COSEWIC
Assessment and Status Report

on the

Eastern Baccharis
Baccharis halimifolia

in Canada

THREATENED
2011

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: 819-953-3215
Fax: 819-994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

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Eastern Baccharis — photo credit Mazerolle and Blaney.

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COSEWIC
Assessment Summary

Assessment Summary – November 2011

Common name
Eastern Baccharis

Scientific name
Baccharis halimifolia

Status
Threatened

Reason for designation
The species is an Atlantic Coastal Plain Flora species. A rare Canadian disjunct shrub restricted to very specific salt marsh habitat in southern Nova Scotia. Its coastal habitat is declining due to increasing shoreline development. Further climate change effects, including rising sea level and increasing and more frequent storm surges, will cause habitat loss and degradation as well as impact individuals over the next few decades.

Occurrence
Nova Scotia

Status history
Designated Threatened in November 2011.

COSEWIC
Executive Summary

Eastern Baccharis
Baccharis halimifolia

Wildlife species description and significance

Eastern Baccharis is a perennial, salt marsh shrub of the Aster family. In Canada, it is 1 to 3 metres tall and deciduous with alternate gray-green leaves. Male and female flowers occur on different plants. It blooms in late summer with inflorescences of tiny flowers that can be very numerous on larger shrubs. The brilliant white pappus (bristles) on the seeds makes female plants easy to detect in late summer and early fall.

In Canada, Eastern Baccharis is rare, localized and 400+ km disjunct from the next nearest occurrence in northern Massachusetts. Eastern Baccharis is the only native representative of its genus and subtribe in Canada. The species is used horticulturally in the United States. *Baccharis* species contain an array of chemicals used medicinally, including some with potential for cancer treatment, but formal investigation of their properties has been limited. American First Nations have used some species in the treatment of sores and wounds, and as antibacterials and emetics. Eastern Baccharis has been introduced to and has become a problematic invasive in Mediterranean Europe and Australia and it is an agricultural weed in some U.S. states.

Distribution

Eastern Baccharis is native along the Gulf of Mexico south to Veracruz, Mexico and along the United States east coast north to northern Massachusetts. Southward, it occurs inland to Oklahoma, Arkansas, Tennessee and the Piedmont east of the Appalachians, although some of this distribution represents post-European colonization. It is also native in Cuba and the Bahamas. Canadian occurrences are restricted to a 25 km stretch of coast in extreme southwestern Nova Scotia. Populations are dominated by large, mature individuals, suggesting long-term occurrence in Nova Scotia.

Habitat

In the U.S., Eastern Baccharis occurs in a variety of moist or disturbed habitats. In Canada, it is restricted to open margins of well-developed salt marshes within harbours or bays that provide protection from wind and waves. It occurs in or near the transition zone to coastal forest with predominantly graminoid vegetation and shrubs 0.5 m to 2 m in height. Climate likely limits its extent of occurrence. Oceanic currents moderate the climate of the coastal zone of southwestern Nova Scotia, especially the area around Yarmouth where Eastern Baccharis occurs, the warmest Canadian winters outside of southern British Columbia, with temperatures considerably milder than the coast of Maine at the same latitude.

Biology

In Nova Scotia, Eastern Baccharis flowers from late July through mid- or late September. Females can produce more than one million seeds. Mature achenes (fruits) are wind- and water-dispersed, aided by the attached pappus. Achenes mature in late August or September, with most having dispersed by late October. In Nova Scotia (but not in the southern U.S.), leaves are deciduous in late October and November, later than most associated shrubs.

Seedlings in Nova Scotia have been observed very infrequently, suggesting establishment from seed is uncommon. Large individuals in Nova Scotia can have trunks up to about 10 cm diameter, suggesting considerable age, and new shoots sprout from the bases of mature shrubs, suggesting that individuals could persist for decades or longer. Eastern Baccharis also spreads vegetatively via the rooting of low branches. Seed banking is likely not significant because seeds have limited dormancy, but seeds can survive a minimum of two years if buried.

Population sizes and trends

The total number of mature individuals in Canada is estimated at 2850 and is probably quite completely documented. Three populations are known, with an additional site (West Pubnico) having only one known individual. These populations are divided into 9 subpopulations, two of which support ~88% of the Canadian population.

Population trends are not documented but are likely fairly stable. Only relatively small and localized development impacts have thus far occurred, but development is active or imminent in some populations and a future threat in others.

Threats and limiting factors

Habitat loss from coastal development, primarily for cottages or residences, is the only imminent threat. Development has been extensive on Nova Scotia's Atlantic coast in the past 30 years, causing vast increases in land values. Eastern Baccharis occurs in aesthetically attractive coastal habitats and most occurrences are within a few hundred metres of good roads. Its habitat along the margin of coastal forest makes it especially prone to clearance by landowners seeking water views or access. It is, however, somewhat protected from development in many sites, including the two large subpopulations, because it occurs on islands within salt marshes for which creating road access would be expensive or against environmental regulations.

Death of individual plants from apparent saltwater inundation was observed very locally and habitat loss from sea level rise may be a future threat. Localized impacts from cattle grazing were also observed at one site.

The extreme concentration of the population (~88% of total) into two dense areas of occurrence totaling 11.5 ha means that development, sea level rise or chance events in those areas could substantially reduce the entire Canadian population. Observations suggesting limited recruitment from seed increase the significance of any threat that would remove mature individuals.

Protection, status, and ranks

Eastern Baccharis presently has no legal protection in Canada, although a provincial status report is being prepared, which could lead to legal protection under the *Nova Scotia Endangered Species Act*. No Canadian populations are within protected areas.

Eastern Baccharis is listed by NatureServe as globally secure (G5) with a national status rank of secure (N5) in the United States and critically imperilled (N1) in Canada. In Nova Scotia, it has a regional rank of critically imperilled (S1) and a National General Status rank of May Be At Risk, which equates to a "Red" rank under the Nova Scotia Department of Natural Resources provincial system. In the United States, it is considered rare only in Rhode Island where it is imperilled (S2) and Pennsylvania where it is Vulnerable (S3) and designated "Rare".

TECHNICAL SUMMARY

Baccharis halimifolia
Eastern Baccharis — Baccharis à feuilles d'arroche
Range of occurrence in Canada: Nova Scotia

Demographic Information

Generation time (average age of parents in the population) *Large trunks clearly many years old and can resprout from base, suggesting potential age of decades or more.*	Unknown; minimum 10-20 years, possibly much longer
Is there a continuing decline in number of mature individuals? *Declines not documented, but small declines because of localized development impacts are likely ongoing with potential to increase in magnitude with future development*	Probable
Estimated percent of continuing decline in total number of mature individuals within 5 years.	Unknown
Observed percent reduction or increase in total number of mature individuals over the last 10 years.	Unknown
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years.	Unknown
Observed percent reduction or increase in total number of mature individuals over any 10 year period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	n/a
Are there extreme fluctuations in number of mature individuals? *None documented and unlikely in a long-lived perennial.*	No

Extent and Occupancy Information

Estimated extent of occurrence *EO is 49 km^2 if West Pubnico (one individual) is excluded.*	75 km²
Index of area of occupancy (IAO) (2x2 km grid) *IAO is 48 km^2 if West Pubnico (one individual) is excluded. The plants occur in a linear narrow habitat between the upland forest and the coast. Biological AO using 10m x 10m grid = 2.26 km^2.*	52 km²
Is the total population severely fragmented?	No
Number of "locations∗" *"Locations" defined by the scale of the primary threat (cottage development). Number of locations is not defined but is >10. If number of private landowners is used, 50 locations are estimated.*	>10
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy? *Continuing decline for a more finely scaled (10m x 10m grid) area of occupancy is possible.*	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations? *Not documented but some locations have likely been and will continue to be lost with coastal development.*	Possibly

∗ See definition of location.

Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? *Small, continuing declines in area and quality of habitat due to coastal development*	Yes
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Tusket River Estuary	>1,476
Surettes Island	21
Morris – Roberts Islands	~1,350
West Pubnico	1
Total	>2,832

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	N/A

Threats (actual or imminent, to populations or habitats)

Habitat loss from coastal development, primarily for cottages or residences, is the only widespread, imminent threat which could affect a moderate or large portion of the Canadian population over the next 3 generations.

Death of individuals from apparent saltwater inundation was observed very locally and climate-change-induced habitat loss from sea level rise may be a future threat.

Localized impacts from cattle were observed at one site.

Concentration of individuals into two dense areas of occurrence means that development, sea level rise or chance events could have major impacts on the total population. Observations suggesting limited recruitment from seed increase the significance of threats that remove mature individuals.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? *The species is secure in the United States (N5). It is not considered rare in Massachusetts (the next nearest occurrence) and is not considered rare in any state except Rhode Island (S2) and Pennsylvania (S3).*	
Is immigration known or possible? *Immigration from Massachusetts across 400+km of ocean is very unlikely.*	Very unlikely
Would immigrants be adapted to survive in Canada? *Occurs in climate zone similar to north-coastal Massachusetts.*	Likely yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	No

∗ See definition of location.

Current Status

COSEWIC: Threatened (November 2011)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Threatened	D2
Reasons for designation: The species is an Atlantic Coastal Plain Flora species. A rare Canadian disjunct shrub restricted to very specific salt marsh habitat in southern Nova Scotia. Its coastal habitat is declining due to increasing shoreline development. Further climate change effects, including rising sea level and increasing and more frequent storm surges, will cause habitat loss and degradation as well as impact individuals over the next few decades.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. There is no documented decline.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. Although EO and IAO are below thresholds for Endangered and habitat quality has declined, the plant occurs in >10 locations and populations are not severely fragmented nor do they undergo extreme fluctuations of mature individuals.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Although there are <10,000 individuals, there is no observed decline in the number of mature individuals.
Criterion D (Very Small or Restricted Total Population): Threatened D2 applies on the basis that the range of the species in Canada is highly restricted (IAO is 52 km²) and that over 88% of mature individuals occur in two subpopulations that could be impacted by a stochastic event such as a storm surge, which would render the species endangered in a short period of time.
Criterion E (Quantitative Analysis): Not done.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2011)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and classification

Scientific Name: *Baccharis halimifolia* Linnaeus

Original Description: Linnaeus, 1753

Synonyms: *Baccharis halimifolia* var. *angustior* de Candolle
Baccharis cuneifolia Moench
Conyza halimifolia Desf

English vernacular names: Eastern Baccharis, Groundsel-tree (Groundseltree), Groundselbush, Sea-myrtle, Salt-myrtle, Consumption weed, Saltbush, Salt marsh elder, Silverling, Tree groundsel, Waterbrush

French vernacular names: Baccharis à feuilles d'arroche, Séneçon en arbre

Genus: *Baccharis*

Subtribe: Baccharidinae

Tribe: Astereae

Family: Asteraceae

Order: Asterales

Major plant group: Angiosperms, Eudicotyledons

Baccharis halimifolia is the type species of the genus *Baccharis* and of section *Baccharis* (Hellwig 1989). The genus *Baccharis* is one of the largest in the Aster family comprising 350-450 dioecious (rarely monoecious) perennial shrub and tree species, all of which are native to the New World (Sundberg and Bogler 2006). It reaches its highest taxonomic and morphological diversity in the South American tropics, where about 90% of the species occur (Nesom 1990). All North American species are southern in distribution (Sundberg and Bogler 2006) and only four of the 22 species occurring in the United States are not also found in Mexico (Nesom 1990). Only recently discovered in Nova Scotia (Fielding 2001), *Baccharis halimifolia* is the sole Canadian representative of the genus.

Morphological description

Eastern Baccharis is a densely branched and often multi-stemmed woody perennial shrub, typically 1 to 3 (6) metres tall (Figure 1). Its leaves are arranged alternately and can be short-petioled or sessile (Figure 2). Although the species can be evergreen throughout most of its global range, it is semi-deciduous or deciduous in the northernmost portion of its North American range (Westman *et al*. 1975; Krischik and Denno 1990). Like most other species in the genus, Eastern Baccharis is dioecious, though male and female plants do not exhibit differences in leaf morphology, branching pattern or shrub size (Krischik 1984). Flower heads contain 20 to 30 florets and are whitish, but profuse pollen production often gives male flowers a yellow colour. The achenes produced by fertile female florets are light brown and are firmly attached to a pappus of two series of 10 to 14 mm long bristles. These pappus hairs elongate and greatly protrude from the receptacle in fruit, making female seed heads much showier than during flowering. Detailed morphological descriptions can be found in Sundberg and Bogler (2006), Gleason and Cronquist (1991), Nesom (1990) and Mahler and Waterfall (1964).

Figure 1. Large, multi-stemmed Eastern Baccharis (*Baccharis halimifolia*) shrub at the interface between salt marsh and forest, growing in association with Black Huckleberry (*Gaylussacia baccata*), Freshwater Cordgrass (*Spartina pectinata*), Tick Quackgrass (*Thinopyrum pycnanthum* – identification uncertain) and Red Maple (*Acer rubrum*) (photo credit Mazerolle and Blaney).

Figure 2. Upper leaves and fruiting pistillate (female) flower heads of Eastern Baccharis (*Baccharis halimifolia*). Long white pappus bristles protrude from the receptacles, giving flower heads a showy appearance (photo credit Mazerolle and Blaney).

Population spatial structure and variability

Morphological and genetic variability has not been investigated in Canadian populations and no studies on the subject for Eastern Baccharis were found in the literature.

Designatable units

Because the species has a very limited range in Canada and is restricted to a small geographic area, all Canadian populations are regarded as a single designatable unit.

Special significance

Canadian Eastern Baccharis populations are more than 400 km disjunct from the nearest occurrence in northern coastal Massachusetts. The effects of genetic drift and natural selection in such isolated and peripheral situations can produce genetic, ecological, and morphological divergence, potentially giving populations a disproportionate significance to the species as a whole (Lesica and Allendorf 1995; García-Ramos and Kirkpatrick 1997; Eckert *et al*. 2008).

Eastern Baccharis is the only native representative of the genus and of the subtribe Baccharidinea in Canada (Brouillet *et al*. 2010).

Eastern Baccharis is recommended as a horticultural planting in several regions of the southeastern and eastern United States because of its hardiness and ability to grow in a wide gradient of soil moisture, soil types, nutrient availability, pH, and salinity conditions. It is most showy when few other species are in flower, making it attractive to both gardeners and pollen-feeding insects.

Baccharis species are known to contain an array of chemicals used for medicinal purposes, many possessing properties that have not yet been investigated (Boldt 1989a). American First Nations have reportedly used some species in the treatment of sores and wounds, as an antibacterial and as an emetic (Boldt 1989a). Based on casual inquiries made to knowledgeable Mi'kmaq of the Yarmouth area, the species does not seem to be of significance to local First Nations people (Lacey, pers. comm. 2011). In Argentina, many *Baccharis* species are promoted as folk medicine for wounds, fever and other ailments (Bandoni *et al.* 1978). Some species have been shown to produce substances of potential use in cancer treatments (Jarvis *et al.* 1981; Mongelli *et al.* 1997).

Eastern Baccharis was introduced in the Mediterranean region of Europe and to Australia in the 17th and 19th centuries respectively, and has become established and invasive in both areas. In association with human activity, the species has also spread considerably beyond its historic range in the southern United States into interior regions of the Atlantic Coastal Plain and beyond (Ervin 2009). It is now considered a serious agricultural weed in several states.

DISTRIBUTION

Global range

Eastern Baccharis occurs in southeastern and south-central North America with a mostly coastal distribution and a high coastal plain affinity (Figure 3). The majority of its range is located along the Gulf of Mexico and United States' Atlantic coast from Veracruz province in Mexico to northern Massachusetts. It is also found as far inland as Oklahoma, Arkansas, Tennessee and the Piedmont Plateau although some inland occurrences represent post-settlement colonization (Ervin 2009). Eastern Baccharis is also native to Cuba (Wunderlin and Hansen 2004) and the Bahamas (Correll and Correll 1982). County-level distribution data (BONAP 2010) for the United States suggests that the species is most widespread from Louisiana to North Carolina, gradually becoming more restricted to the coast as it nears the northern limit of its continuous distribution, from Virginia to Massachusetts.

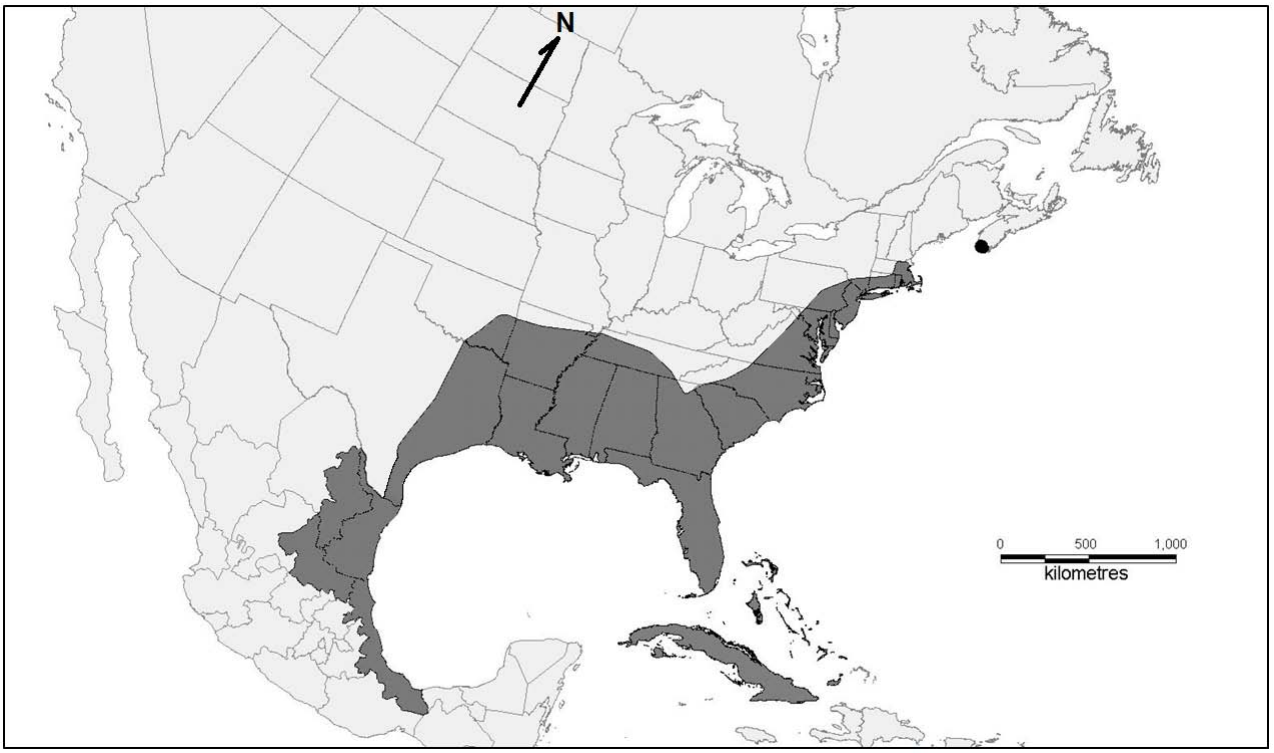

Figure 3. Known native global range of Eastern Baccharis (*Baccharis halimifolia*). Range outlined in the United States is based on county-level distribution data (BONAP 2010), range outlined in Mexico and the Caribbean is based on state and country-level occurrence.

Canadian range

Canadian occurrences are restricted to a 25 km wide coastal region of extreme southwestern Nova Scotia (Figure 4). The two most important areas of occurrence are: 1) the Tusket River Estuary between Tusket and Upper Wedgeport, and 2) Lobster Bay on the shores of Surettes, Morris and Roberts Islands. A single individual is present in an outlying area of occurrence in Pubnico Harbour near West Pubnico, approximately 12 km southeast of the nearest location on Morris Island.

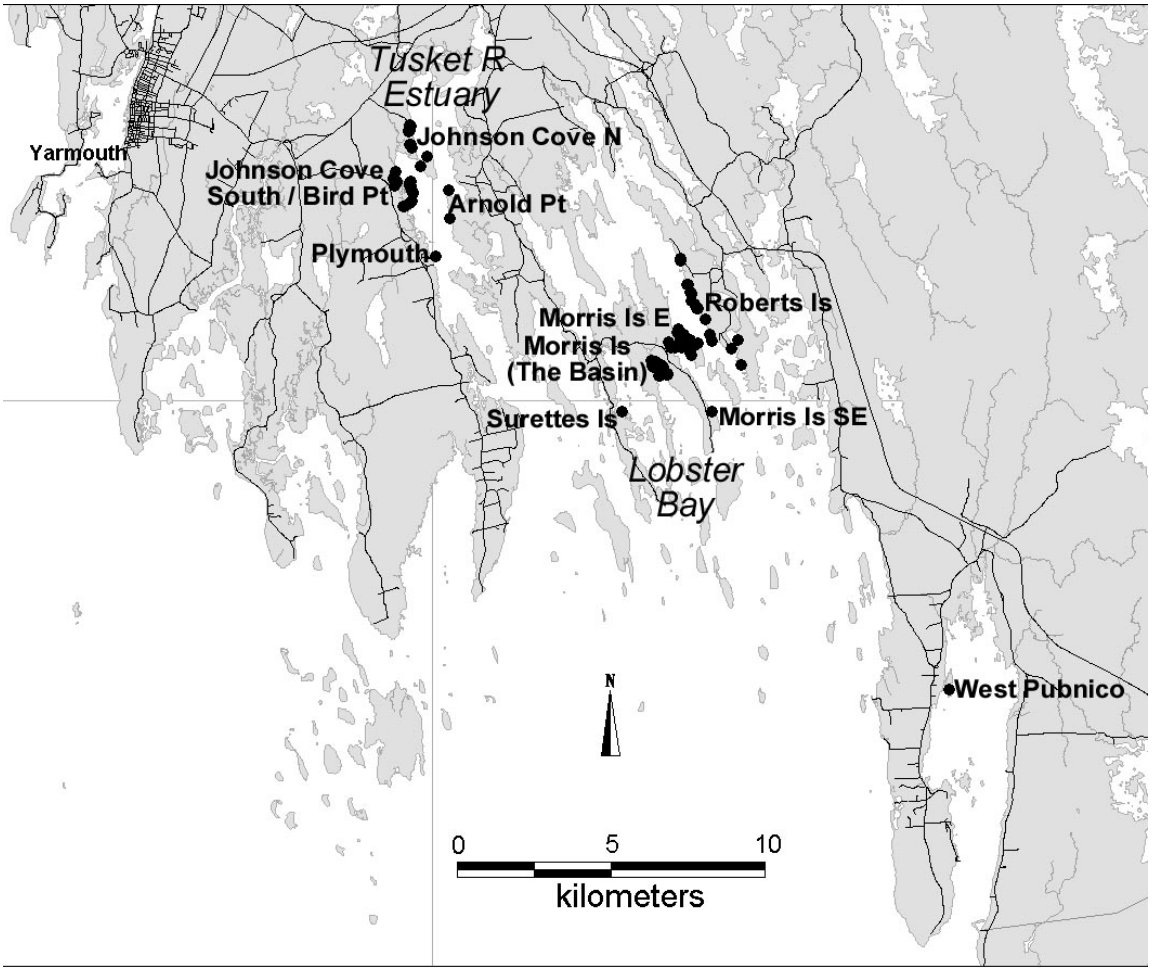

Figure 4. Canadian distribution of Eastern Baccharis, with subpopulation names as noted in Table 1. The three populations are: 1) Tusket River Estuary, 2) Surettes Island, 3) Morris and Roberts Islands and there is a single individual plant at West Pubnico.

The species' presence in Canada was first reported by Fielding (2001), following his collection of several voucher specimens from Tête-à-Milie on the east shore of Morris Island, Nova Scotia. Canadian populations are presumed native because: a) they are in a localized, highly ocean-moderated climate zone with exceptionally warm winters for the Maritimes, b) they are associated with a suite of other nationally rare southern salt marsh species also restricted to the same region of southern Nova Scotia, c) areas of occurrence have few exotic species and are generally not heavily disturbed by humans, and d) the species has spread over 25 km with populations dominated by large, mature individuals, suggesting long-term occurrence in Nova Scotia.

The extent of occurrence (EO) including the single West Pubnico individual is 75.1 km^2; however, the West Pubnico occurrence is a single individual, making its status as a "population" questionable. If the West Pubnico occurrence is excluded, EO is 49.4 km^2. EO values were calculated in MapInfo GIS using standard COSEWIC methods (COSEWIC 2010). The index of area of occupancy (IAO), calculated as the number of occupied 2 km x 2 km grid boxes using the UTM NAD83 grid aligned with the 10 km grid square margins (with some adjustment because of irregular square size across the UTM Zone 19-20 boundary), is 52 km^2. If the West Pubnico individual is excluded, the IAO is 48 km^2. The plants occur in a linear habitat between the upland forest and coastal marshes and thus occupy less area than the IAO suggests.

The known distribution of the species is documented well enough that the actual area of occupancy can be fairly precisely estimated. Using a 10m x 10m grid, the total area of occupancy for the species in Canada is approximately 2.26 km^2.

HABITAT

Habitat requirements

Throughout its native range, Eastern Baccharis occurs in a variety of habitats including open coastal forests, coppices, beaches, saline to freshwater intertidal marshes, and open or shrubby marshes (Penfound and Hathaway 1938; Mahler and Waterfall 1964; Allain and Grace 2001), open gravelly flats and palm flats (Correll and Correll 1982). In the southern United States, it can also be found in anthropogenically disturbed habitats such as fields, waste areas, roadsides and railways (Boldt 1989a; Lance 2004).

In Canada, Eastern Baccharis is strictly a coastal species and occurs in a much more restricted range of habitats. All known occurrences are in well-developed salt marshes located within harbours or bays providing some protection from onshore wind and waves. The species is most often found in the upland fringe of salt marshes, in or near the transition zone to coastal forest, where soil salinity is lower and vegetation cover is predominantly graminoids and low shrubs. These habitats are characterized by an assemblage of both halophytic and non-halophytic species commonly including Saltwater Cordgrass (*Spartina alterniflora*), Freshwater Cordgrass (*Spartina pectinata*),

Tick Quackgrass (*Thinopyrum pycnanthum*), New Belgium Aster (*Symphyotrichum novi-belgii*), Seaside Goldenrod (*Solidago sempervirens*), Virginia Rose (*Rosa virginiana*), Black Huckleberry (*Gaylussacia baccata*), Bayberry (*Morella pensylvanica*), Winterberry Holly (*Ilex verticillata*), Red Maple (*Acer rubrum*) and Red or White Spruce (*Picea rubens* or *P. glauca*). Eastern Baccharis frequently occurs with or near other provincially and/or nationally rare species such as Beaked Spikerush (*Eleocharis rostellata*), Big-leaf Marsh-elder (*Iva frutescens* ssp*. oraria*), Olney's Bulrush (*Schoenoplectus americanus; =Scirpus olneyi*) and Salt-marsh False-foxglove (*Agalinis maritima*).

At all known Canadian sites, individuals seem to be restricted to open and semi-open areas, where tree cover does not exceed 60%. Studies indicate that both fruit production and seed germination are considerably reduced under dense shade (Westman *et al.* 1975).

The species exhibits a high degree of habitat specificity in Canada but can reportedly tolerate a wide range of conditions with regard to pH (3.6 to 9) and available nutrients (560-5500 ppm Kjeldhal nitrogen and 4-73 ppm phosphorus) (Westman *et al.* 1975). It is considered to be tolerant of fairly high levels of soil and groundwater salinity (Young *et al.* 1994; Westman *et al.* 1975) and can withstand salt spray (Wells and Shunk 1938), periodic flooding and drought (Westman *et al.* 1975). It typically grows in moist highly organic soils, but can thrive in a wide variety of substrates from pure sand to pure clay (Dirr and Heuser 1987) (see **Physiology and Adaptability**).

Climate likely plays a major role in limiting the species' distribution. Through the influence of ocean currents, the coastal zone of southwestern Nova Scotia from Digby to Liverpool, especially the area around Yarmouth where Eastern Baccharis occurs, has the warmest Canadian winters outside of southern British Columbia (USDA 1990), with temperatures considerably milder than the coast of Maine at the same latitudes (USDA 1990; Agriculture and Agrifood Canada 2000).

Habitat trends

A substantial majority of the habitat occupied by Eastern Baccharis in Canada is minimally altered, with very low levels of anthropogenic disturbance. Recent coastline development has, however, resulted in degradation and loss of a small proportion of occupied habitat. A number of new homes, cottages, roads and waterfront lots for sale were observed within or near Eastern Baccharis occurrences in 2010 (Blaney and Mazerolle, pers. obs. 2010, Figure 5). Eastern Baccharis occurs in aesthetically attractive areas that are generally fairly close to existing roads, so shoreline development is certain to increase over time. The species occurs at the boundary between salt marsh and adjacent upland forest, which makes its habitat especially susceptible to landowners clearing brush for access to water and views.

Figure 5. Eastern Baccharis (large shrub in centre, foreground) at Roberts Island, Nova Scotia, near recently built cottage that removed suitable habitat and probably some Eastern Baccharis individuals. Eastern Baccharis is also visible on the distant salt marsh margin in the upper left (photo credit Mazerolle and Blaney).

The two large subpopulations (Johnson Cove South / Bird Point and Morris Island East) supporting about 88% of the total Canadian population both have small existing shoreline developments and high potential for further shoreline development affecting some plants. In both cases, however, the areas where most of the plants occur have reduced development potential because they are on small islands within salt marsh. At these sites, developing road access would require building expensive causeways for which it might be difficult to receive government approval. Detailed site by site analysis of development threat and specific habitat alterations is given under **Population – Threats and Limiting Factors** below.

Almost all Eastern Baccharis in Canada occur within 2 m of current sea level, thus climate change-induced sea level rise, coupled with natural land subsidence, could have significant impacts on Eastern Baccharis habitat and numbers over time, especially if the apparently slow rate of establishment from seed made the species incapable of moving along with the potential (but not necessarily certain) inland migration of salt-marsh habitat. Small numbers of dead and unhealthy Eastern Baccharis shrubs observed in lower marsh zones on Morris Island and Surettes Island could be the result of local increases in tidal flooding and salinity. Predicting sea level rise is difficult at a local scale, but global sea level rise to 2090 has recently been modelled at 22 to 44 cm, with regional variation of +/- 15 cm (NASA 2011). Natural land subsidence in Nova Scotia adds to the relative sea level rise by roughly 17 cm per century (Shaw *et al*. 1998), and the range of Eastern Baccharis in Canada is fully within a zone designated as having high sensitivity to flooding, erosion, beach migration, and coastal dune destabilization as a result of sea level rise (Shaw *et al*. 1998). Researchers expect climate warming to result in more frequent and intense storms in Nova Scotia (Government of Nova Scotia 2009) so storm surges could also present a potential threat.

BIOLOGY

Life cycle and reproduction

Eastern Baccharis is a perennial, woody shrub. In Nova Scotia, flowering takes place from early August (perhaps as early as late July, Blaney, pers. obs. 2006) to late September but extends to November further south (Mahler and Waterfall 1964; Sundberg and Bogler 2006). The dioecious plants are in bloom during the same period, with males flowering slightly earlier than females (Krischik and Denno 1990).

Pollination in this species is reported to be anemophilous, the pollen carried by wind from male plants to flowers on female plants (Krischik and Denno 1990). Because male flowers produce abundant nectar (USDA 2006), insect-mediated pollination may also be important.

After fertilization, white pappus bristles attached to the maturing fruits gradually elongate and protrude from the female flower heads. Mature fruits are released soon after ripening and dispersed by wind and water, aided by the attached pappus (Westman *et al.* 1975). Achenes mature in late August or September in Nova Scotia, with most having dispersed by late October (Blaney, pers. obs. 2006; Blaney and Mazerolle, pers. obs. 2010).

Seed production can be prolific, possibly exceeding a million seeds in large healthy individuals (Westman *et al.* 1975). Seed production decreases with plant age and density, but increases with available light (Panetta 1979). Eastern Baccharis achenes have a facultative light requirement for germination and lack an innate dormancy (Panetta 1979). Germination potential varies from 70% to 99% (Diatloff 1964, Panetta

1979). When forced into dormancy through burial, seeds remain viable for a minimum of two years (Karrfalt and Olson undated). The species produces abundant seeds in Nova Scotia and seed viability has been demonstrated by germination in greenhouse conditions at Acadia University (P. Mills, pers. comm. 2010). The apparently low seedling recruitment and rarity of small individuals observed in Canadian populations suggest that establishment from seed may be a significant natural limiting factor, perhaps because of low winter survival of seedlings. Westman *et al.* (1975) suggested that the spread of the species into southern Australia was limited by prolonged freezing.

In late fall, leaves generally turn yellow and plants become dormant. Eastern Baccharis exhibits a deciduous growth habit in the northernmost portions of its North American range, but can retain its foliage year-round in southern parts of its global range (Westman *et al.* 1975; Krischik and Denno 1990).

In Australia, the species reportedly reaches reproductive maturity two years after germination (Panetta 1979), but it is likely much slower to mature in Nova Scotia where it is at the limit of its climatic tolerance. Seedlings were observed at the Morris Island and Johnson Cove South / Bird Point subpopulations (Blaney and Mazerolle, pers. obs. 2010), but not elsewhere, and very few seedlings and few smaller, non-reproductive individuals were present, suggesting that establishment from seed and recruitment into the reproductive population is uncommon. However, targeted searches for seedling recruitment were not done and many of the sites were observed from a distance, which did not provide opportunities to search for seedlings. Large individuals in Nova Scotia can have trunks up to about 10 cm diameter, must appear many years old (Blaney and Mazerolle, pers. obs 2010). New stems sprout from the bases of mature shrubs, meaning that individuals could persist for decades or longer (Blaney, pers. obs. 2006; Blaney and Mazerolle 2010). Eastern Baccharis was also observed spreading vegetatively in Nova Scotia via the rooting of low branches that became buried in wave-driven wrack (Blaney and Mazerolle 2010), although the extent to which this was producing potentially physiologically independent units was not clear.

Physiology and adaptability

Eastern Baccharis is well adapted to harsh and dynamic coastal environments. Although it may best be described in Canada as a species of fairly stable habitats in upper salt marshes and coastal forest edges, many of its characteristics are often associated with pioneer and early succession species. These characteristics include prolific seed production, long-range dispersal by wind and water, promotion of germination by exposure to light, tolerance of a range of soil nutrient and salinity conditions and an ability to survive periodic flooding and drought (Westman *et al.* 1975).

Seedlings have the ability to maintain growth under conditions of low nitrogen during their first 13 weeks and can survive in situations where all nutrients are scarce (Westman *et al.* 1975).

In a study of the response of coastal shrub species to freshwater and saltwater flooding, Tolliver *et al.* (1997) determined that Eastern Baccharis could tolerate freshwater flooding without adverse effects for nine days. During prolonged flooding by salt water (20 and 30 g L^{-1}), onset of mortality occurred after 17 days (Tolliver *et al.* 1997).

Skewed sex ratios and spatial segregation of sexes along environmental gradients have been well documented in dioecious plant populations (Bierzychudek and Eckhart 1988; Freeman *et al.* 1976). Likely due to the higher energy cost of fruit production, populations are often female-biased in moister, nutrient-rich habitats and male-biased in xeric nutrient-poor sites (Charnov 1982; Bierzychudek and Eckhart 1988). For wind-pollinated dioecious species, Freeman *et al.* (1976) suggest this may be a strategy to maximize seed set in females and pollen dispersal in males. The ability to skew sex ratios according to available conditions may also help populations to persist in suboptimal conditions over long periods of time and maximize the use of resources when they become available.

Krischik and Denno (1990) observed strong sex-related differences in the tolerance of Eastern Baccharis for nutrient and moisture limitations, noting that plants grown at high density with low nutrient and water supply showed poor growth and a male-biased sex ratio (73%) while plants grown in optimal conditions flowered frequently and showed a female-biased sex ratio (75%). They considered skewed sex ratios to be most likely due to differential mortality rather than gender switching, as there are no known cases of any species of Baccharis switching sexes (Espirito-Santo *et al*. 2003). Sex ratios did not appear strongly skewed in Nova Scotia (Blaney and Mazerolle, pers. obs. 2010).

Eastern Baccharis effectively deters most generalist insect herbivores through the production of acetone-soluble secondary chemicals secreted by resin glands on the surface of its leaves (Kraft and Denno 1982; Krischik and Denno 1990). Cardiac glycosides in the leaves and flowers make it unpalatable to most mammals and it is toxic to livestock (Van Deelen 1991).

Dispersal and migration

Eastern Baccharis produces numerous small wind-dispersed achenes with a seed mass of approximately 0.1 mg (Panetta 1977). According to Diatloff (1964), seeds borne by a steady 17 km/h wind may drift as far 140 m from a 2 m tall parent plant. Storm winds could therefore easily carry achenes over much greater distances. Seeds in this species have a mean flotation time of over 40 days (Elsey-Quirk *et al.* 2009) and can therefore be carried by water over considerable distances.

The species can also spread vegetatively over short distances as new shoots sprout from the base of established individuals and low-arching stems produce roots (Van Deelen 1991; Blaney and Mazerolle, pers. obs. 2010).

Although animal-mediated dispersal has not been documented, achenes could be spread by small and large mammals and songbirds passing through or perching in shrubs, or secondarily by waterfowl, shorebirds or other animals via dispersal of seeds in mud.

Interspecific interactions

At least 145 species of phytophagous insects have been documented from Eastern Baccharis (Palmer 1987; Palmer and Bennett 1988), and at least 15 of those species are considered monophagous (occurring on no other plant species) (Palmer 1987; Palmer and Bennett 1988). The dominant leaf-feeding insect over most of the range of Eastern Baccharis is a leaf beetle *Trirhabda bacharidis* (Chrysomelidae) (Johnson and Lyon 1976; Palmer 1986). Found from Texas to Massachusetts in the United States, both larvae and adults of *Trirhabda bacharidis* exhibit very high host specificity (Hogue 1970; Boldt 1989b) and the species has been introduced as a biological control agent for Eastern Baccharis in Australia (Palmer and Haseler 1992). Competitive interactions within phytophagous insect communities with Eastern Baccharis have been the subject of several studies (Kraft and Denno 1982; Krischik and Denno 1990; Hudson 1995; Hudson and Stiling 1997).

Other *Baccharis* specialists include defoliating and stem-boring lepidopterans such as *Aristotella ivae* (Gelechiidae), *Bucculatrix ivella* (Bucculatricidae) and *Hellensia balanotes* (Pterophoridae) (Julien and Griffiths 1998; Palmer and Haseler 1992; Sims-Chilton *et al.* 2009), a stem-boring long-horned beetle *Amniscus perplexus* (Cerambycidae) (Palmer and Tomley 1993) and a gall-forming fly *Neolasioptera lathamii* (Cecidomyiidae) (Hudson and Stiling 1997). None of these *Baccharis*-dependent species are yet known from Canada, but no effort has been made to look for them. Bees and small butterflies use the abundant nectar produced by male flowers (USDA 2006).

Eastern Baccharis is also susceptible to infection by the macrocyclic autoecious fungus Groundsel-bush Rust (*Puccinia evadens*, Pucciniaceae) (Sims-Chilton *et al.* 2009), but no signs of disease were detected during surveys of Canadian populations.

Grelen (1975) listed Eastern Baccharis as a “desirable” browse species for White-tailed Deer (*Odocoileus virginianus*) in Louisiana, although it is elsewhere considered unpalatable to mammals because of cardiac glycosides in the leaves and flowers and it is toxic to livestock (USDA 2006). Despite abundant deer within Eastern Baccharis sites, no browsing was noted on Nova Scotia plants (Blaney and Mazerolle, pers. obs. 2010).

The presence of salt marsh grass species such as Salt-water Cordgrass has been shown to facilitate the establishment and growth of Eastern Baccharis, presumably through the alleviation of environmental stressors such as soil salinity and nutrient availability (Egerova *et al.* 2003).

POPULATION SIZES AND TRENDS

Search effort

Population and distribution have been thoroughly documented for Eastern Baccharis in Nova Scotia. As a large, showy shrub of open habitats, Eastern Baccharis is readily detectable. During October 2010 fieldwork (Blaney and Mazerolle, pers. obs. 2010), female plants with seeds were found to be detectable through binoculars from distances of 500 m to 1+ km, while male plants could be tentatively identified from that distance and fairly certainly identified from distances of 100 m to 500 m.

Rare plant records (AC CDC 2010) indicate that botanical survey effort in the Tusket River estuary and Lobster Bay had been very limited prior to the discovery of Eastern Baccharis in 1999 (Fielding 2001), which explains how it had remained undetected to that time. Since 2001, the potential range of Eastern Baccharis in Nova Scotia has been quite thoroughly surveyed for the species. In 2006, Sean Blaney, Sean Basquill and Sherman Boates further documented the species' distribution on the east side of Morris Island and on Roberts Island (AC CDC 2010). From 2007 to 2010, Pamela Mills of Nova Scotia Department of Natural Resources (NS DNR) discovered eight new populations through helicopter-based surveys that covered virtually all of the hundreds of kilometres of shoreline (including islands) from Roseway Harbour (39 km straight-line distance east of the known range) to Chegoggin River (5 km west of the known range). Areas west of Chegoggin River may not be suitable for Eastern Baccharis, as none of the rare southern salt-marsh species that co-occur with Eastern Baccharis are known from Digby or Annapolis Counties (AC CDC 2010), likely because of habitat differences created by the higher tidal amplitude along the Bay of Fundy shore and a reduction in oceanic moderation of winter temperatures.

Ground-level field surveys for this report by Sean Blaney and David Mazerolle demonstrated that the helicopter surveys have been very effective in spotting Eastern Baccharis plants but less effective at counting numbers of individuals in larger populations. Field surveys in 2010 found only small numbers of new sites representing very few individuals during four person-days of searching within suitable habitat, but did significantly increase total number of individuals known at previously identified sites. The demonstrated effectiveness of the comprehensive helicopter surveys in finding Eastern Baccharis, along with the differences in climate and the absence of associated rare species to the east and west of the known distribution, suggest that the currently documented range limits of Eastern Baccharis in Nova Scotia likely represent all or almost all of the actual range.

Surveys for this report were carried out in the Tusket River Estuary, Lobster Bay and Pubnico Harbour areas in Yarmouth County, on October 14 and 15, 2010, during the August to October period in which Eastern Baccharis is most detectable because of the showy pappus of mature seeds on female plants. Eastern Baccharis plants are also especially visible in autumn because leaves change colour and fall relatively late, remaining a dull blue-greyish green through to mid-October and contrasting with many

associated shrubs which have lost leaves or have changed to yellow, orange or red by that time. Surveys included comprehensive counts of individuals at five of ten known subpopulations [Johnson Cove North, Johnson Cove South / Bird Point, Surettes Island, Morris Island East, and Morris Island (The Basin)], and nearly comprehensive counts of individuals at the Roberts Island subpopulation. The West Pubnico site was not accessible but was surveyed from shore by binoculars, with the single individual originally located by helicopter relocated. The three unsurveyed subpopulations were Morris Island Southeast, Plymouth, and Arnold Point. The latter of these had 14 plants counted from helicopter, while the other two had no counts, likely indicating few individuals. Assuming that none of the unsurveyed subpopulations had more than 50 individuals (which is almost certainly the case), the 2010 field surveys counted at least 95% of the total number of individuals in Canada.

Defining populations and locations

Populations are defined in this report using habitat-based plant element occurrence delimitation standards (NatureServe 2004), under which occurrences are lumped into a single population if separated by less than 1 km, or if separated by 1 to 3 km with no break in suitable habitat between them exceeding 1 km, or if separated by 3 to 10 km but connected by linear water flow and having no break in suitable habitat between them exceeding 3 km. Under this definition, there are three populations of Eastern Baccharis in Canada: 1) Tusket River Estuary, 2) Surettes Island, 3) Morris and Roberts Islands, and a single plant occurs at a disjunct site at West Pubnico.

For the purposes of COSEWIC assessment, locations are defined as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. In the case of multiple threats, the location should be defined by the most serious plausible threat. For Eastern Baccharis, that is coastal development for cottages or residences, which occurs at a scale of tens of metres up to hundreds of metres. The number of locations is not defined in this report but is much greater than 10 (a threshold number for COSEWIC's B criterion). Eastern Baccharis would occur at 91 locations if they were defined by a 10 m separation distance (roughly the smallest shore frontage on a single cottage property). Property boundaries provide an alternate means of determining number of locations, because development typically occurs on a property-by-property basis. Eastern Baccharis occurs on properties belonging to about 50 different landowners (Benjamin pers. comm. 2010), with imprecise GPS and helicopter-based points making it impossible to get an exact number. The 24 occurrences on Crown land are afforded little protection because they generally occur just outside private properties below the legal high tide mark, and would tend to be treated as private property by adjacent landowners. Thus they would generally best be treated as parts of their adjacent private land locations if one were to define locations by ownership.

Sea level rise is not considered an immediate threat, but if it were, number of locations would be low because sea level rise would affect individuals relatively uniformly, because all or almost all individuals are within 2 m of current sea level.

Abundance

The total Canadian population is estimated at 2850 individuals in three populations. The West Pubnico occurrence has only a single plant known. There is a small population (21 plants, less than 1% of the Canadian population) on Surettes Island in Lobster Bay and two large populations. Approximately 48% of the Canadian population is in the Morris and Roberts Islands population in Lobster Bay, which includes three subpopulations. The remaining 52% of Canadian plants are in the Tusket River Estuary west of Lobster Bay in three subpopulations (Table 1).

Table 1. Number of locations and individuals recorded at each known site, with area of occupancy and land ownership.

Population	Subpopulation	# "locations"[1]	Number of individuals[2]	Actual area of occupancy[3]	Land tenure
1. Tusket River Estuary	Johnson Cove (North section)	4	62	1200 m^2	3 properties, 1 location on Crown land
1. Tusket River Estuary	Johnson Cove (South section) and Bird Point	10	>1400	8500 m^2	7 properties, 3 locations on Crown land
1. Tusket River Estuary	Plymouth	1	Not recorded, likely few	100 m^2	Crown
1. Tusket River Estuary	Arnold Point	2	14	200 m^2	Private (2 properties)
2. Surettes Island	Surettes Island	1	21	100 m^2	Private (1 property)
3. Morris – Roberts Islands	Morris Island (The Basin)	6	>140	2800 m^2	5 properties, 1 location on Crown land
3. Morris – Roberts Islands	Morris Island (East shore, including Tête-à-Milie)	3	>1100	>7600 m^2	2 properties, 1 location on Crown land
3. Morris – Roberts Islands	Morris Island (Southeast shore)	1	Not recorded, likely few	100 m^2	Private (1 property)
3. Morris – Roberts Islands	Roberts Island	12	110	1900 m^2	11 properties, 1 location on Crown land
[West Pubnico]	[West Pubnico]	1	1	100 m^2	Private (1 property)

[1]Defined by property ownership [2]The most recent estimate available from: Blaney and Mazerolle 2010 fieldwork, Blaney *et al.* 2006 fieldwork, Mills 2007 fieldwork.[3]Based on a 10m x 10m grid.

It is important to note the extreme concentration of populations into two small areas, making the species especially sensitive to any alteration of those sites. Most of the documented sites include only small numbers of plants but the margins of a few small upland islands within salt marsh at the Morris Island East subpopulation and the Johnson Cove / Bird Point subpopulation in the Tusket River estuary support large, dense populations that each contain more than 1000 plants and thus represent 70%+ of Canadian plants. These areas are only 300 x 250 m at Morris Island East and 400 x 100 m at Johnson Cove / Bird Point.

Fluctuations and trends

Given the recent discovery of this species in Canada, survey data are insufficient to detect fluctuations or trends in population size. Populations would be unlikely to fluctuate significantly on the short term because individuals are long-lived and appear to reproduce infrequently in Canada.

Cottage and home development is still ongoing and over the past 30 – 60 years (three generations assuming a generation time of 10 – 20 years) has likely removed some individuals, probably not representing a substantial portion of the total population because most of the species' area of occurrence is still undeveloped.

Rescue effect

The 400+ km disjunction from the next nearest population in Massachusetts means that there is very limited chance for a rescue effect from outside Canada.

THREATS AND LIMITING FACTORS

Coastal development and habitat alteration

Human alteration of the coastal habitats used by Eastern Baccharis is the most immediate and widespread threat to populations. Housing development and recreational activity have dramatically increased in Nova Scotia's coastal areas since the 1950s (Wood 1990; Province of Nova Scotia 2009) and coastal land prices have seen vast increases in that time. Because much of the available prime waterfront real estate has already been developed (Province of Nova Scotia 2009), future expansions may increasingly encroach into areas adjacent to salt marsh. Known and high potential development impacts are described comprehensively below.

Construction of cottages and year-round homes over the past 10 to 20 years has influenced portions of the Roberts Island, Morris Island East and Johnson Cove North subpopulations. Additionally, the mainland portions of the largest subpopulation at Johnson Cove South / Bird Point and the nearby Plymouth subpopulation have very high potential for future development. Potential for future development at the Morris Island (The Basin) and Morris Island Southeast subpopulations is at least moderate. Additional recent construction observed during 2010 surveys included a large public school addition adjacent to the Johnson Cove / Bird Point subpopulation and a large mink farm adjacent to Roberts Island occurrences, neither of which was yet having much direct influence on Eastern Baccharis habitat.

At the south end of Roberts Island, the 17 ha point with 1.3 km of shoreline that forms the west side of Kenny Cove, is occupied by the Roberts Island Estates subdivision, which is currently under development. A sign on site indicates seven of eleven lots have been sold (Blaney and Mazerolle, pers. obs. 2010). Real estate listings online (Victory Realty 2010) show that this point has been further subdivided into 19 lots. Only a few of these lots have yet been developed. Several additional, relatively recent cottages have also been built immediately west of this subdivision within shoreline sparsely occupied by Eastern Baccharis. Existing developments on Roberts Island have clearly reduced available habitat (see Figure 5), and have presumably eliminated some individuals (at least one shrub was seen to have been cut to the base but was resprouting), but have not yet affected a high proportion of the 110 plants known on the island. The Roberts Island occurrences further northwest of the cottage areas are also in readily developable areas because of existing roads nearby and because of non-swampy uplands predominating up to the edge of the salt marsh. One additional property in this area was signed as “for sale by owner”.

At Morris Island East near Tête-à-Milie, one new cabin and one old cabin have small zones cleared of shoreline shrubs within an area of Eastern Baccharis occurrence. A new access road to the shoreline has also been constructed and a 26 ha block of properties with 500 m of shoreline frontage is for sale (as of November 2010) as a development site. These properties support somewhere under 50 plants. Most of the remainder of the ~1100 plants in the Morris Island East subpopulation are nearby but are around upland islands surrounded by salt marsh. These would be less promising as major development sites because of the need to develop causeways for access, although ATV-accessed cabins could be developed.

Johnson Cove South / Bird Point is the largest subpopulation at ~1400 plants. About 90% of that subpopulation occurs near an island within the salt marsh that has reduced development potential because of lack of road access. This subpopulation and the nearby Plymouth subpopulation (few plants, not counted) occur about 400 m from the settlement of Plymouth. Because this area is along a well-maintained secondary highway (Highway 334) and only five minutes from the town of Yarmouth, there is considerable potential for future subdivision and development of waterfront lots that could impact at least the ~10% of the population that occurs on the mainland shore. Also at this subpopulation, the property of Plymouth Public School borders salt marsh occupied by Eastern Baccharis and there is a well-used vehicle trail extending into the upper salt marsh from near the school parking lot. The salt marsh around the trail supported at least 17 plants and was somewhat disturbed by vehicle traffic, although Eastern Baccharis did not appear substantially impacted. There are also active dairy farms in this subpopulation, with cleared and fenced pasture locally extending into areas occupied by Eastern Baccharis and potentially reducing numbers relative to historic levels.

At Johnson Cove North, the resident's lawn extends to the shoreline where 19 plants occur. Seven more plants out of the 62 total in this subpopulation might also be susceptible to development because of the existence of a good access road and upland habitats adjacent to Eastern Baccharis occurrences.

Areas of occurrence within the Morris Island (The Basin) (~140 plants) and Morris Island Southeast (unknown numbers, likely few) subpopulations seem to have some potential for development, given proximity of paved roads. Other subpopulations at Surettes Island and Arnold Point, plus the site of the single individual at West Pubnico (which collectively total less than 1% of the population), have lower development potential because of difficulty of access across salt marsh and open water channels.

Restricted geographic range

The primary natural limiting factor for this species in Canada is likely the very limited area of climatically suitable salt marsh. The spread of the species outside this region is likely prevented by colder winter temperatures. Even within the small zone in which Eastern Baccharis occurs, it is highly concentrated into two small areas around the margins of small, upland islands within salt marsh. A 300m x 250m area within the Morris Island East subpopulation and a 400m x 100m area within the Johnson Cove South / Bird Point subpopulation on the Tusket River Estuary each support over 1000 individuals and together make up more than 70% of the population. This concentration makes the species very susceptible to large, rapid population declines if development, storm events or other impacts were to affect the key sites.

Climate change and sea level rise

All or virtually all Eastern Baccharis in Canada is within 2 m of current sea levels. While Eastern Baccharis could see an increase in climatically suitable habitat with a warmer climate in southern Nova Scotia, human-induced climate change may not be strictly beneficial to the species. Climate change is anticipated to lead to increases in the rate of sea level rise and storm frequency and severity (Houghton *et al.* 1996; Shaw 2001; Kont *et al.* 2003; Environment Canada 2006). In Canada, the region considered most sensitive to flooding, erosion, beach migration, and coastal dune destabilization as a result of sea level rise includes much of the Maritimes coast, including the range of Eastern Baccharis (Shaw *et al.* 1998). Sea level in Nova Scotia is rising at an additional 17 cm per century because of regional land subsidence (Shaw *et al.* 1998; Forbes *et al.* 2008). While regional tide gauge data show a rise of approximately 30 cm during the 20th century (Shaw *et al.* 1998), global projections (excluding subsidence effects) range from 22-44 cm (+/- 15 cm regional variation) by 2090 (NASA 2011) to 120 cm by 2100 (Rahmstorf 2007). Land subsidence in the region is estimated to add approximately 17 cm per century to the relative sea level rise (Forbes *et al.* 2008).

Where landforms and absence of human development permit, coastal marshes may migrate inland in response to sea level rise. For coastal wetlands to be maintained in place, accretion of marsh soils must match relative sea level rise. In the northeastern United States and elsewhere, differential rates of marsh accretion and sea level rise have resulted in the rapid loss of coastal wetlands (Warren and Niering 1993; Roman *et al.* 1997). In addition to loss of area due to permanent submergence, higher water levels can result in greater frequency and duration of tidal flooding in upper marsh zones, leading to increased soil saturation and salinity (Warren and Niering 1993). In New England, dramatic changes in vegetation were observed from 1995 to 1998 as low-marsh species rapidly migrated landward at the expense of upper marsh species in response to sea level rise (Donnelly and Bertness 2001).

As a species primarily restricted to the mid- and upper zones in tidal marshes, Eastern Baccharis does not tolerate prolonged exposure to high-salinity conditions (Tolliver *et al.* 1997). Projected increases in regional sea level rise could thus lead to loss of habitat and therefore represent a threat to all Canadian occurrences. At single locations on Surettes Island and Morris Islands, dead individuals observed in lower marsh zones suggest a response to recent increases in tidal flooding.

PROTECTION, STATUS, AND RANKS

Legal protection and status

The species does not presently benefit from legal protection. A status report is being prepared for the province of Nova Scotia, which could lead to the addition of Eastern Baccharis to the list of provincial species at risk, granting it legal protection under the *Nova Scotia Endangered Species Act*.

Non-legal status and ranks

Eastern Baccharis is listed as globally secure (G5) with a national status rank of secure (N5) in the United States (NatureServe 2011). In Canada, it is ranked critically imperilled (N1) and in Nova Scotia it has a subnational status rank of critically imperilled (S1) (NatureServe 2011). It has a National General Status rank of May Be At Risk, which equates to a “Red” rank under the NS DNR provincial ranks.

Subnational status ranks in the United States, as listed by NatureServe (2011), are as follows: Not Ranked (SNR) in Alabama, Arkansas, Connecticut, District of Columbia, Florida, Georgia, Louisiana, Maryland, Massachusetts, Mississippi, Oklahoma, South Carolina, and Texas; Secure (S5) in Delaware, New Jersey, New York, North Carolina, and Virginia; Vulnerable (S3) in Pennsylvania (where it is also “Rare” under their Native Plant Species Legislative Authority) and Imperilled (S2) in Rhode Island (NatureServe 2011).

Habitat protection and ownership

Approximately 89% of the Canadian Eastern Baccharis population is on private land in about 50 properties. This represents 74% of all known Canadian “locations” as defined by a 10 m separation distance. The remainder of the population occurs on Crown land on Roberts Island, Morris Island and in the Tusket River Estuary. No occurrences are situated on protected land. Occurrence on Crown land provides little protection for the species because in most cases, the Crown land is salt marsh with its upper boundary defined by the high water mark, precisely where Eastern Baccharis is most likely to occur. Private landowners will often not recognize these boundaries and thus may cut or remove shrubs on the Crown land adjacent to their property boundaries. Also, the GIS boundaries of the landward edge of salt marshes may differ from what would be defined by a surveyor so some of the above occurrences listed on Crown land might actually be on private land and vice versa.

Eastern Baccharis habitat receives some protection through various provincial laws and regulations concerning the conservation of wetlands and coastal zones. These include the *Environmental Assessment Regulations* of the *Environment Act*, the *Off Highway Vehicle Act* and the *Forest Act*’s *Wildlife Habitat and Watercourses Protection Regulations*.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER(S)

David Mazerolle completed an undergraduate degree with a major in biology and a minor in geography, followed by a Master's degree in environmental studies, both at the Université de Moncton. For his M.Sc. he studied the geography of exotic vegetation in Kouchibouguac National Park and created a strategy for the management of the park's exotic invasive flora. David has worked as a botanist at the Atlantic Canada Conservation Data Centre since 2007. Prior to this he was coordinator for rare plant survey and monitoring projects at the Bouctouche Dune Irving Eco-Centre from 2003 to 2006, where his work focused on the rare coastal plants of New Brunswick's Northumberland Coast. He has over ten years' experience working on various research, survey and monitoring projects and has authored and coauthored numerous status reports and technical reports pertaining to rare plants in Atlantic Canada.

Sean Blaney is the Botanist and Assistant Director of the Atlantic Canada Conservation Data Centre (AC CDC), where he is responsible for maintaining status ranks and a rare plant occurrence database for plants in each of the three Maritime provinces. Since beginning with the AC CDC in 1999, he has discovered dozens of new provincial records for vascular plants and documented several thousand rare plant locations during extensive fieldwork across the Maritimes. Sean is also a member of the COSEWIC Vascular Plant Species Specialist Committee, the Nova Scotia Atlantic Coastal Plain Flora Recovery Team, and has co-authored several COSEWIC and provincial status reports. Prior to employment with AC CDC, Sean received a B.Sc. in Biology (Botany Minor) from the University of Guelph and an M.Sc. in Plant Ecology from the University of Toronto, and worked on a number of biological inventory projects in Ontario as well as spending eight summers as a naturalist in Algonquin Park, where he co-authored the second edition of the park's plant checklist.

COLLECTIONS EXAMINED

All known Nova Scotia specimens were already documented in the Atlantic Canada Conservation Data Centre database (AC CDC 2010) prior to the preparation of this report, so no further examination of herbarium specimens was undertaken.