciodes pulchella camillus*, *Plebejus melissa*, *Polites* (*Yvretta*) *rhesus*, *Pontia protodice*, *Pyrgus communis*.

*Senecio* (*Packera*) *werneriaefolius* yellow: *Colias scudderii*, *Lycaena cupreus snowi*, *Parnassius phoebus smintheus* 2x, *Pyrgus centaureae*.

*Senecio* spp. yellow: *Aglais milberti*, *Argynnis* (*Speyeria*) *callippe*, *Argynnis* (*Speyeria*) *coronis* 3x, *Argynnis* (*Speyeria*) *egleis* 12x, *Argynnis* (*Speyeria*) *hesperis irene*, *Argynnis* (*Speyeria*) *hesperis many* 2x, *Argynnis* (*Speyeria*) *hydaspe* 3x, *Argynnis* (*Speyeria*) *mormonia* 4x, *Argynnis* (*Speyeria*) *zerene* 21x, *Boloria alaskensis halli*, *Boloria epithore* 2x, *Boloria titania* 2x, *Callophrys dumetorum homoperplexa*, *Callophrys eryphon*, *Callophrys gryneus nelsoni*, *Cercyonis oetus*, *Chlosyne gorgone* 3x, *Chlosyne hoffmanni*, *Chlosyne whitneyi damoetas* 4x, *Coenonympha haydenii*, *Coenonympha tullia*, *Colias meadii*, *Colias pelidne skinneri*, *Colias scudderii* 2x, *Colias scudderii harroweri* 11x, *Euphydryas anicia eurytion* 2x, *Eurema proterpia*, *Lycaena cupreus snowi*, *Lycaena florus tall* 2x, *Lycaena heteronea*, *Lycaena mariposa*, *Lycaena nivalis*, *Microtia* (*Texola*) *elada*, *Neominois ridingsii*, *Papilio zelicaon*, *Parnassius clodius*, *Phyciodes orseis orseis*, *Phyciodes pulchella camillus* 2x, *Phyciodes pulchella montana*, *Pieris marginalis mcdunnoughii*, *Poladryas minuta arachne*, *Polygonia gracilis zephyrus* 3x, *Vanessa cardui many*, *Vanessa virginensis*.

*Senecio?* yellow: *Erebia callias*, *Hesperia uncas*, *Hesperia viridis* several, *Oarisma garita*, *Poladryas minuta arachne* 10x, *Poladryas minuta near-minuta*.

*Solidago altissima* “*canadensis*” yellow: *Argynnis* (*Speyeria*) *aphrodite*, *Argynnis* (*Speyeria*) *callippe* 2x, *Argynnis* (*Speyeria*) *coronis*, *Argynnis* (*Speyeria*) *hesperis* 11x, *Argynnis* (*Speyeria*) *mormonia*, *Asterocampa celtis jeffermont*, *Atrytone arogos* 56x, *Callophrys gryneus siva* 4x, *Celastrina humulus hop-ecotype*, *Cercyonis oetus* 14x, *Cercyonis pegala* 21x, *Chlosyne gorgone* 3x, *Colias eurytheme* 3x, *Colias philodice* 5x, *Danaus plexippus* 2x, *Erynnis afranius*, *Euphyes vestris* 4x, *Hesperia comma*, *Hesperia ottoe*, *Hesperia viridis*, *Limenitis weidemeyerii*, *Lycaena arota*, *Lycaena florus*, *Lycaena helloides*, *Lycaena heteronea* 17x, *Lycaena hyllus*, *Lycaena xanthoides* “*editha*” *vurali*, *Ochlodes sylvanoides* 20x, *Papilio eurymedon*, *Papilio polyxenes*, *Phyciodes cocyta*, *Phyciodes pallida* 2x, *Phyciodes tharos orantain*, *Phyciodes tharos tharos*, *Pieris rapae* 4x, *Piruna pirus* 4x, *Polites origenes* few, *Polites peckius* none, *Polites sabuleti* 2x, *Polygonia faunus*, *Polygonia gracilis zephyrus* 3x, *Satyrium behrii* 4x, *Satyrium calanus* 10x, *Satyrium californica* 14x, *Satyrium liparops* 13x, *Satyrium saepium* 25x, *Satyrium titus* 42x, *Strymon melinus*, *Vanessa atalanta* 4x, *Vanessa cardui* 2x. *Solidago* species are most often bee pollinated. *Solidago* “*canadensis*” is pollinated by the wasp *Polistes fuscatus* and locust borer *Megacyllene robiniae* in Ohio (Blackwell and Powell 1981). In Illinois it is visited by 380 species of insects, and a wide variety visit for pollen or nectar including long- and short-tongued bees, wasps, flies, beetles, and a few butterflies and moths (Hilty 2013). The bees *Andrena hirticincta*, *A. nubecula*, *A. simplex*, *A. solidaginis*, and *A. simulans armata* specialize on *Solidago* (including *Euthamia* and *Oligoneuron*) and *Aster*, while *A. placata* specializes on *Solidago* (incl. *Oligoneuron*).

*Solidago* (*Euthamia*) *gymnospermoides* yellow: *Colias philodice*, *Pieris rapae*, *Polites sabuleti*.



*Solidago missouriensis* yellow: *Argynnis* (*Speyeria*) *aphrodite* 2x, *Argynnis* (*Speyeria*) *hesperis*, *Atrytone arogos*, *Callophrys gryneus siva*, *Cercyonis meadii* 2x, *Cercyonis oetus* 3x, *Cercyonis pegala* 7x, *Chlosyne gorgone* 2x, *Colias eurytheme* 3x, *Colias philodice* 7x, *Euptoieta claudia*, *Hemiargus isola* 2x, *Hesperia comma* 6x, *Hesperia leonardus pawnee*, *Lycaena heteronea* 13x, *Lycaena hyllus* 2x, *Lycaena rubidus*, *Nathalis iole*, *Neophasia menapia* 3x, *Ochlodes sylvanoides* 4x, *Phyciodes picta*, *Phyciodes pulchella camillus*, *Phyciodes tharos orantain*, *Pieris rapae*, *Plebejus melissa* 2x, [*Polites themistocles* and *P. peckius* did not visit this, except *Polites peckius* landed on it but did not feed], *Polites sabuleti* 4x, *Polygonia gracilis zephyrus*, *Satyrium behrii* 3x, *Satyrium calanus*, *Satyrium liparops* 2x, *Satyrium saepium* 12x, *Satyrium titus* 12x, *Strymon melinus*, *Vanessa atalanta*.

*Solidago multiradiata* yellow: *Argynnis* (*Speyeria*) *mormonia*, *Boloria titania* 2x, *Colias meadii*, *Erebia epipsodea*, *Lycaena florus* 4x, *Lycaena rubidus*, 2x *Lycaena xanthoides* “*editha*” *vurali*, *Plebejus glandon* 6x.

*Solidago nana* yellow sprawling low mat: *Cercyonis oetus* 6x, *Strymon melinus*.

*Solidago* (*Euthamia*) *occidentalis* yellow: *Chlosyne gorgone* 2x, *Colias eurytheme* 2x, *Colias philodice*, *Danaus plexippus* 4x, *Lycaena arota* 395x, *Lycaena helloides* 4x, *Lycaena hyllus* 2x, *Phyciodes pulchella camillus*, *Phyciodes tharos orantain* 3x, *Pieris rapae*, *Poladryas minuta arachne*, *Polites sabuleti* 19x, *Pontia protodice*, *Strymon melinus* 2x, *Vanessa carye* 2x.

*Solidago* (*Oligoneuron*) *rigida* yellow: *Colias eurytheme*, *Colias philodice* 13x, *Danaus plexippus*, *Lycaena hyllus*, *Satyrium titus* yellow, *Strymon melinus* 2x, *Vanessa cardui*.

*Solidago simplex* var. *nana=decumbens* yellow: *Aglais milberti*, *Argynnis* (*Speyeria*) *mormonia* 6x (one after passing over 10 *Achillea millefolium* “*lanulosa*” white), *Boloria titania* 2x, *Colias alexandra*, *Colias meadii* 7x, *Colias scudderii* 5x, *Erebia callias*, *Erebia stubbendorffii* “*theano*” *ethela* 60x, *Hesperia comma colorado*, *Lycaena florus* 5x + another only 1-2 sec., *Lycaena heteronea*, *Lycaena rubidus*, *Oeneis calais altacordillera* 2x, *Pieris marginalis mcdunnoughii* 2x, *Plebejus glandon* 20x, *Plebejus alupini lutzi*, *Plebejus saepiolus*, *Plebejus shasta pitkinensis* 5x, *Poladryas minuta arachne* 3x, *Polygonia gracilis zephyrus*, *Pontia protodice*, *Strymon melinus*, *Vanessa cardui*.

*Solidago* yellow: *Argynnis* (*Speyeria*) *hesperis*, *Argynnis* (*Speyeria*) *coronis carolae* many, *Atalopedes campestris*, *Atrytone arogos* 2x, *Boloria selene mtn.-sabulocollis* Las Animas Co. CO, *Callophrys gryneus siva*, *Celastrina neglecta ?cinerea*, *Cercyonis oetus*, *Colias eurytheme*, *Colias philodice*, *Danaus plexippus*, *Hesperia comma*, *Hesperia leonardus* ssp. occasionally (Scott and Stanford 1981), *Libythea carinenta bachmanii* 2x, *Lycaena heteronea*, *Nathalis iole* many, *Neophasia menapia* 2x, *Ochlodes yuma*, *Phyciodes tharos tharos*, *Plebejus icarioides*, *Pontia protodice* Janet Chu, *Satyrium californica* 2x, *Satyrium saepium*, *Strymon melinus*, *Vanessa carye*.

*Sonchus arvensis* [*oleraceus*?] yellow: *Euphyes dion*. This is reportedly pollinated by honeybees and solitary bees and flies; it sometimes self-pollinates.

*Sonchus uliginosus* yellow: *Danaus plexippus* 2x, *Ochlodes sylvanoides*, *Polites peckius*, *Vanessa cardui*.

*Stephanomeria*? yellow: *Poladryas minuta* near-*minuta*. Some *Stephanomeria* are self-pollinating, but most are pollinated presumably by insects.

sunflower yellow (many undetermined genera and species): *Aglais milberti* 2x, *Anatrytone logan lagus* (raiting?), *Apyrrothrix araxes* (sunflower very-large-leaf), *Argynnis* (*Speyeria*) *cybele carpenterii*, *Argynnis* (*Speyeria*) *hesperis electa* (orange and yellow sunflowers) many, *Argynnis* (*Speyeria*) *mormonia*, *Argynnis* (*Speyeria*) *nokomis* 2x, *Atalopedes campestris*, *Atalopedes campestris*, *Atlides halesus*, *Atrytone arogos* 2x Janet Chu, *Boloria improba acrocneema* 1x, *Boloria titania* 2x, *Calephelis rawsoni arizonensis*, *Calephelis rawsoni arizonensis* hispid-leaved, *Chlosyne endeis* several, *Chlosyne janais* several, *Chlosyne whitneyi damoetas* 1x, *Colias eurytheme*, *Colias meadii*, *Copaeodes aurantiaca*, *Danaus plexippus*, *Emesis ares* (like *Helianthus pumilus* yellow but leaves hairless) 2x, *Erebia stubbendorffii* “*theano*” *ethela* two species, *Euphydryas anicia capella*, *Euphydryas chalcedona mcglashani-wheeleri*, *Euphydryas editha hutchinsi* 4” [not *Psilostrophe bakeri*? a guess], *Hylephila phyleus*, *Junonia coenia*, *Lerodea eufala*, *Microtia* (*Texola*) *elada*, *Neophasia menapia* 2x, *Ochlodes sylvanoides*, *Oeneis bore taygete*, *Phoebis sennae*, *Plebejus glandon*, *Polites sabuleti*, *Polygonia faunus*

11x, *Polygonia gracilis zephyrus*, *Pontia beckerii*, *Pontia protodice*, *Pyrgus philetas* (with dissected leaves), *Strymon melinus*, *Vanessa carye* 2x, *Vanessa virginiensis*.

*Tagetes erecta* yellow-orange: *Atalopedes campestris* 25x, *Hesperia leonardus pawnee*, *Polites peckius* 4x, *Pyrgus communis*, *Vanessa carye*. *Tagetes* is reportedly pollinated by honeybees, bees, flies, beetles and butterflies.

*Tagetes patula* orange-yellow: *Atalopedes campestris* (orangish 4x, yellow 3x), *Colias eurytheme* 2x, *Colias philodice*, *Danaus plexippus* 1x (+ another 3 sec.), *Euptoieta claudia* 3x, *Hemiargus isola*, *Ochlodes sylvanoides*, *Poladryas minuta arachne*, *Polites peckius* orange 2x, *Polites themistocles* (yellow-orange) 11x (but not very popular for this), *Pontia protodice* 1x + yellow with red center 2x, *Pyrgus communis* 8x (2 orange-yellow, rest orangish/orange), *Vanessa cardui* (yellow-orange) 13x.

*Tagetes tenuifolia* yellow: *Pyrgus communis* 2x.  
(*Tanacetum vulgare* has no records because it is rare in Colorado, but it is moderately popular elsewhere. It is pollinated by honeybees, and visited by solitary bees.)

*Taraxacum officinale* yellow is very common in spring (less common later) and also popular: *Aglais milberti* 4x, *Amblyscirtes vialis* 4x, *Ancyloxypha numitor* 8x (and seed head very briefly), *Argynnis* (*Speyeria*) *atlantis sorocko* 2x, *Argynnis* (*Speyeria*) *coronis* 2x, *Argynnis* (*Speyeria*) *hesperis*, *Argynnis* (*Speyeria*) *mormonia* 13x, *Argynnis* (*Speyeria*) *zerene* 3x, *Boloria titania* 3x, *Callophrys eryphon*, *Callophrys mossii schryveri*, *Callophrys spinetorum*, *Chlosyne gorgone* 7x, *Chlosyne palla australomontana*, *Colias eurytheme* 17x, *Colias occidentalis sacajawea*, *Colias pelidne skinneri*, *Colias philodice* 16x, *Colias scudderii*, *Cupido amyntula*, *Danaus plexippus* 4x, *Erebia epipsodea* 3x, *Erynnis afranius*, *Erynnis martialis*, *Erynnis pacuvius*, *Erynnis telemachus* 4x, *Euchloe ausonides*, *Euphydryas bernadetta bernadetta* small 2x, *Euptoieta claudia* 20x + one only 1 sec., *Hesperia uncas* 2x, *Inachis io*, *Junonia coenia* 3x, *Nathalis iole*, *Notamblyscirtes simius* 1x, *Oeneis calais altacordillera* 12x, *Parnassius phoebus smintheus* 7x, *Phyciodes cocyta selenis*, *Phyciodes diminutor*, *Phyciodes pallida*, *Phyciodes pulchella camillus* 5x, *Phyciodes tharos orantain*, *Pieris marginalis mcdunnoughii* 4x, *Pieris rapae* 29x, *Plebejus alupini texanus*, *Plebejus glandon* 3x, *Plebejus saepiolus*, *Polites* (*Yvretta*) *rhesus*, *Polites draco* 5x, *Polites mystic*, *Polites peckius* 2x, *Polites sabuleti*, *Polites sonora*, *Polites themistocles* 13x, *Polygonia faunus* 14x, *Polygonia gracilis zephyrus* 11x (one covered with dandelion pollen), *Polygonia satyrus*, *Pontia protodice* 5x, *Pyrgus centaureae* 9x, *Pyrgus communis* 11x (+ one only ¼ sec.), *Pyrgus xanthus* often, *Stinga morrisoni*, *Strymon melinus*, *Thorybes mexicana* 2x, *Vanessa cardui* 182x, *Vanessa carye*, *Vanessa virginiensis* 2x. This usually self-pollinates so it can bloom in winter when there are no pollinators, and is sometimes pollinated by bumblebees bees butterflies and syrphid flies, and by megachilid bees (*Osmia lignaria*) in Kansas.

*Tetradymia canescens* yellow is popular in W Colorado: *Cercyonis oetus* 6x, *Lycaena heteronea*, *Oarisma garita*, *Plebejus glandon*, *Satyrium behrii* 9x, *Satyrium californica* 13x, *Satyrium fuliginosum* 9x. Reportedly visited by moths bees flies beetles and other insects.

*Thelesperma filifolium* yellow: *Hesperia uncas*, *Plebejus alupini texanus*, *Pontia protodice*, *Pyrgus communis*.

*Thelesperma megapotamicum* yellowish: *Poladryas minuta near-minuta*, *Strymon melinus*. Reportedly pollinated by various insects.

*Townsendia excapa* white: *Colias edwardsii altiplano*, *Colias philodice*. (*Townsendia aprica* is pollinated by solitary bees [9 sp. of metallic blue and green megachilid *Osmia* bees, and the anthophorid bee *Tetralonia fulvitarisus*, and other visitors are Apidae bees [*Ceratinia nanula*, *Nomada*, *Synhalonia fulvitarisus*], the halictid bee *Lasioglossum*, the bees *Dioxys pomonae* and *Stelis paronia*, plus a few flies [Tepedino et al. 2004]. *Townsendia spathulata* is reportedly pollinated by bumblebees.)

*Townsendia grandiflora* bluish-white: *Callophrys eryphon*, *Erynnis persius* 6x, *Euptoieta claudia*, *Papilio zelicaon* 2x.

*Townsendia hookeri* white: *Euchloe ausonides* 2x, *Oarisma garita*.

*Tragopogon dubius major* lemon-yellow: *Euphydryas anicia brucei*, *Papilio zelicaon*, *Parnassius phoebus smintheus*, *Plebejus glandon*, *Vanessa cardui*. Generalist bees and flies evidently usually pollinate it in Idaho-Washington.

*Verbesina encelioides* golden-orange: *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) edwardsii*, *Chlosyne gorgone* 7x, *Colias eurytheme* 2x, *Colias philodice* 4x, *Hesperia leonardus pawnee* ~30x, *Hesperia uncas*, *Polites sabuleti*, *Pontia protodice* 2x, *Pyrgus communis*, *Strymon melinus*, *Vanessa cardui*. It sometimes self-pollinates. (This *Verbesina* is a major source of nectar for all butterflies in Texas, and it and other Asteraceae are commonly visited by the butterfly *Chlosyne lacinia* in Texas, which also visits *Verbesina virginica*, *Heterotheca latifolia*, *Viguiera dentata*, *Gaillardia pulchella*, *Zexmenia hispida*, *Eysenhardtia texana*, and seldom visits the unpopular *Helianthus annuus*, *Lantana horrida*, *L. macropoda*, and *Rubus trivialis*, and also visits mud, watermelon rind, carrion, and dung; Neck 1977).

*Vernonia angustifolia* purple: *Hesperia leonardus* ssp. occasionally (Scott and Stanford 1981). Internet photos show *Vanessa cardui* and *Papilio glaucus* on it. It is reportedly pollinated by bees and butterflies, and the bees *Melissodea denticulata* and *M. vernoniae* specialize on *Vernonia*. *Vernonia baldwinii* in Illinois is pollinated primarily by long-tongued bees including bumblebees (short-tongued bees collect nectar but are non-pollinating), butterflies (including *Papilio* and *Colias*) and skippers that visit for nectar, while other bee visitors are Epeoline cuckoo bees, and miner bees (Hilty 2013).

*Viguiera (Heliomeris) multiflora* yellow: *Argynnis (Speyeria) hesperis* 3x, *Argynnis (Speyeria) hesperis electa*, *Argynnis (Speyeria) hesperis* near *ratonensis*, *Cercyonis oetus* 3x, *Colias philodice*, *Hesperia comma* 9x, *Lycaena arota*, *Ochlodes sylvanoides* 11x (+6x only 1-2 sec. each), *Phyciodes batesii anasazi?*, *Pieris rapae*, *Plebejus melissa* 2x, *Pyrgus communis* 2x, *Strymon melinus*.

*Wyethia amplexicaulis* yellow: *Polygonia gracilis zephyrus*. *Wyethia amplexicaulis* is reportedly pollinated by flies, bumblebees, native bees, and butterflies; it is frequently pollinated by *Osmia californica* and *O. montana* bees (which are specialists on Asteraceae flowers) (Cane 2005, 2011). *Wyethia reticulata* is pollinated chiefly by native bees (Ayres and Ryan 1999).

*Wyethia ~angustifolia* yellow: *Chlosyne whitneyi whitneyi*. Bumblebees visit this.

*Wyethia helenoides* yellow: *Coenonympha tullia californica* 3x, *Euchloe ausonides ausonides*, *Junonia coenia* 52x, *Papilio zelicaon*.

(*Xanthium* has tiny ugly greenish flowers and is wind-pollinated, so has no records.)

*Zinnia angustifolia* red: *Polites peckius* (not popular, and had no visits of *Polites themistocles* in several days.)

*Zinnia elegans* usually pink but varies from red to white to orange to yellow: *Apyrrothrix araxes* many, *Argynnis (Speyeria) aphrodite* (orange), *Atalopedes campestris* 38x (including yellow around pink, pink 10x, yellow 3x, small hybrid white 5x), *Battus philenor* several, *Colias eurytheme* (1x, pink 1x, red "Thumbelina Series" 1x), *Danaus plexippus* (?pink 1x, pink 1x), *Epargyreus clarus* (pink 1x, yellow with orange center 30 min. 1x), *Euptoieta hegesia* several, *Hesperia pahaska* small 9x, *Hylephila phyleus* 9x, *Junonia coenia* (small hybrids white), *Lerema accius* 4x, *Ochlodes sylvanoides* (pink) common, *Papilio multicaudata* (orange and red) 5x, *Papilio polyxenes* (usually pink) 5x, *Pieris rapae* (pink 2x red 1x), *Polites peckius* 27x (crimson for 1x, red and orange 2x, pink for 7x, orange for 4x, yellow with orange center 1x, white for 1x), *Polites themistocles* 84x (crimson for 1x, violet-red 3x, rose-white for 7x, pink for 57x, orange for 15x, yellow for 15x, yellow around pink 1x, white for 14x), *Pontia protodice* Thumbelina (pink), *Pyrgus communis* 7x (incl. yellow 3x, orange 2x), *Strymon melinus* 2x, *Vanessa cardui* 72x (incl. yellow 11x, yellow Thumbelina 1x, orangish-yellow 1x, orangish 2x, orange Thumbelina 1x, pink 7x, pink Thumbelina 12x, red 10x, red with yellow centers [yellow and white ones ignored] 3x, red center yellow outer 2x, purple 1x, white 1x), *Vanessa carye* (white with yellow center) 2x, *Zerene cesonia*. Honeybees pollinate *Zinnia*. Some internet sites say this flower is pollinated by butterflies more than by bees.

*Zinnia grandiflora* 5-10 cm roadside yellow-with-orange-center: *Erynnis funeralis*, *Euptoieta claudia*, *Junonia evarete nigrosuffusa* 10x, *Vanessa cardui*, *Vanessa virginiensis* (yellow with brown-red center).

*Zinnia* ?pink or yellow: *Copaeodes aurantiaca*.

*Zinnia* small hybrids white: *Vanessa cardui*.

APIACEAE=UMBELLIFERAE

In general these are unpopular, although *Harbouria* and *Conium* and *Heracleum* are somewhat popular. Apiaceae usually have small scented flowers in large heads (umbels) that are visited by a wide range of small generalist pollinators (flies, mosquitoes, gnats, bees, beetles, butterflies and moths) (Dodson and Dunmire 2007, Judd et al. 2008). Sawflies and other wasps are frequent on the flowers. Honeybees and *Musca domestica* and *Calliphora* flies are used to pollinate Apiaceae in greenhouses (*Angelica*, and the edible genera *Anethum*, *Daucus*, *Petroselinum*, *Pimpinella*), while *Calliphora* is used to pollinate edible *Apium* and *Pastinaca* in greenhouses. *Zizia* (rare in Colorado) and *Thaspium* are pollinated by a specialist bee *Andrena ziziae* that visits mostly *Zizia trifoliata* and *Thaspium barbinode* and *T. trifoliatum* (Lindsey 1984)[and also visits *Pastinaca*, *Polytaenia*, *Sanicula*, and *Taenidia*].

(*Aegopodium podagraria* “Variegata” white is common around houses but is shunned.)

*Aletes acaulis* yellow: *Callophrys dumetorum homoperplexa* 2x, *Callophrys augustinus iroides*, *Callophrys gryneus siva*, *Celastrina lucia sidara* 2x, *Oeneis chryxus*, *Polites draco* (for *Aletes ~acaulis* [?anisatus] yellow). This is visited by bees (*Apis mellifera*, *Paregle*, *Dialictus*) (Sandy Friedley, Pollinator Conservation Digital Library).

*Aletes anisatus* yellow: *Oeneis chryxus*.

*Anethum graveolens* yellow: *Celastrina* evidently *neglecta* (Lakewood, Jeff. Co. CO). This is pollinated by bees and flies.

(*Angelica* is uncommon and I have not seen butterflies on it.)

(*Cicuta maculata* whitish is fairly common but not visited.)

*Conium maculatum* white: *Argynnis (Speyeria) hesperis*, *Callophrys eryphon*, *Hesperia viridis*, *Limenitis weidemeyerii*, *Lycaena heteronea*, *Callophrys gryneus siva* 4x, *Papilio polyxenes* 4x, *Glaucopsyche piasus* 5 sec., *Satyrium behrii* big umbel 2x.

*Cryptotaenia canadensis* white: *Celastrina neglecta*. Pollinated by various insects.

*Cymopterus acaulis* white: *Callophrys sheridanii* 2x. *Cymopterus beckii* is visited by numerous potential pollinating insects but halictid bees may be the most important pollinators (Tepedino and Messinger 2004).

(*Daucus carota* has no records, but its white flowers are rare in Colorado (carrots are eaten before they flower). 334 species of insects of 37 families were recorded visiting it in Utah [Hawthorn et al. 1956], and the most efficient pollinators were honeybees, *Halictus* and *Lasioglossum* bees, the sphecid wasp *Tachytes*, *Eristalis* and *Syritta* hoverflies, and the soldier fly *Stratiomys* (Koul et al 1989; Perez-Banon et al. 2007). In greenhouses even *Musca domestica* houseflies pollinate.)

*Foeniculum vulgare* yellow: *Lycaena xanthoides nigromaculata*. Pollinators of this in India were *Apis mellifera* Italian honeybees (the most important), *A. cerana*, *A. dorsata*, *A. florea*, and flies (*Episyrphus balteanus*, *Sphaerophoria scripti*, *Eristalis arborum*, *E. sp.*, *Musca*), while *Andrena minutula* and *Osmia rufa* bees and the butterflies *Lampides boeticus*, *Pieris brassicae*, *Colias fieldi*, and *Danaus chrysippus* also visited (Chaudhary 2006).

*Heracleum sphondylium montanum=lanatum* white: *Argynnis (Speyeria) coronis*, *Argynnis (Speyeria) edwardsii*, *Argynnis (Speyeria) hesperis* 7x, *Chlosyne gorgone*, *Chlosyne nycteis*, *Euphydryas chalcedona chalcedona*, *Limenitis lorquini*, *Limenitis weidemeyerii* (photo in “Colorado’s Best Wildflower Hikes, The Front Range” 1998), *Oeneis chryxus*, *Papilio multicaudata* ¼ sec, *Satyrium calanus*. In Poland 108 insect species visited it, especially syrphid flies (*Thricops nigrifrons*, *Eristalis*) and the calliphorid fly *Lucilia* (those two are the important pollinators), the Chloropidae fly *Eriozona syrphoides*, the Fanniidae fly *Meliscaeva cinctella*, muscid and Sepsidae flies, *Phaonia angelicae* flies, bumblebees *Bombus terrestris*, the Apidae bee *Arge ustulata* sometimes, beetles (the cerambycid *Stenurella* had big pollen loads, and *Dasytes*, Melyridae, Nitidulidae), most of which pollinated a little but only 53% of visitors carried pollen; even a few Neuroptera and butterflies (*Papilio machaon*, *Gonepteryx rhamni*, *Pieris brassicae*) visited rarely (Zych 2002, 2007).

*Harbouria trachypleura* yellow: *Argynnis (Speyeria) callippe*, *Argynnis (Speyeria) edwardsii* *Callophrys dumetorum homoperplexa* 6x, *Callophrys eryphon* 3x (one briefly), *Callophrys gryneus siva* 3x, *Celastrina lucia sidara*, *Coenonympha tullia* 5x, *Erynnis persius?*, *Euphydryas anicia capella* 2x, *Euptoieta claudia* 2 sec, *Glaucopsyche lydamus*, *Hesperia juba*, *Hesperia nevada*, *Papilio zelicaon* (1x

+ 1x f. nitra), *Parnassius phoebus smintheus* 11x, *Phyciodes pulchella camillus* 2x, *Plebejus icarioides*, *Poladryas minuta arachne*, *Polites draco*.

*Ligusticum? porteri* white umbel: *Boloria titania*. Flies frequent this.

*Ligusticum tenuifolium* white: *Pontia callidice occidentalis*.

*Lomatium marginatum* yellow or reddish-purple: *Pontia sisymbrii*. *Lomatium bradshawii* is visited by 38 species of bees (incl. 7 sp. of solitary bees), 7 sp. of syrphid and 11 sp. of other flies, 4 sp. of wasps, 4 sp. of beetles, and occasional caddisflies, planthoppers, true bugs, and ants; 26 species mostly bees and syrphids carried pollen on body or legs (Kaye and Kirkland 1994). Several specialist bees *Andrena* and *Micrandrena* gather pollen from *Lomatium dissectum*, and cultivated fields of *L. dissectum* are frequented by honeybees and *Halictus* and *Lasioglossum* bees (USDA research, www.fs.fed.us).

*Lomatium orientale* white: *Callophrys sheridanii*, *Pontia sisymbrii* 2x.

*Musineon divaricatum* yellow: *Colias eurytheme*, *Phyciodes pulchella camillus*, *Polites (Yvretta) rhesus*.

Pollinated by various insects.

*Oreoxis alpina* yellow: *Boloria freija*. This cushion plant is pollinated by ants in the Cascade Mts., and it often self-pollinates.

*Oxyptis fendleri* white: *Limenitis weidemeyerii*, *Pieris marginalis mcdunnoughii* a short time.

*Pastinaca sativa* yellow: *Danaus plexippus*, *Phyciodes diminutor*. This attracts numerous beetles in Europe (Jury 1996).

*Pseudocymopterus montanus* yellow: *Callophrys spinetorum* Janet Chu, *Lycaena florus* 1x + 1 sec. This is visited by andrenid and halictid bees, and anthomyid, muscoid, syrphid and tachinid flies in Colorado (Schlessman and Graceffa 2002).

ADOXACEAE (includes *Sambucus* and *Viburnum* formerly placed in Caprifoliaceae)

These have large showy umbel-like clusters of whitish flowers (that produce nice berries) but are mostly shunned. Adoxaceae in general are pollinated by insects esp. bees wasps and flies (Judd et al. 2008).

*Sambucus canadensis* white: *Celastrina neglecta*. *Sambucus* have no nectar and pollination is mostly by wind, with some selfing, but they are visited sparingly by flies and pollen-collecting bees, and honeybees reportedly help pollinate (Charlebois et al. 2010).

*Viburnum carlesii* white: *Vanessa cardui* 2x.

(*Viburnum* various cultivated spp. including *V. opulus* bushes have showy mostly whitish flowers but attract few butterflies. *Viburnum* spp. have nectar and reportedly attract many bees flies beetles and Lepidoptera. *Cetonia* beetles [Scarabeidae] are good long-distance pollinators of *Viburnum opulus* flowers [Englund 1993])

CAPRIFOLIACEAE (includes Dipsacaceae)

*Dipsacus* and *Scabiosa* were formerly included in Dipsacaceae, and are moderately popular. *Centranthus* and *Valeriana* were formerly included in Valerianaceae; they are uncommon but are fairly popular. The remaining flowers that were always placed into Caprifoliaceae are mostly not popular (including *Lonicera*), except *Symphoricarpos* and *Valeriana* seem to be moderately popular. Caprifoliaceae in general are pollinated by nectar-gathering insects (mainly bees and wasps) and birds (Judd et al. 2008).

*Centranthus ruber* (red or bluish-red or red-blue) is moderately popular (some other garden flowers are more popular): *Junonia coenia* 25x, *Lycaena xanthoides nigromaculata* 6x, *Papilio multicaudata* 2x, *Papilio zelicaon* 2x, *Pieris rapae* 4x, *Poanes taxiles*, *Polites peckius* 4x, *Polites themistocles* 6x, *Vanessa cardui*. Proctor et al. (1996, table 4.2) list this as butterfly-pollinated.

*Dipsacus fullonum* var. *sylvestris*: A) blue-white: *Lycaena xanthoides nigromaculata* 15x; B) violet-pink: *Danaus plexippus* 4x, *Ochlodes sylvanoides* 8x incl. Anne U. White, *Papilio polyxenes* 13x; C) white to lilac: *Argynnis (Speyeria) aphrodite* Anne U. White, *Argynnis (Speyeria) hesperis* Anne U. White, *Argynnis (Speyeria) nokomis* 2x, *Cercyonis pegala*, *Epargyreus clarus* 5x, *Hesperia comma*, *Pieris rapae*, *Vanessa cardui* 15x. This plant has leaves that broadly join to the stem and trap water there, and those water pools trap insects like pitcher plants and likewise may absorb their nutrients. It is pollinated mostly by bumblebees, and visited by numerous insects esp. bees and other Hymenoptera and some

Diptera and butterflies. In Europe the bee *Andrena hattorfiana* specializes on gathering pollen of “Dipsacaceae” (including *Dipsacus*) flowers.

*Lonicera involucrata* yellow or red-tinged: *Glaucopsyche lygdamus* Janet Chu. Reportedly pollinated by hummingbirds. *Lonicera alpigena* is pollinated by wasps, *L. caprifolium* and *L. periclymenum* by nocturnal sphingid moths, and other *Lonicera* spp. by bees and bumblebees. The red *Lonicera* (*L. cardinalis*, *L. sempervirens*, *L. laxiflora*) are pollinated by hummingbirds (Grant 1994).

*Lonicera tatarica* pink: *Danaus plexippus*, *Papilio glaucus glaucus* 2x, *Vanessa cardui* many.

(*Lonicera japonica* flowers open at dusk and are pollinated by nocturnal moths *Theretra japonica* and bumblebees *Bombus lucorum* and diurnal bees *Tetralonia nipponensis* and *Lasioglossum* sp.)

*Scabiosa caucasica* whitish: *Papilio multicaudata*.

*Scabiosa columbaria* blue-lilac: *Colias eurytheme*, *Papilio multicaudata*, *Papilio polyxenes*, *Pieris rapae* 2x, *Poanes taxiles* 2x, *Polites peckius* 9x, (no visits were seen by *Polites themistocles*), *Vanessa cardui* 6x, *Vanessa carye* much (likes it). This is visited by bees including *Andrena*, bombyliid and syrphid flies, and sawflies. Bumblebees visit *Scabiosa* spp.

*Symphoricarpos albus* pink: *Amblyscirtes oslari*, *Argynnis* (*Speyeria*) *callippe*, *Argynnis* (*Speyeria*) *hesperis*, *Erynnis afranius* 2x, *Erynnis horatius*, *Erynnis pacuvius*, *Euphydryas anicia capella* 3x, *Euphyes vestris*, *Hesperia pahaska*, *Lycaena arota*, *Lycaena dione*, *Oarisma edwardsii*, *Oarisma garita*, *Poanes hobomok* many, *Poanes taxiles*, *Polites origenes* many, *Polites themistocles* many, *Satyrium liparops*, *Satyrium titus*, *Thorybes mexicana*, *Thorybes pylades*, *Vanessa atalanta* 26x, *Vanessa cardui*. The flowers are pollinated by a variety of bees (including honeybees), wasps, and syrphids (Gilbert 1995), and occasionally butterflies. Some *Symphoricarpos* are reportedly visited chiefly by wasps.

*Symphoricarpos occidentalis* pink: *Argynnis* (*Speyeria*) *aphrodite*, *Cercyonis pegala* several, *Danaus plexippus*, *Epargyreus clarus*, *Euphyes vestris*, *Lycaena dione*, *Polites peckius*, *Thorybes pylades*, *Vanessa atalanta*, *Vanessa cardui* 2x.

*Symphoricarpos rotundifolius* pink: *Argynnis* (*Speyeria*) *edwardsii* 2x, *Epargyreus clarus*, *Erebia epipsodea* 7x, *Vanessa atalanta*, *Vanessa cardui*.

*Valeriana* ~white/rose (Ariz.): *Ancyloxypha arene*, *Copaeodes aurantiaca*, *Microtia dymas* some, *Microtia* (*Texola*) *elada* some, *Phyciodes picta*, *Phyciodes tharos tharos*, *Staphylus ceos*, *Codatractus valeriana*. *Valeriana sitchensis* in Olympic Mts. Wash. is pollinated by bumblebees (Aluri and Robart 1991).

*Valeriana officinalis* is listed as butterfly pollinated by Proctor et al. (1996, table 4.2).

*Valeriana capitata acutiloba* pinkish-white: *Boloria frigga* 5 min.

#### UNKNOWN FLOWER FAMILY

bell flowers that are tiny white on plant 6” tall with leaves like elm: *Argynnis* (*Speyeria*) *coronis*.

blue flower: *Hesperia nevada*.

“catkins” large Ariz. shrub in stream with erect brown “catkins”: *Callophrys gryneus siva*, *Ministrymon leda*.

cushion plant blue flower: *Argynnis* (*Speyeria*) *mormonia*.

dull whitish-cream flower: *Callophrys spinetorum*.

flower: *Callophrys spinetorum*, *Erebia callias* often.

orange flower: *Coenonympha tullia californica*, *Euchloe ausonides*.

orange winged flower: *Leptotes marina*.

Pinguinca tree flower (Sinaloa Mex.): *Ascia monuste*, *Chioides zilpa*, *Eurema nise*.

purple flower: *Lerodea eufala* many, *Phyciodes pulchella deltarufa*.

red color: *Asterocampa clyton* (probing my red truck), *Lethe eurydice* (probing red ribbon with proboscis).

vine weedy with alternate gray-green willow-shaped leaves every 3 cm along stem + spiny-white flower ball, in Mexico: many species listed but none specifically stated to be on this flower.

white-flowered shrub: *Callophrys gryneus siva*, *Hesperia woodgatei*, *Thorybes pylades*, *Vanessa cardui*, *Vanessa virginiensis*.

white-flowered plant on Hualpai Mts. AZ road-cut: *Adelpha eulalia*, *Atlides halesus* abundant, *Atrytonopsis python*, *Callophrys gryneus siva*, *Celastrina neglecta cinerea*, *Colias eurytheme*, *Colias philodice*, *Danaus gilippus*, *Epargyreus clarus*, *Erynnis afranius*, *Erynnis pacuvius*, *Erynnis telemachus*, *Heliopetes*

*ericetorum* many, *Leptotes marina*, *Libythea carinenta larvata*, *Limenitis arthemis arizonensis*, *Plebejus alupini texanus*, *Pontia protodice*, *Satyrium favonius ilavia* abundant, *Zerene cesonia*.  
white flowers: *Apodemia mormo pueblo*, *Erynnis brizo*, *Eurema nicippe* (tiny flower), *Hesperia comma*, *Junonia coenia* (tall flower) 1x, *Pontia beckerii* (tiny flower), *Satyrium favonius autolytus* 22x, *Satyrium sylvinus nootka* tiny, *Vanessa cardui* dense.  
white-flowered small vine: *Lerodea eufala*.  
white-yellow-flowered tiny-leaf tiny “*Cercocarpus*”: *Libythea carinenta larvata* common, *Phoebis sennae* tiny.  
yellow flower: *Callophrys spinetorum*, *Erynnis telemachus*, *Hesperia comma*, *Lycaena cupreus snowi*, *Ochlodes sylvanoides* several, *Poladryas minuta arachne* 2x.  
yellow-flowered low bush: *Hemiargus isola*, *Leptotes marina*, *Nathalis iole*, *Pyrgus communis*.  
yellow-flowered tiny plant like long-leaf *Artemisia dracuncululus*: *Erynnis funeralis*.  
yellow-flowered tiny-leaf “*Cercocarpus*”: *Danaus gilippus*.

## OTHER FOODS (sap, mud, honeydew, rotten fruit, dung, etc.)

Blood: *Cupido comyntas* many fed on blood of chicken on ground.  
Carrion: *Argynnis (Speyeria) aphrodite* (dead deer), *Cercyonis oetus* (dead deer leg) 3x, *Limenitis weidemeyerii* sucking inside of a dead pupa, *Phyciodes batesii anasazi* (dead cow in shade), *Phyciodes diminutor* (dead all-brown hawk 3x).  
Compost: *Pyrgus communis* male fed repeatedly on fresh vegetable-compost spread in garden.  
Dung: *Amblyscirtes aenus* (bird dung, sucking drops dripping from anus onto dung); *Argynnis (Speyeria) aphrodite* (dog and horse dung); *Argynnis (Speyeria) edwardsii* 2x; *Argynnis (Speyeria) hesperis* (horse dung); *Argynnis (Speyeria) zerene* (dog turd); *Celastrina humulus* lupine-ecotype (dog? dung); *Celastrina lucia sidara* (horse dung) 2x; *Cercyonis oetus* (horse dung); *Cercyonis pegala* dung 3x (incl. horse dung); *Chlosyne gorgone* dung 11x (1-2 dung of human, 1 of horse, but usually of dog [3 males found dead on one dog dung that evidently killed them perhaps because of some de-worming? chemical fed to the dog]); *Cupido amyntula* (horse dung); *Cyllopsis pertepida* (male on dry cow dung); *Epargyreus clarus* (dung of bird fed on in shade); *Erebia callias* many; *Erynnis telemachus*; *Euphilotes glaucon centralis*; *Euphyes vestris* (white bird droppings 3x [2 of them observed sucking on dung on leaf after diluting it with drop from abdomen]); *Glaucopteryx lygdamus* (dog? dung); *Glaucopteryx lygdamus* (white bird dung); *Lethe eurydice*; *Limenitis weidemeyerii* (coyote dung Janet Chu); *Papilio cresphontes* (cow manure); *Plebejus alupini texanus* (manure); *Poanes taxiles* (bird dung [abdomen dips down to put a drop onto dung, proboscis extends back under body nearly to midpoint of abdomen and sucks up diluted dung]); *Polites sonora* (manure); *Polygona gracilis zephyrus* (dog dung); *Pyrgus communis* (human dung); *Pyrgus scriptura* (manure); *Pyrgus xanthus* (manure, Scott 1975b); *Vanessa cardui* (dog dung); *Vanessa virginiensis* (male near horse turds).  
Fruit of *Aesculus glabra* var. *arguta*: *Limenitis arthemis astyanax*.  
Fruit rotten *Pyrus malus* apple: *Nymphalis antiopa* 2x, *Vanessa atalanta* 2x.  
Fruit broken apple: *Vanessa cardui*.  
Fruit rotten crabapple: *Polygona interrogationis*.  
Fruit (immature) of *Crataegus erythropoda*: *Limenitis weidemeyerii*.  
Fruit *Rubus deliciosus* purple berries: *Asterocampa celtis jeffermont*, *Cercyonis pegala*, *Lycaena arota* 13x, *Polygona gracilis zephyrus* often.  
Fruit of green raspberry (old flower-young berry): *Poanes hobomok*.  
Fruit bait (mixed using rotten bananas/rotten peaches/sugar): *Asterocampa celtis jeffermont* 6x, *Cercyonis oetus* female, *Cercyonis pegala* 7x, *Nymphalis antiopa* 6x, *Polygona faunus* 33x, *Polygona faunus cenveray* 50x, *Polygona gracilis zephyrus* 45x, *Polygona oreas* (ssp. *satellow*, *nigrozephyrus*, and *oreas*) 33x, *Polygona satyrus near-satyrus* 208x, *Vanessa atalanta* 4x.  
Fungus?, diseased black small *Cirsium ochrocentrum* unexpanded flower head: *Vanessa atalanta* sucking unknown juices from this diseased flower.

Fungusy yellow stuff exuding from *Salix irrorata* trunk base: *Nymphalis antiopa*.

Honeydew of aphids/leafhoppers: *Adelpha californica*, *Argynnis (Speyeria) cybele charlottii* sucked sugary viscous stuff on *Quercus gambelii* leaves (maybe aphid honeydew?), *Asterocampa celtis jeffermont* (proboscis repeatedly touching aphids on *Cirsium vulgare* seeking 'aphid-honeydew', Janet Chu), *Celastrina humulus* hop-ecotype (honeydew from cream-colored small leafhoppers=Cicadellidae on ups of leaf bases of two *Lactuca serriola* plants), *Celastrina lucia sidara* (fed on sugar? ~honeydew? on leaves of *Conium maculatum*), *Plebejus icarioides* (female sucked leafhopper honeydew from tops of *Monarda fistulosa* and top of *Heterotheca villosa* plants), *Polygonia gracilis zephyrus* (sucking aphid honeydew on *Salix lemmonii* ~5x), *Satyrion liparops* (female probing young 2 cm *Prunus virginiana* white leaf for 'aphid honeydew' for a minute or two [a little black beetle was on leaf too] but no honeydew seen). In eastern U.S. *Feniseca tarquinius* frequently sips honeydew from the woolly aphids that its larvae eats, and *Megisto cymela* and *Limenitis archippus* are also known to visit aphid honeydew.

Honeydew from coccids (sucking something from fungus-infested [orange-yellow spots] leaf of *Crataegus macracantha* that had curled edge and white coccids in curl of underside): *Limenitis weidemeyerii*.

Mud (includes wet dirt/soil/sand). Evidently nearly all butterflies visit mud when dehydrated. Males often visit mud to get sodium in order to better manufacture their spermatophores, although I have numerous records of females visiting mud, so butterflies very often visit mud to get moisture rather than sodium (it is a bogus myth that butterflies only visit mud to get sodium). *Achalarus casica* 4x, *Adelpha eulalia* 73x, *Agathymus aryxna aryxna* 7x, *Agathymus aryxna baueri* 18x, *Agathymus aryxna freemani* 3x incl. female, *Agathymus evansi* ~10x, *Agathymus neumoeogeni neumoeogeni* 17x, *Agathymus remingtoni estelleae*, *Aglais milberti* 10x, *Amblyscirtes aenus* 4x, *Amblyscirtes eos* wet sand, *Amblyscirtes nereus*, *Amblyscirtes nysa* 2x, *Amblyscirtes oslari* 7x, *Amblyscirtes phylace* 3x, *Amblyscirtes vialis* 13x, *Anaea andria* (Scott and Scott 1978), *Anatrytone logan lagus* 4x, *Ancyloxypha numitor* 3x, *Anthocharis sara coriande*, *Apodemia nais* 10x, *Apyrrothrix araxes* 2x (landing with wings spread on water and lowering proboscis to imbibe, Scott 1989), *Argynnis (Speyeria) aphrodite* 7x, *Argynnis (Speyeria) callippe* 12x, *Argynnis (Speyeria) coronis* 4x, *Argynnis (Speyeria) cybele cybele* 2x, *Argynnis (Speyeria) edwardsii* 5x, *Argynnis (Speyeria) egleis*, *Argynnis (Speyeria) hesperis* 6x, *Argynnis (Speyeria) hesperis ratonensis*, *Argynnis (Speyeria) hydaspae*, *Argynnis (Speyeria) mormonia*, *Argynnis (Speyeria) nokomis* female, *Asterocampa celtis jeffermont* 6x, *Atalopedes campestris* 2x, *Atlides halesus* (Scott 1973b), *Atrytone arogos* 7x, *Atrytonopsis cestus* some, *Atrytonopsis hianna hianna* 2x, *Atrytonopsis ovinia edwardsi* 7x, *Atrytonopsis pittacus* 3x, *Boloria bellona*, *Boloria freija*, *Boloria frigga*, *Boloria improba acrocneuma* soil moisture 2x, *Boloria improba harryi* wet soil 2x, *Boloria titania*, *Callophrys dumetorum homoperplexa* 9x, *Callophrys augustinus* 5x, *Callophrys eryphon* 7x, *Callophrys gryneus gryneus*, *Callophrys gryneus siva* 7x, *Callophrys johnsoni* some (Scott 1973b), *Callophrys mossii windi*, *Callophrys polios* 2x incl. female, *Callophrys sheridanii pseudodumetorum*, *Callophrys spinetorum* 16x incl. female, *Celastrina humulus* hop-ecotype 13x incl. female, *Celastrina humulus lupine-ecotype* 14x, *Celastrina lucia sidara* 182x (includes form *lucimargina* 6x), *Celastrina neglecta* common, *Celastrina neglecta cinerea* 19x, *Cercyonis meadii* 3x (and probed ground and cones etc. after a slight rain), *Cercyonis oetus* 30x, *Cercyonis pegala* 6x, *Chlosyne acastus* 2x, *Chlosyne gorgone* 115x, *Chlosyne nycteis*, *Chlosyne palla calydon* 2x, *Codatractus arizonensis*, *Codatractus valeriana*, *Coenonympha tullia* 4x, *Cogia caicus* 2x, *Cogia hippalus* wet sand, *Colias alexandra* 4x, *Colias eurytheme* 69x, *Colias occidentalis christina*, *Colias philodice* 23x, *Copaeodes aurantiaca* 3x, *Cupido amyntula* 104x, *Cupido amyntula amyntula*, *Cupido comyntas* 13x, *Cyllopsis pertepida*, *Danaus gilippus* 6x, *Danaus plexippus*, *Emesis ares*, *Emesis zela*, *Epargyreus clarus* 9x (one was in recycling position with proboscis below abdomen), *Erebia callias* 67x, *Erebia epipsodea* 4x, *Erora laeta quaderna* (Scott 1973b), *Erynnis afranius* 23x, *Erynnis brizo* 12x, *Erynnis funeralis* 6x, *Erynnis horatius* 3x, *Erynnis icelus* 9x, *Erynnis martialis* 10x, *Erynnis pacuvius* 19x, *Erynnis persius* 64x incl. female, *Erynnis propertius propertius* 2x, *Erynnis telemachus* 22x, *Erynnis tristis tatius* 10x, *Euchloe ausonides* 2x, *Euphilotes ancilla barnesi* 106x, *Euphilotes battoides battoides*, *Euphilotes battoides intermedia*, *Euphilotes enoptes dammersi*, *Euphilotes glaucon centralis* 19x, *Euphilotes rita coloradensis* 5x, *Euphilotes spaldingi pinjuna* many, *Euphydryas anicia capella* 83x, *Euphydryas anicia hermosa*, *Euphydryas bernadetta bernadetta* 4x (3 flew down-valley apparently to see



mud), *Euphydryas chalcedona mcglashani-wheeleri*, *Euphydryas colon wallacensis*, *Euphydryas gillettii*, *Euphyes vestris* 8x, *Euptoieta claudia* 6x, *Eurema nicippe*, *Eurema proterpia*, *Glaucopsyche lygdamus* 35x, *Glaucopsyche piasus* 24x, *Gyrocheilus patrobas* 2x, *Habrodais grunus*, *Heliopetes domicella*, *Heliopetes ericetorum* 5x, *Hemiargus ceraunus gyas*, *Hemiargus isola* 26x, *Hesperia comma* 78x, *Hesperia juba* 19x, *Hesperia leonardus pawnee* 23x, *Hesperia lindseyi*, *Hesperia nevada* 13x, *Hesperia ottoe* 5x, *Hesperia pahaska* 3x, *Hesperia uncas* 3x incl. female, *Hesperia viridis* 5x, *Hypaurotis crysalus* wet sand 8x, *Junonia coenia* 3x, *Kricogonia lyside*, *Leptotes marina* 68x, *Lethe anthedon* female probed dirt for moisture, *Lethe eurydice*, *Libythea carinenta bachmanii* 4x, *Libythea carinenta larvata* 3x, *Limenitis arthemis astyanax*, *Limenitis weidemeyerii* 10x incl. female, *Lycaena arota* 5x, *Lycaena heteronea* 14x incl. female, *Lycaena nivalis*, *Lycaena rubidus* 2x, *Megathymus yuccae*, *Nymphalis antiopa* 5x, *Nymphalis californica* 8x, *Oarisma garita*, *Ochlodes sylvanoides* 72x, *Oeneis alberta* abundant (Scott and Scott 1978), *Oeneis calais altacordillera* two females ~ 1 min. and 3 min., *Oeneis chryxus* 17x (incl. 5 females), *Oeneis uhleri* 215x incl. females (10 flew down-valley to seek mud), *Papilio astyalus*, *Papilio eurymedon* 12x, *Papilio glaucus rutulus* 11x, *Papilio indra* 2x, *Papilio machaon bairdii* and *brucei* 5x, *Papilio multicaudata* 7x, *Papilio pilumnus*, *Papilio zelicaon* 3x, *Paratrytone snowi* 3x, *Parnassius phoebus smintheus* 5x, *Phoebis sennae*, *Pholisora catullus* 3x, *Pholisora mejicanus*, *Phyciodes batesii anasazi* 2x, *Phyciodes batesii apsaalooke*, *Phyciodes cocyta* 12x, *Phyciodes diminutor* 2x, *Phyciodes pallida* 4x, *Phyciodes pulchella camillus* 170x, *Phyciodes tharos tharos* 4x, *Pieris rapae* 11x, *Piruna aea mexicana* 14x, *Piruna pirus* 16x, *Plebejus alupini lutzi* 4x, *Plebejus alupini texanus* 40x, *Plebejus atrapraetextus longinus* 6x, *Plebejus glandon* 26x, *Plebejus icarioides* 112x, *Plebejus melissa* 81x, *Plebejus saepiolus* 14x, *Poanes taxiles* 12x incl. female, *Polites (Yvretta) carus* many, *Polites draco* 8x, *Polites mystic* 4x, *Polites origenes* 5x, *Polites sabuleti* 2x, *Polites sonora* 2x, *Polites themistocles* 2x, *Polygonia faunus* 11x, *Polygonia gracilis zephyrus* 19x, *Polygonia interrogationis* 4x, *Polygonia oreas nigrozephyrus*, *Polygonia satyrus* 7x, *Pontia protodice*, *Pontia sisymbrii*, *Pyrgus centaureae* 2x, *Pyrgus communis* 32x, *Pyrgus philetas* 30x, *Pyrgus ruralis*, *Pyrgus scriptura* 4x, *Pyrgus xanthus* 5x, *Satyrium auretteorum*, *Satyrium behrii* 3x, *Satyrium californica* 7x, *Satyrium saepium* 3x, *Satyrium sylvinus*, *Satyrium titus* 2x, *Stinga morrisoni* 14x, *Strymon melinus* 4x, *Systasea zampa=evansi*, *Thorybes drusius*, *Thorybes mexicana* 5x, *Thorybes pylades* 15x, *Vanessa atalanta* 13x, *Vanessa cardui* 8x, *Vanessa virginiensis* 3x, *Zerene cesonia*, *Zestusa dorus* 26x.

“Mud” algae-water: *Polygonia gracilis zephyrus*.

Raindrops on leaves: *Hypaurotis crysalus* some fed on.

Sap usually from wounds on the trunks of trees is popular with some Papilionoidea butterflies such as Nymphalini, *Anaea*, Apaturini, *Limenitis*, and Theclini. Butterflies in taxa that frequent sap (such as Nymphalinae butterflies *Nymphalis*, *Polygonia*, etc.) fly near the sap, and then usually land ABOVE the sap and walk down to it and suck. They do this evidently to avoid becoming stuck in the viscous sap that gets thicker the farther it drips down the trunk of the tree. Thus they avoid becoming fossilized in amber like the numerous insect fossils in Baltic amber. The sap is thick, so they evidently extrude a little fluid from their proboscis to dissolve a little sap, then suck up the diluted sap.

Sap of *Acer negundo*: *Asterocampa celtis jeffermont*.

Sap? from *Cirsium ochrocentrum* rose-purple phyllaries: *Vanessa cardui*.

Sap? of *Pinus edulis* cones: *Vanessa atalanta*.

Sap of *Populus angustifolia*: *Nymphalis antiopa*.

Sap of *Populus deltoides monilifera*: *Anaea andria* (Scott and Scott 1978), *Nymphalis antiopa*, *Polygonia satyrus*.

Sap of *Populus tremula tremuloides*: *Limenitis weidemeyerii* (upside down on), *Nymphalis antiopa* 6x (at least one observed upside down on thus approaching from above), *Polygonia faunus* 5x, *Vanessa atalanta*.

Sap of *Quercus gambelii*: *Hypaurotis crysalus* 18+ adults of both sexes sucking sap oozing from *Quercus gambelii* twigs (seeping knobs including one where a leaf fell off) and sap from new acorns, many on one 5m tree (Scott 1974c, Scott and Scott 1978); *Limenitis weidemeyerii* probed twigs for sap; *Satyrium calanus* female sucking a *Quercus gambelii* acorn evidently to get sap.

“Sap” juices from expanding *Quercus gambelii* leaf buds: *Erynnis telemachus* 4x.  
 Sap, probed *Pseudotsuga menziesii* twigs for sap: *Limenitis weidemeyerii*.  
 Sap of *Rhus aromatica trilobata*: *Argynnis (Speyeria) aphrodite* repeatedly landing on it, perhaps getting sap on yellowish seed bunches (Janet Chu).  
 Sap of *Robinia neomexicana*: *Asterocampa celtis jeffermont* (Janet Chu).  
 Sap of *Salix amygdaloides*: *Aglais milberti*, *Anaea andria* (Scott and Scott 1978), *Argynnis (Speyeria) aphrodite*, *Argynnis (Speyeria) hesperis*, *Asterocampa celtis jeffermont* 29x, *Cercyonis pegala* 3x, *Limenitis weidemeyerii* 3x, *Lycaena heteronea*, *Nymphalis antiopa* 6x, *Parnassius phoebus smintheus* females, *Polites origenes*, *Polygonia gracilis zephyrus* 2x, *Polygonia satyrus* 2x, *Satyrium behrii*, *Vanessa atalanta* 4x.  
 Sap of *Salix bebbiana*: *Polygonia faunus*, *Polygonia satyrus*.  
 Sap of *Salix exigua*: *Nymphalis antiopa* 3x (one aimed down, one sideways, one landed head-up then flew), *Polygonia satyrus* 2x.  
 Sap of *Salix*: *Cyllopsis pertepida* female on sap.  
 Sap of *Ulmus pumila*: *Asterocampa celtis jeffermont* 73x, *Cercyonis pegala* 83x, *Nymphalis antiopa*, *Polygonia satyrus*, *Vanessa atalanta* 2x.  
 Spit of human: *Argynnis (Speyeria) callippe*.  
 Sweat on net handle: *Plebejus icarioides*. *Asterocampa celtis* and *A. clyton* also suck sweat in search of salts (Bright and Ogard 2010).  
 Urine: *Cercyonis pegala*, *Cupido amyntula*, *Plebejus melissa*.  
 Wood (wet rotting wood): *Celastrina lucia sidara* 2x, *Erynnis telemachus* many.

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## APPENDIX A. USING MICROSOFT WORD TO CALCULATE THE TOTAL NUMBER OF ADULT BUTTERFLY VISITATIONS TO FLOWERS AND OTHER FOODS FROM A MS WORD FILE OF VISITATIONS

Microsoft Word has a Replace All feature, which automatically counts the number of replacements every time the Replace All feature is used. You can use those counts to determine the number of visitations. Begin with the basic data-entry file in which each record consists of one paragraph listing one butterfly species visiting one flower species (or mud or whatever) and the number of visits seen and the date (example “*Notamblyscirtes simius Cryptantha jamesii* white 15x 11vi69”). Make a copy of the basic file and rename it as AAA-Counts or whatever, because you will trash it in the following process. The x will be used for the counts (example 15x means 15 visits to the flower *Cryptantha jamesii* were seen on that day), so if you also used x to mean October etc., you must first change a date such as 10x04 (meaning October 10, 2004) to 10Oct04 (the simplest way is to search for x0 and replace it by Oct0, and search for x8 and replace it by Oct8 to change 9x84 to 9Oct84, etc. for each decade of records). Do this also for November and December if those months have x’s in your file (September should be no problem because it is abbreviated ix which will not cause trouble in the process below). If you used vague words (rare, scarce, uncommon, infrequent, occasional, sparse, few, some, several, couple, often, many, frequent, frequently, common, numerous, abundant, dozens, swarming, superabundant, plentiful, etc.) to describe the number of visits, you may want to quantify those and replace them by your estimate of the numbers, such as 10x for many etc.). If you used 1x for only one observed visit in the entries in your basic file, you will have to replace it with the word “once” in your records; the easiest way is to replace (blank-space)1x by the word once. When the x’s are fixed the file is ready. In the following process, after every Replace All, you must record the number of replacements made by the computer. Now make the paragraph marks visible, and Replace All the paragraph marks with \*(paragraph mark) (in Microsoft Word, the paragraph mark symbol is ^p so replace ^p with \*^p); the number of replacements is the number of paragraphs which is the total number of basic butterfly/plant/day records. Now Replace All 0x with #x, and Replace All 1x to 9x also (all nine) by #x. These latter counts should be multiplied by the number (1 to 9) to determine how many visits there were in the single-digit column of each of the x numbers. Now Replace All 0#x by \$#x, and Replace All 1#x to 9#x also (all nine) by \$#x. These latter counts should be multiplied by the number (10 to 90) to determine how many visits there were in the tens-digit column of each of the x numbers. Now Replace All 0\$#x by %\$#x, and Replace All 1\$#x to 9\$#x also (all nine) by %\$#x. These latter counts should be multiplied by the number (100 to 900) to determine how many visits there were in the hundreds-digit column of each of the x numbers. Continue the process in the thousands column if you have x numbers that large (I do not). Now Replace All #x by @x which tells you the total number of records that have an x number in the entry. Subtract that number from the total number of basic butterfly/plant/day records (the total number of paragraph entries) which you determined above, to get the total number of records with just one visit. To that number we need to add the number of visits recorded in the records with more than one visit per record (the x numbers), so add the number of visits that you already calculated above in the single-digit column of the x numbers and the tens-digit column of the x numbers and the hundreds-digit column of the x numbers, to determine the total number of butterfly visits that you observed to flowers/mud etc. If you have trouble with this process at any time, simply exit Microsoft Word without saving and try again.

## **APPENDIX B. CHANGING A FILE ALPHABETIZED BY BUTTERFLY GENERA AND SPECIES INTO A FILE ALPHABETIZED BY PLANT GENERA AND SPECIES**

Begin not with the file of original chronological records; use instead a compressed file in which each line is a record of the butterfly species, the flower/food species visited, and the total number of records/visits for that butterfly on that food listed summed over many days and localities (for example one line of my file is “*Notamblyscirtes simius Opuntia polyacantha* yellow 77x”, because there are 77 total recorded visits of that butterfly to that yellow-flowered *O. polyacantha* cactus). To alphabetize the flower species, I went through that entire file and inserted a tab mark at the starting first letter of each flower genus (these tab stops were quickly inserted by using the index of a local flora/flower book to proceed through the flower genera from A to Z, by replacing each flower genus by a tab stop-flower genus: for example Aster was replaced [Replace All] by ^tAster, which places a tab in front of every word Aster in the file), then I went through the file to add tab stops in front of those genera that were missed by those replacements. I then attempted to alphabetize the resulting entire Microsoft Word file by sorting the whole file using Field 2; however MS Word failed to alphabetize any file using Field 2 that was longer than 2 pages. So, the whole file had to be converted to a single table. Before doing this, make sure the butterfly records are alphabetized (select the entire file, and on the Home menu choose the Sort box [the AZ down-arrow box] where you sort by paragraphs and click ok to alphabetize the entire file by butterfly genus/species). Now, to convert the entire file to a single table, select the whole file (light up the whole file in blue), then click the Insert menu, click the Table menu to go to the Convert Text to Table menu, where you choose Tab to separate the text and choose 2 columns, then click ok to convert the entire file to a table. Now, to alphabetize the flower species, select the entire table, then go to the Home menu and click the Sorting menu and choose Sort by column 2 (type in “column 2” where it says “column 1”), and MS Word will alphabetize the whole file by the flower genus-species in column 2. Now the entire file must be reconverted to text form again, so select the entire table, and the words “Table Tools” will pop up on top middle of screen (perched on top of the Home menu bar). Click “Layout” which pops into view just below “Table Tools”, then go to the far right and click Convert to Text, then in that menu make sure that the text will be separated with tabs, then click ok. MS Word will then convert the file to text, so now the file lists each flower/food species alphabetically after the tabs, and to the left of the tabs the butterfly species records visiting each flower are all listed alphabetically. Save this file with a new name. Then I laboriously went through the file to compress the records for each flower into one paragraph, placing the flower at the head of the paragraph (when there are many butterfly species visiting each flower, to save time place (type or copy) the flower genus-species at the head of those records, use the Replace feature [the Replace All is faster] to replace space ^t[meaning tab mark] flower genus-species with nothing, then use the Replace feature [do NOT use Replace All here] to replace ^p[meaning paragraph mark] with comma space.

(Use of spreadsheet or database. Some people may want to place their records into a spreadsheet or database program, in which case Appendix A and B would not be needed, but I have found that those programs take too much time to enter the raw data, much longer than a simple word processor file, in which you can simply type the butterfly name and plant name and number of visits (if more than one) and enter key (paragraph mark), and at the end of that day’s records you can copy the date onto the end of each paragraph entry. And if there are multiple flowers species in your notebooks for that butterfly on that locality/day, you can simply leave off the butterfly name from the additional records and copy the name to those records after you finish with that butterfly species on that locality/day.)