Life Cycles, Dispersal, and Critical Habitat Utilization of Vertebrates Dependent upon Small Isolated Water Bodies in the Munson Sandhills and Woodville Karst Plain, Leon County, Florida

Final Report

To the Department of Transportation for OMNI Project 010562
By D. Bruce Means, Ph.D., Department of Biological Science, Florida State University, Tallahassee, Florida 32306 and Coastal Plains Institute and Land Conservancy, 1313 Milton Street, Tallahassee, Florida 32303


Mole salamander


Striped Newt


Common Newt


Dwarf Salamander


Spadefoot


Oak Toad


Southern Toad

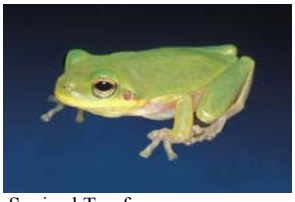

Narrowmouth


Ornate Chorus Frog


Cricket Frog


Little Grass Frog


Spring Peeper


Squirrel Treefrog


Pinewoods Treefrog


Barking Treefrog


Southern Leopard Frog


Gopher Frog


Bullfrog


Mud Turtle


Stinkpot


Chicken Turtle


Florida Cooter (L), Pond Slider


Banded Water Snake


Swamp Snake

30 March 2007

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
OMNI 010562		

4. Title and Subtitle	5. Report Date
Life Cycles, Dispesal, and Critical Habitat Utilization of Vertebrates Dependent upon Small Isolated Water Bodies in the Munson Sandhills and Woodville Karst Plain, Leon County, Florida	30 March 2007
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
D. Bruce Means	
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Deparment of Biological Science, Florida State University, Tallahassee, FL 32306	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Florida Department of Transportation	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

A long-term study of the Striped Newt (*Notophthalmus perstriatus*) and Gopher Frog (*Rana capito*), two candidate species for federal threatened status, and ~25 other vertebrate animals has been underway for 12 years at 265 small, isolated water bodies (temporary, or ephemeral ponds) in the Munson Sandhills in southern Leon County, Florida. The principal objectives of the study were to determine the life cycles, dispersal, and critical habitat utilization of these species. The study has had two components: 1) monitoring by drift fence the immigration and emigration of animals in and out of Study Pond 1, and 2) periodically surveying 265 temporary ponds in the Munson Sandhills, especially 18 ponds in which the Striped Newt has been found.

This report deals with the aftermath of a long-term drought that began in the fifth year, 1999, and has continued to the present. The effects of the drought have been so strong that many study ponds have been dry for long periods of time (>16 months), and one of the principal study animals, the Striped Newt, has declined or disappeared from almost all of its breeding ponds. During the report period (24 February 2004 – 31 March 2006 with no-cost time extensions until 30 March 2007), water levels returned in Study Pond 1, but only 2 adult Striped Newts entered the pond in years 7 – 10. In year 10, the drift fence was discontinued because of the possibility that the drift fence, itself, was hindering the normal migrations of pond animals. Striped newts and other pond-utilizing animals were thereafter sought by dipnetting in Study Pond 1 and in most of the 265 other ponds of the Munson Sandhills in years 11 and 12.

Only 3 adult Striped Newts from 2 of 18 known potential breeding ponds were found in the past 8 years, and none were taken during this time from Study Pond 1. The Gopher Frog and all the other pond-utilizing vertebrates in the Munson Sandhills have bred in many ponds following the 1999-2000 drought—even though less severe drought conditions have persisted during the period of this report. Only the Striped Newt seems not to have recovered. Potential causes of the Striped Newt decline and recommend-ations for habitat management and future study are made.

17. Key Word	18. Distribution Statement
Munson Sandhills, Striped Newt, Gopher Frog, decline, amphibian	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
		78	

Form DOT F 1700.7 (8-72)

Table of Contents

Executive Summary

A long-term study of the Striped Newt (*Notophthalmus perstriatus*) and Gopher Frog (*Rana capito*), two candidate species for federal threatened status, and ~25 other vertebrate animals has been underway for 12 years at 265 small, isolated water bodies (temporary, or ephemeral ponds) in the Munson Sandhills in southern Leon County, Florida. The principal objectives of the study were to determine the life cycles, dispersal, and critical habitat utilization of these species. The study has had two components: 1) monitoring by drift fence the immigration and emigration of animals in and out of Study Pond 1, and 2) periodically surveying 265 temporary ponds in the Munson Sandhills, especially 18 ponds in which the Striped Newt has been found.

This report deals with the aftermath of a long-term drought that began in the fifth year, 1999, and has continued to the present. The effects of the drought have been so strong that many study ponds have been dry for long periods of time (>16 months), and one of the principal study animals, the Striped Newt, has declined or disappeared from almost all of its breeding ponds. During the report period (24 February 2004 – 31 March 2006 with no-cost time extensions until 30 March 2007), water levels returned in Study Pond 1, but only 2 adult Striped Newts entered the pond in years 7 – 10. In year 10, the drift fence was discontinued because of the possibility that the drift fence, itself, was hindering the normal migrations of pond animals. Striped newts and other pond-utilizing animals were thereafter sought by dipnetting in Study Pond 1 and in most of the 265 other ponds of the Munson Sandhills in years 11 and 12.

Only 3 adult Striped Newts from 2 of 18 known potential breeding ponds were found in the past 8 years, and none were taken during this time from Study Pond 1. The Gopher Frog and all the other pond-utilizing vertebrates in the Munson Sandhills have bred in many ponds following the 1999-2000 drought—even though less severe drought conditions have persisted during the period of this report. Only the Striped Newt seems not to have recovered. Potential causes of the Striped Newt decline and recommend-ations for habitat management and future study are made.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

Introduction

The Coastal Plain of the southeastern U. S. once lay under the ocean (Murray 1961, Thornbury 1965). As sea levels receded, ancient sea beds became dry land--often composed of limestones--which were created over the eons by the accumulation of the shells and the hard parts of sea creatures. Rainwater works its way through vertical cracks, fissures, and bedding planes in limestone dissolving elaborate tunnels and passageways through which it flows back to the sea as circulating groundwater. Sandhills--deposits of deep sand that once lined ancient shorelines in the Coastal Plain--often lie on top of limestones. Sandhill regions underlain by limestones are pitted with numerous depressions that form when the land collapses into the tunnels or gently sinks as the circulating groundwater slowly dissolves the surface of the limestone underneath the sandy overburden. One important sandhill area lies in southern Leon County, Florida. It is called the Munson Sandhills and is part of the larger Woodville Karst Plain in Leon and adjacent Wakulla County (Swanson et al. 1992).

All sandhills areas in the Coastal Plain are vegetated with a distinctive type of forest/grassland called the longleaf pine savannah (Means 1996a, Platt 1999). Longleaf pine savanna, which also grew on clayhills and flatwoods, once occupied about 60% of the landscape of the Coastal Plain from east Texas to southern Virginia (Ware et al. 1993), but today has been severely reduced to less than 2% of its original extent of ~80,000,000 acres (Ware et al. 1993). Because of its dominance on the landscape and antiquity (Means 2005), longleaf pine savanna is home to one of the largest diversities of vertebrate animals (212 species) in the United States and Canada (Means 2005), including 38 species that are specialists occurring exclusively or primarily in longleaf pine savannas.

In such severely reduced and fragmented longleaf pine savanna remnants, the populations of many specialist species of the longleaf pine endemic fauna have, themselves, declined severely. Among these animals are federally threatened species such as the red-cockaded woodpecker (*Picoides borealis*), eastern indigo snake (*Drymarchon corais*), and flatwoods salamander (*Ambystoma cingulatum*). Many other species are declining severely and are likely to be candidates for federal listing, such as Bishop's salamander (*Ambystoma bishopi*), gopher tortoise (*Gopherus polyphemus*), southern hognose snake (*Heterodon simus*), pine snake (*Pituophis melanoleucus*), red-tailed skink (*Eumeces egregius*), Bachman's sparrow (*Aimophila aestivalis*), Fox squirrel (*Sciurus niger*), and Florida mouse (*Podomys floridanus*).

Two declining longleaf pine savanna species, the gopher frog (*Rana capito*) and striped newt (*Notophthalmus perstriatus*), are found in the Munson Sandhills at the northeastern corner of the Apalachicola National Forest, in Leon County, Florida (Means and Means 1998a, Means and Means 2003). These two species, and 25 other vertebrates, not only require longleaf pine forest habitat in their terrestrial lives, but they obligately must also have small, isolated water bodies in which to breed and pass through the natal, aquatic stages of their lives (Moler and Franz 1987, Means 1990). Moreover, these ponds must not be permanent water bodies, but must dry out periodically to kill off any

Fig. 1.—Study Pond #1, only about 60 feet in diameter, has produced during single emergences 50,000 baby Spadefoot Toads (upper L), 5,000 Mole Salamanders (upper R), more than 1,000 of each newt (Striped top, Common below, lower L), 3,000 Gopher Frogs (lower R, hiding its eyes), and thousands more of 16 other species of salamanders and frogs that live in the longleaf pine uplands most of their lives. Temporary ponds are vitally important to upland vertebrate food webs in longleaf ecosystems.

fish that might colonize them. They are called temporary or ephemeral ponds, and their importance in the overall longleaf pine sandhill communities is huge (Fig. 1).

Unfortunately, the sandhills habitats of all these species are rapidly being converted to living space for humans. The global distribution of the striped newt is small and restricted to the northern half of the Florida peninsula and parts of southern Georgia (Conant and Collins, 1998; Johnson 2002). Dodd (1993) and Franz and Smith (1994) resurveyed all 162 historical localities for the striped newt in Georgia and Florida and concluded that the striped newt is presently known from only three general and widely separated locations in Georgia and from 27 ponds in Florida. Based on the newt's limited distribution and low number of breeding ponds in Georgia, Dodd (1993) recommended the "…initiation of immediate efforts to conserve and manage known striped newt breeding ponds." Franz and Smith (1994) found a similar paucity of recent records from Florida, which also strongly suggested a serious decline in the striped newt throughout its Florida range. They concluded that "…this salamander is threatened throughout its geographic range and that there is sufficient evidence to warrant both state and federal listing." The Munson Sandhills/Woodville Karst Plain, containing more than half of the known Florida breeding ponds of the striped newt, may well be the most important refuge left in its global range (Means et al. 1994a,b; Means and Means 2003).

Likewise, the gopher frog is rare and declining throughout its geographic range, but does not appear to be so severely reduced in Florida as the striped newt. Franz and Smith (1994) surveyed museum records, scientific literature, unpublished field notes, and conducted their own fieldwork establishing 259 sites in 45 counties for the gopher frog. The species was active in 79 of these sites, including only two historic sites. Franz and Smith (1994) plotted only 6 localities on their range map for the gopher frog between the Apalachicola and Suwannee rivers in the Florida panhandle. Half of these were in the Woodville Karst Plain on the Apalachicola National Forest and were also known to harbor the striped newt.

History of Temporary Pond Research in the Munson Sandhills and Woodville Karst Plain.--A long-term study of the vertebrate life of limesink ponds in the Munson Sandhills/Woodville Karst Plain has been running over a 41-year period beginning with >75 casual collecting visits to various ponds from 1966 to 1992, and then a series of systematic studies beginning in 1993 (Means 1966, 1999, 2001, 2004, 2006, Means and Means 1997, 1998a,b, 2005, Means and Printiss 1996, Means et al. 1994a,b). From 31 January 1993 to 3 August 1998, Means and his technicians dipnetted and measured the growth of Striped Newt larvae (and the larvae of other salamanders) from one special pond designated "Study Pond #1" on 307 separate occasions (Means et al. 1994b and unpublished). Then, to more fully understand the population dynamics of the Striped Newt, Gopher Frog, and 25 other species of amphibians and reptiles that utilize Study Pond #1, a 338-m (1100 feet) long drift fence was emplaced in the ground completely surrounding Study Pond #1 on 6 September 1995 and ran continuously for ten years until 05/11/05. Its objective was to study the biology, immigration, and emigration of amphibians and reptiles in and out of Study Pond #1 in relation to rainfall and pond hydrology. Results of some of this work are in published and unpublished reports (Means 1996b, 1999, 2001, Means and Means 1997, 1998a, 2003, Means and Printiss

1996, and Means et al. 1994a, b). When the drift fence was terminated in its 10th year of uninterrupted operation, it had become the second longest running drift fence study after the famous 20-year Rainbow Bay project on the Savanna River Ecology Laboratory, Georgia (Semlitsch 1996).

The 12-year project was funded by a consortium of cooperating state, federal, and nonprofit NGO agencies (Table 1), beginning with the US Fish and Wildlife Service which initiated support for the project in January 1995 under Order No. 43910-5-0077. Drift-fencing research began at Study Pond #1 under a Challenge Cost-Share Agreement between Apalachicola National Forest and the Coastal Plains Institute and Land Conservancy from September 1995 to September 1997. Next, the Florida Department of Transportation (FDOT) funded the project with two contracts to faculty members of the Department of Biological Science, Florida State University. The first FDOT contract ran from 1997–2001. Then the US Fish and Wildlife Service supported these studies under Order No. 1448-43910-2-M718A from July 2002 through June 2003. The second FDOT contract covered the period from 24 February 2004 until 31 March 2006, with two no-cost time extensions through 30 March 2007. The Coastal Plains Institute and Land Conservancy funded gaps in agency funding and miscellaneous aspects of the project including labor, transportation, laboratory, and office space from 1993 to 2007.

Table 1.—Funding sources by year of the biology of amphibians and reptiles that utilize ponds in the Munson Sandhills and especially Study Pond #1 adjacent to U. S. Highway 319 south of Tallahassee, Florida. Study years begin and terminate in the first week of September each year.

	01/18/95 – 04/13/98	US Fish and Wildlife Service Order No. 43910-5-077.
Year 1:	09/06/95 – 09/05/96	Challenge Cost-share Agreement between US Forest Service and Coastal Plains Institute and Land Conservancy.
Year 2:	09/06/96 – 09/07/97	Challenge Cost-share Agreement between US Forest Service and Coastal Plains Institute and Land Conservancy.
Year 3:	09/08/97 – 09/04/98	Florida Department of Transportation contract.
Year 4:	09/07/98 – 09/05/99	Florida Department of Transportation contract.
Year 5:	09/06/99 – 09/06/00	Florida Department of Transportation contract.
Year 6:	09/08/00 – 09/07/01	Florida Department of Transportation contract.
Year 7:	09/10/01 – 06/30/02	Coastal Plains Institute and Land Conservancy.
	07/01/02 – 09/05/02	US Fish and Wildlife Service Order No. 1448-43910-2-M718A.
Year 8:	09/07/02 – 6/30/03	US Fish and Wildlife Service Order No. 1448-43910-2-M718A.
	07/01/03 – 09/08/03	Coastal Plains Institute and Land Conservancy.
Year 9:	09/09/03 – 09/08/04	Florida Department of Transportation contract.
Year 10:	09/09/04—05/11/05	Florida Department of Transportation contract.
	05/12/05—09/06/05	Florida Department of Transportation contract.
Year 11:	09/07/05—09/06/06	Florida Department of Transportation contract.
Year 12:	09/07/06—03/31/07	Florida Department of Transportation contract.

This is the final report to FDOT for OMNI Project 010562. OMNI Project 010562 began as FDOT contract # BD543, to have been completed on or before March 31, 2006. The FDOT funding was especially earmarked to monitor breeding ponds of the principal study animals (Striped Newt and Gopher Frog) through a severe regional drought that began in 1999. Incredibly, the drought persisted through the original

completion date and, in spite of two no-cost time extensions, was still in full force nine months later as of 30 March 2007.

Under the funding from OMNI Project 010562, two study projects were to be carried out. Project 1 was intended "to continue monitoring the population status of the wildlife that breeds in Study Pond #1 by means of the drift fence and dipnetting regimen," which had been running there since 6 September 1995. Both the Striped Newt and Gopher Frog had not bred in Study Pond #1 for several years through the period of the drought, and it was hoped to find them breeding in the pond when the drought broke. Project 2 was to learn the long-term effects of the 1999-2003 drought on the Striped Newt and Gopher Frog throughout all of the potential breeding ponds (n = 265) in the Munson Sandhills, searching for ponds in which larvae had not been found previously and re-checking known breeding ponds.

This report provides the results of Projects 1 & 2 under OMNI Project 010562 for the time period of the contract, 24 February 2004 to 31 March 2007. This report also gives overall conclusions about the significance and potential causes of the 12-year population fluctuations of the Striped Newt, Gopher Frog, and some other pond-utilizing vertebrates in the Munson Sandhills. The effects of highways and roads on study animal populations are discussed and recommendations are given for future studies.

Study Area

The study area is a west-to-east trending belt of sandy hills in the southern portion of Leon County, Florida, and just south of the capital city of Tallahassee (Fig. 2). The hills form a small physiographic region called the Munson Sand Hills, a subdivision of the larger Gulf Coastal Lowlands (Hendry and Sproul 1966). They represent sands up to ~35 ft (~10 m) deep capping limestones of the Pliocene Jackson Bluff Formation which overlie late Miocene limestones of the St. Marks Formation, very much the same geology as that of the adjacent Woodville Karst Plain. The only distinction between the Munson Sand Hills and the Woodville Karst Plain is the depth of the sands and the fact that the deeper sands of the Munson Sand Hills are a more hilly terrain.

The deep sands of the Munson Sand Hills probably were deposited off the mouth of the ancient Ochlockonee River as a barrier island complex when sea levels were higher in the late Miocene or Pliocene (Hendry and Sproul 1966). Relief in the Munson Sand Hills has been exaggerated by dissolution of the underlying limestones over the millenia since the sands were deposited. For the purposes of this study, the Munson Sand Hills are divided into an eastern and a western portion (Fig. 2), using Woodville Highway (Fla. Rd. 363 on Fig. 2) as an arbitrary dividing line. The eastern portion of the Munson Sand Hills narrows eastward and terminates at the St. Marks River. The western portion of the Munson Sand Hills is about twice as large, depending upon how it is circumscribed. For the purposes of this study, most of the fieldwork in the western half of the Munson Sand Hills was confined to land lying between Woodville Highway on the east and Springhill Road (Fla. Rd. 373 on Fig. 2) on the west. The reason for this is that the portion of the

western Munson Sand Hills that lies northwest of Springhill Road is highly developed with homes, a regional airport, and slash pine plantations.

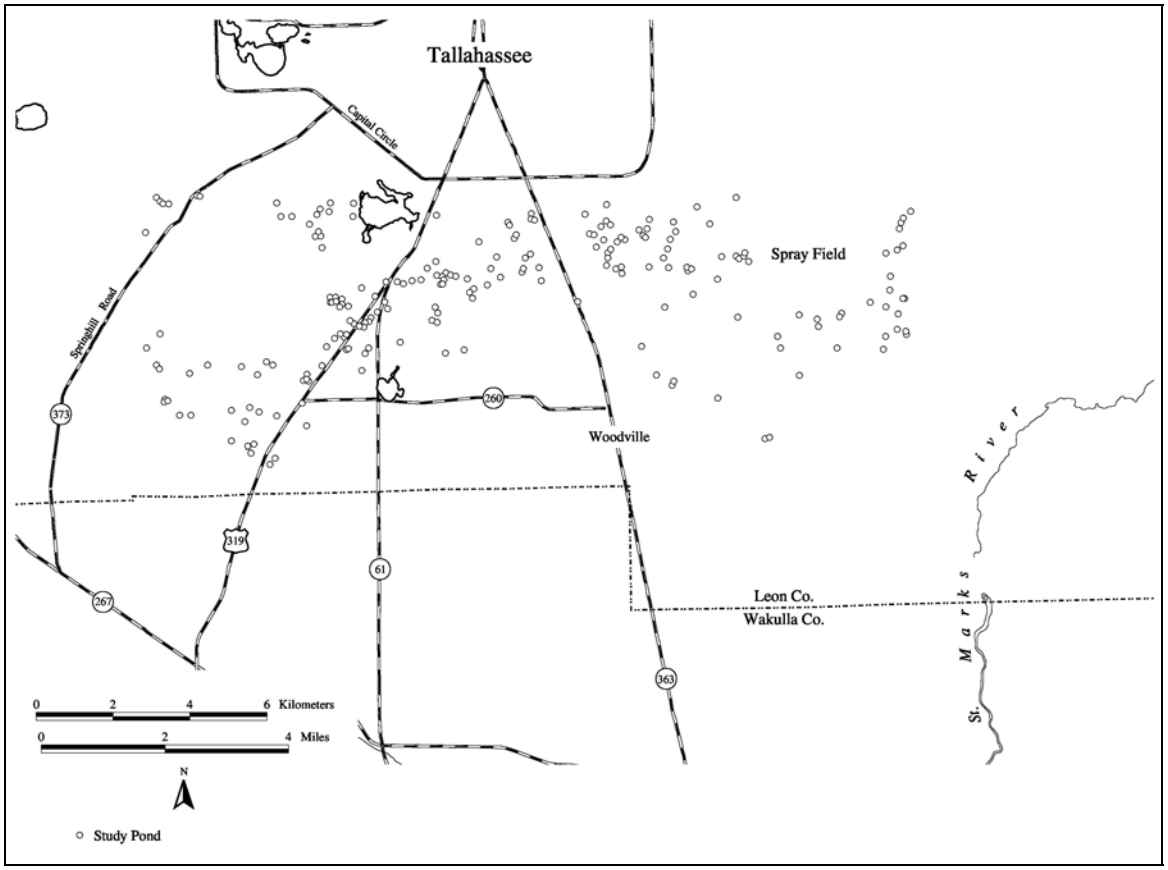


Fig. 2. Map of the Study Area, Munson Sandhills south ofTallahassee, Florida, showing the 265 temporary ponds (open circles) of this study.

Methods and Materials

Project 1, Study Pond #1.—Study Pond #1 is a classic limesink depression, a gently inclined basin with slopes of < 5˚ leading to two small, circular potholes in the center (Fig. 3). It is located on the west side of U. S. Highway 319 about 0.2 mi. south of its junction with Florida Road 61 in the NW1/4 of the SW1/4 of Section 35, T1S, R1W in the Apalachicola National Forest (see Means et al. 1994a). The basin is aligned in a NE-SW direction with the slightly larger of the two potholes to the NE (Pothole #1). The vegetation in the depression is largely governed by fluctuating water levels, so that the treeless part of the basin is about 1100 feet (338 M) in circumference. The area of a circle with such a circumference is about 0.9 ha. The treeless portion of the limesink depression is approximately circular, or slightly oblong in the NE-SW direction (Fig. 3). Its area is probably only slightly less than 0.9 ha, or about 0.8 ha. The soil along the upper margin of the basin is bare sand or the ground is only sparsely vegetated with

different zones of low, sparse groundcover consisting of tennis-ball-sized clumps Small's Bogbutton (*Lachnocaulon minus*), scattered clumps of broomsedge (*Andropogon* sp.), ans assorted other herbs.

Fig. 3. Aerial photograph of Study Pond #1 on the west side of US Highway 319. Note the two potholes aligned SW-NE.

The two potholes in the center of the depression hold water long enough to have deep beds of peat and support wetland vegetation. In Pothole #1 no hard substrate was detected by pushing a 2-m rod into the peat. Most significantly, a zone of buttonbush (*Cephalanthus occidentalis*) surrounds both potholes, downslope of which the gradient steepens slightly and where both potholes are open-water for several months after filling. However, when water levels are stable for several months, smartweed (*Polygonum hydropiperoides*) can be seen choking the surface around the edges of the open-water zones of both ponds. When the potholes have held water for several months, one or two submersed species float to just under the water's surface in the deeper parts of the ponds. The pond edge rises and recedes though the buttonbush zone, so that the diameter of the fluctuating pond edges is too dynamic to assign a meaningful measure. However, the edge of the buttonbush zone has been quite stable over the past decade, so it was used to estimate the average size of the potholes. Pothole #1 (NE) is 240 ft (74 m) in

circumference, or about 0.04 ha in area. Pothole #2 (SW) is 200 ft (m) in circumference, or about 0.03 ha in area.

The inner edges of the two potholes lie ~27 ft (8.3 m) apart and are separated by a low, sandy ridge that is ~4.5 ft (1.4 m) above the bed of Pothole #1, and ~3.5 ft (1.1 m) above the bed of Pothole #2. This means that Pothole #2 is ~12 inches (0.3 m) higher than the bed of Pothole #1, which is born out when the ponds dry down because Pothole #2 dries first and Pothole #1 has a substantially longer hydroperiod.

The northeast, north, northwest, and southwest sides of the drift fence face a zone of 20-50 yards of gently rising terrain with a mesic forest of longleaf pines and a dense shrubby growth of *Vaccinium arboreum* and *V. darrowi*. Beyond, the land rises more steeply into a second-growth longleaf pine/wiregrass/turkey oak sandhill habitat, the pines having been clear-cut in the 1930s. The southeast side of the drift fence lies adjacent to a major two-lane federal highway. Until 2004, a narrow forested zone about 30 feet (9 m) wide separated the limesink depression from the grassy road shoulder. After 2004, the highway was widened and a three-foot-high, vertical, concrete barrier was placed parallel with the road. A 20-foot wide strip of mowed road shoulder lies between the concrete barrier and the 30-feet wide forested strip.

An approximate 1,000-ft long drift fence was buried on edge about 10 cm in the ground around the inside of the limesink depression of Study Pond #1. The fencing was the standard black plastic silt-fence used to prevent sedimentation in wetlands during road construction, about 36 inches high and supported by 1"X 1" upright wooden rods to which it is tacked. Thirty-three pairs of 5-gallon plastic buckets were buried flush with the ground surface on each side of the fence about every 30 feet (10 m). A unique number was spray painted over each bucket so that immigrating individuals dropped into odd-numbered buckets and emigrating individuals dropped into even-numbered ones.

Weather data were monitored with a min-max thermometer and a rain gage placed within 20 feet of the fence. Water depth of Pothole #1 in the middle of the limesink depression was monitored by driving a white, one-inch diameter, PVC pipe into the deepest part of the pond, and measuring the water column above the top of the pond-bottom sediments. The PVC pipe was graduated with bold black centimeter marks for viewing from a distance. Later, in 2002, a standard 2-meter tall, graduated (in cm) gage was placed next to the old PVC-pipe gage.

Drift fence buckets were checked for animals every two days throughout the year except that if heavy rains fell the fence was checked daily. All animals (especially the amphibians and reptiles) were removed from each bucket and released on the opposite side of the fence, under the assumption that an animal had been moving in that direction when intercepted by the bucket into which it fell. Four to six inches of water were maintained in the buckets to aid the amphibians and reptiles in resisting desiccation.

The drift fence was operated for ten years until 11 May 2005 when it was decided to remove the drift fence to insure that it was not responsible for severely reduced Striped

Newt and Common Newt immigration. Following the drift fence removal, newt and other pond-inhabiting vertebrates were monitored over the next two years by dipnetting.

Project 2, Sampling 265 Ponds.--Following methodology established in Means et al. (1994a,b), ponds were found by inspecting USGS topographic quadrangles and Florida Department of Transportation aerial photographs, then reached by means of a four-wheel drive vehicle or on foot. Some ponds were discovered by simple field reconaissance. Ponds were sampled in a standard fashion by 50 to 200 sweeps of a 24 X 46-cm dipnet (1 mm X 1 mm mesh) until we sampled and measured either ten newts or made 50 or more sweeps of the dipnet. Some ponds were seined using a 4' X 10' net with 1/4-inch mesh.

Tail length and snout-vent length (snout to the posterior angle of the vent) of live newts and larvae were measured in the field with a clear plastic ruler to the nearest mm, and in preserved specimens in the laboratory by means of a Helios dial caliper to the nearest 0.1 mm. Larvae were preserved within about two hours in 10% formalin.

Results—Project 1

12-year Rainfall and Pond Depth Trends.—Means (2001) reported that Study Pond #1 was never dry in the first three years (1995-1998) of drift fence operation. In the spring of 1999, the pond went dry and remained dry for 16 months until September 2000 (Fig. 4, 5). Over the next year (the sixth year, 2000-2001), Study Pond #1 dried out completely three times after three short bouts of filling, but filled quickly following heavy rains at the end of the reporting period in August 2001 (Fig. 6). For the next 4 years (2001-2005), the pond went dry briefly in late summer of 2002 but retained water until May 2006. During this period of continuous water, breeding activity of all the animals utilizing Study Pond 1 was expected to resume (Fig 6). Unfortunately, the breeding activity of two species, the Striped Newt and Common Newt, did not recover following the 16-month dry period (Table 2). The drift fence was removed and drift-fencing operations were ceased in the 10^{th} year. This was done in case the drift fence operation, itself, was responsible for reduced newt immigration. In years 11 and 12 (2005-2007), Study Pond 1 retained water throughout 2005 (Fig. 6) but went dry in May of 2006 and remained dry until late December 2006.

Following the removal of the drift fence, Study Pond 1 went dry again in the spring of 2006 and remained dry for 7-8 months until the end of Project 1 in December 2006. A rainfall deficit has been recorded at the Tallahassee Airport for six of the past 8 years, beginning with the 16-month drought of 1999 (Figs. 5,6). This is the longest and most severe drought ever recorded in the local area since records have been kept dating from the late 1800s.

October 1994

December 1999

September 2003

August 2006

Figure 4. Study Pond #1 showing extremes of its hydrological cycle. The high water level of October 1994 followed the passage of 3 tropical storms and produced the highest water levels in rivers, lakes, and ponds in local recorded history.

Table 2. Observations of water levels in Study Ponds in years 11 - 12 (2005-2007).

Date	Pond water level
02/23/05	SP 1, nearly dry, pond only 20' X 25', 30 cm deep; DBM-3232
05/7-06/08/05	Dipnet all newt ponds, Study Pond 1: 20 cm, water levels average, RCM
02/01-03/15/06	Dipnet 285 ponds survey; water levels average at first, going down fast in March
03/14/06	SP 1, 90 cm, predaceous odonate larvae hugely abundant, no tadpoles
04/29/06	SP 6 going dry—very low! DBM-3307
05/06	A severe dry period begins in April; many ponds dry by the end of the May
07/6-7/06	Dipnet all newt ponds: most are dry! DBM-3318 to -3335
07/07/06	SP 1 bone dry, was dry for ~ 1 mo previously; DBM-3326
08/01/06	SP 1 bone dry; shoved pole 2 m down, no sandy bottom; DBM-3338
08/1-2/06	Dipnet all newt ponds: most bone dry
01/27/07	SP 1, 90 cm, *Rana capito* tads present; DBM-3379
03/12-03/14/07	Dipnet all newt ponds: water at average levels, but going down

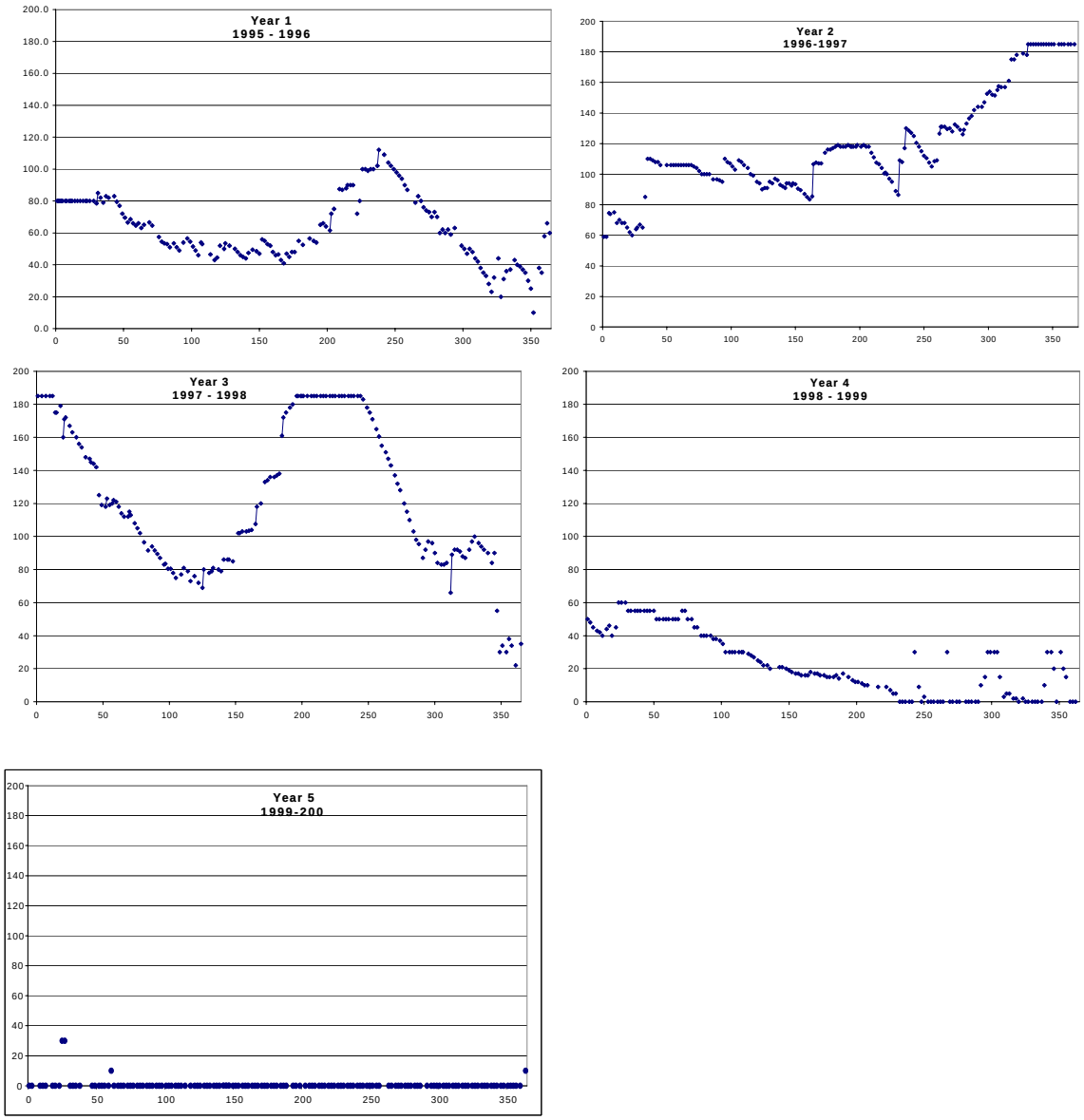


Fig. 5. Water depth of Study Pond 1, first 5 years (1995-2000).

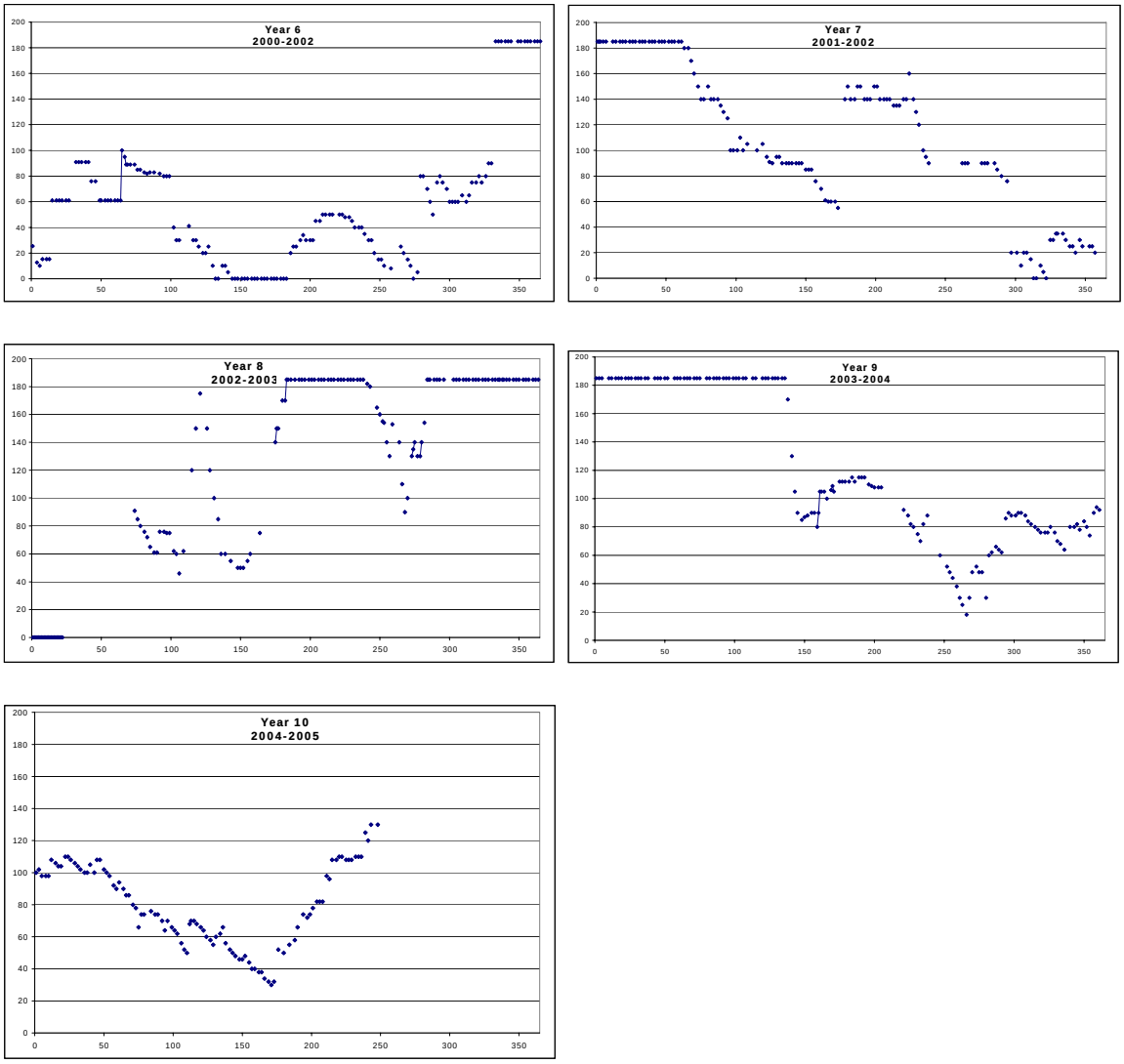
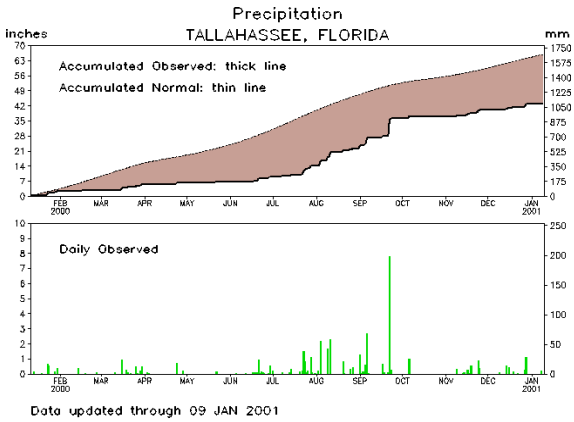
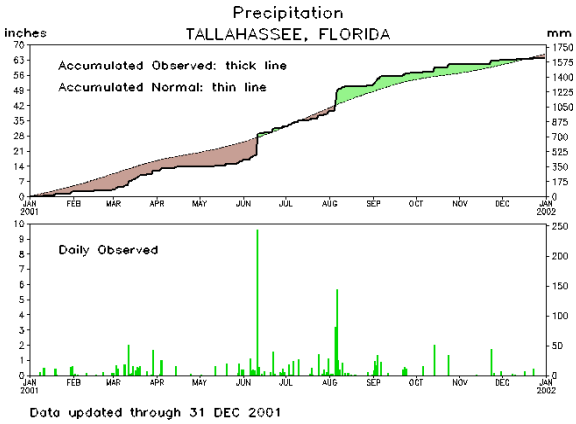
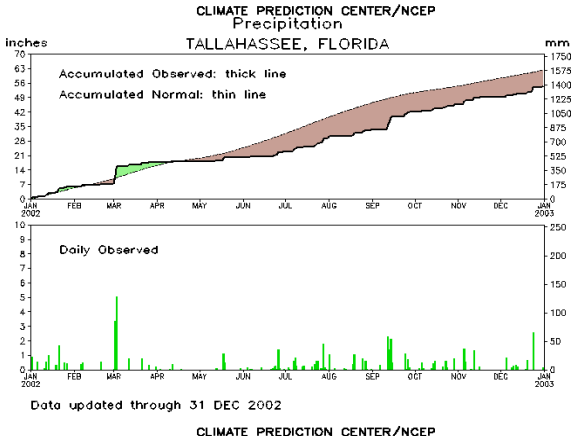
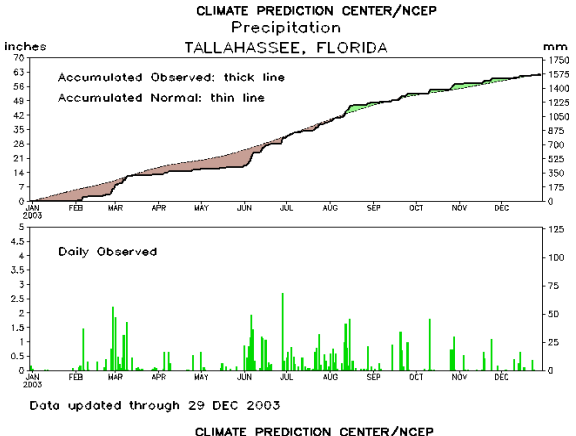


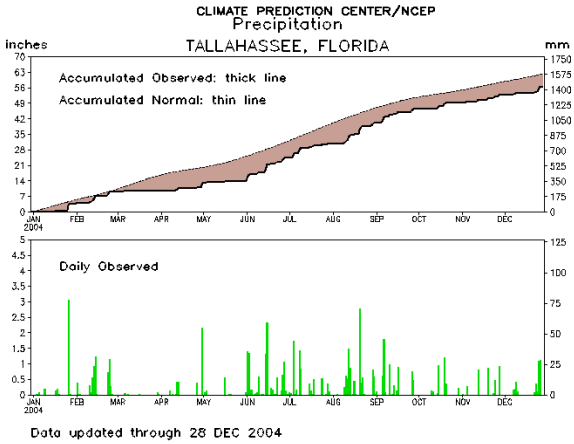
Fig. 6. Water depth of Study Pond 1, second 5 years (2000-2005).

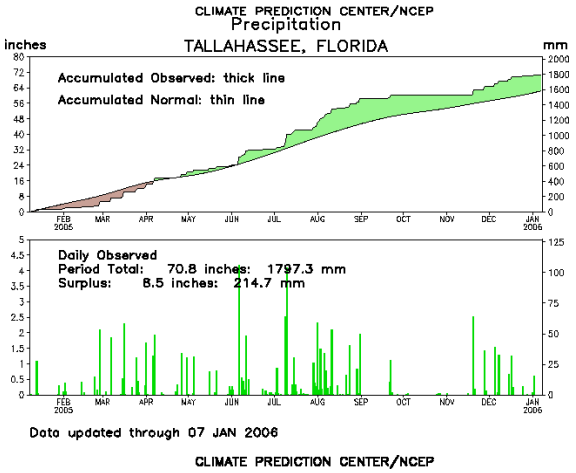












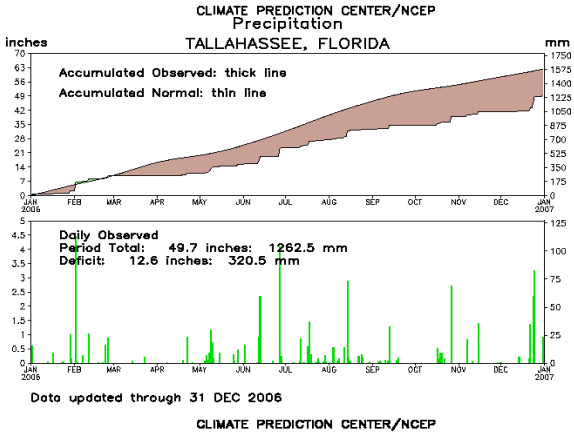


Fig.7.—Rainfall trends for Tallahassee, FL, 2000 – 2006, produced by the US National Weather Service. Overall, for the 7-year period, the region has experienced a severe rainfall deficit (brown area under the accumulated normal lines) compared with 1961-1999.

Status of the Striped Newt, Gopher Frog, and Other Vertebrates in Study Pond #1.—Prior to erecting the drift fence around Study Pond #1, adults, larvae, or neotenes of the Striped Newt were dipnetted 96 times in 121 attempts between 1966 and 8 September 1995, when the drift fence began operation. During the three-year period of this report, 24 Febuary 2004 to 30 March 2007, only one Striped Newt was intercepted going in to the pond by the drift fence (Appendix I) or by dipnetting during 5 of 7 attempts at favorable times of the year—when the pond held water (Table 3). Striped Newt larvae are easily dipnetted from Study Pond 1 beginning in April and, if water remains in the pond, through the following April as neotenes before they metamorphose (Means et al. 1994). The Striped Newt has not been observed at Study Pond 1 since 2004, in spite of a good hydroperiod in 2005. Dipnetting in 2006 and midwinter of 2007 did not turn up any adults or larvae. Because only 7 adults and no larvae or metamorphs were recorded in the past 8 years, the species would seem to be extirpated from study Pond 1.

On the other hand, other species have been making a comeback since 1999-2000. The Mole Salamander, Leopard Frog, and Gopher Frog bred in Study Pond 1 following heavy rains in late December 2006 and early January 2007 (Table 4). Three Common Newt gravid females were dipnetted, but no Striped Newts. It is possible that these species will be able to make it to metamorphosis by the end of April, 2007, but there has been almost no rainfall in the six weeks following the rains that filled Study Pond 1. Moreover, April and May are normally a period of low rainfall. If the lack of rain continues, the reproduction of these species for 2007 will be unsuccessful.

Table 3. Total numbers of individuals during immigration into (IN) and emigration (OUT) of Study Pond #1, by year from 1995 - 2005, for selected species of amphibians.

Year	*Ambystoma talpoideum*		*Notophthalmus perstriatus*		*Notophthalmus viridescens*	
	IN	OUT	IN	OUT	IN	OUT
1: 1995-1996	595	6376	73	168	111	536
2: 1996-1997	718	556	91	10	149	26
3: 1997-1998	675	690	77	419	55	467
4: 1998-1999	29	323	79	1106	241	2547
5: 1999-2000	1	0	0	0	17	0
6: 2000-2001	543	171	5	0	16	11
7: 2001-2002	34	36	1	0	1	1
8: 2002-2003	26	122	0	0	15	8
9: 2003-2004	38	480	1	3	13	13
10: 2004-2005	34	18	0	0	4	15

Table 4. Amphibian presence in Study Pond 1 during dipnetting surveys after closure of the drift fence, 05/1/05 – 03/31/07.

Species	5/17/05	2/15/06	3/14/06	7/07/06	8/01/06	1/27/07	3/12/07
Ambystoma talpoideum	0	0	0	dry	dry	0	10s
Notophthalmus perstriatus	0	0	0	"	"	0	0
Notophthalmus viridescens	0	4	15	"	"	0	3
Pseudacris ornata	0	0	0	"	"	0	1
Rana capito	0	0	0	"	"	10s	100s
Rana sphenocephala	10s	0	0	"	"	100s	1000s

Discussion, Project 1, Study Pond 1.—For 6 years following the drying of Study Pond 1 in May 1999, no breeding of the Striped Newt took place (Table 3). Likewise, although 1-17 Common Newts went into Study Pond 1 during these years, only adults emerged again and no larvae were produced (Table 3). In the following two years, no Striped Newts were dipnetted from Study Pond 1. However, one breeding adult and 15 neotenic Common Newts were dipnetted, which is evidence that the Common Newt successfully bred in the previous year, February and March, 2005.

Another salamander, the Mole Salamander (*Ambystoma talpoideum*), did not produce larvae in years 5, 6 and 7 but did produce metamorphs in years 8 and 9 (Table 3). No larvae were dipnetted in years 10 and 11, but it is probable that the Mole Salamander had a successful emergence of metamorphs in 2005 following closure of the drift fence on May 11th in spite of no larvae having been dipnetted on 17 May 2005 (Table 4). Likewise, no Mole Salamander larvae were dipnetted on 2/15/06 and 03/14/06, a rather strange result considering that there was water in the pond. Interestingly, following the nine-month drought in 2006, young Mole Salamander larvae appeared less than two months later following heavy rains that filled the pond in late December and early January. The Mole Salamander is the most productive and successful salamander in the Munson Sandhills (Tables 3, 5).

When the 2006 nine-month drought broke in late December and early January 2007, the Gopher and Leopard frogs bred and their larvae were dipetted in abundance in late January and mid-March (Table 4).

Results, Project 2

Status of Striped Newt, Gopher Frog, other Vertebrates in the Munson Sandhills.—Seven species of winter-breeding amphibians have larvae that remain in ponds for many months, provided that the ponds retain water (Table 5). Other winter-breeders were not included because they are less likely to be sampled; they can climb out of the drift fence (e.g. Spring Peeper) or spend most of their lives close to the pond edge (e.g. Florida Chorus Frog).

From 153 ponds sampled between 1995 and 2007, seven species were encountered according to the following ranking: Leopard Frog (114), Ornate Chorus Frog (86), Mole Salamander (72), Gopher Frog (49), Common Newt (34), Dwarf Salamander (28), Striped Newt (18). All of the Striped Newt occurrences were found before the severe drought of 1999-2000. In hundreds of person-hours of sampling after the drought, especially targeting the 18 ponds in which they had previously been recorded, the Striped Newt was found only three times, twice in Study Pond 6 (03/14/06, 01/27/07), and once in Study Pond 37 (03/21/06). And while dipnetting Study Pond 1, in which successful recruitment had taken place in the first four years of the 10-year drift fencing operation (Table 3), not a single adult or larva was taken. This is in contrast with the Common Newt, whose presence in Study Pond 1 has recently recovered somewhat. On 03/14/06, 15 neotenes and adults were dipnetted. The neotenes indicated that a successful breeding had taken place a year earlier in March-April, 2005, and that sexually mature adults (both neotenes and aquatic-stage adults) had been present during the normal breeding season in 2006. Unfortunately, Study Pond 1 went dry again for six months from June-December, 2006, so that any larvae produced in 2006 probably would have died.

Table 5.—Use of Ponds by Selected Winter-breeding Amphibians in the Munson Sandhills. An X indicates that the species was recorded at least once in the pond, and most often, as larvae. Numbers are for convenience as a running sequence of the ponds utilized by each species.

Pond Number	Striped Newt	Common Newt	Gopher Frog	Leopard Frog	Ornate Chorus Frog	Mole Salamander	Dwarf Salamander
1	X	X	X	X	X	X	X
2		X	X	X	X	X	
3	X	X	X	X	X	X	
4		X		X	X	X	X
5		X	X	X		X	X
6	X	X	X	X	X	X	X
7			X	X	X	X	
9		X			X	X	
11				X		X	
12			X	X		X	
13			X	X	X	X	
14			X	X		X	X
15			X	X	X	X	X
16	X		X	X	X	X	
17			X	X	X		X
18	X		X	X	X		X
19					X		

Pond Number	Striped Newt	Common Newt	Gopher Frog	Leopard Frog	Ornate Chorus Frog	Mole Salamander	Dwarf Salamander
CONTINUED							
20	X	X	X	X	X	X	X
21			X	X	X		
22			X	X	X		
24			X	X	X	X	X
25			X	X	X	X	X
26	X	X	X	X	X	X	
27		X		X	X		
28		X		X		X	
29		X	X	X	X	X	
30			X	X	X	X	
33	X			X		X	
36				X	X		
37	X	X	X	X	X	X	X
38				X	X	X	
39					X		
40				X	X	X	X
41	X			X	X		
42	X		X	X	X	X	
43			X	X		X	X
45			X	X		X	
46		X			X	X	X
47					X		
48	X	X	X	X	X	X	
50	X	X	X	X	X	X	X
51		X	X	X	X	X	X
52		X	X	X	X	X	X
53			X	X			
54	X		X	X	X	X	
55			X	X			
56			X	X		X	
57					X		X
58				X	X	X	
59					X		
60	X	X	X	X	X	X	
62					X		
64			X	X	X		
66					X		
67		X		X	X		
70				X			
71X	X	X	X	X	X		
73	X	X	X	X	X	X	
74			X				
75	X	X		X	X	X	X
81		X		X			
83		X		X			
85					X		
87			X	X		X	
88				X			
89			X	X	X		
91		X	X	X			
95	X						

Pond Number	Striped Newt	Common Newt	Gopher Frog	Leopard Frog	Ornate Chorus Frog	Mole Salamander	Dwarf Salamander
CONTINUED							
98			X				
100			X	X			
105			X		X		
108			X		X		
109			X		X		
117			X		X		
121				X			
124			X				
128				X			
129			X	X	X		
131	X			X			
134				X	X		
135			X				
136			X	X			
137				X			
138			X	X			
139				X			
141			X		X	X	
142		X	X		X		
143			X				
145			X				
147				X			
148				X			
149			X				
156				X			
158			X				
167				X			
169				X			
170			X	X			
172			X	X			
177				X	X		
178			X	X			X
181				X	X		
182				X			
183			X				
184		X	X		X		
186	X		X	X			
187		X	X		X		
188		X	X		X		
190			X				
191	X		X				
192				X			
193			X				
194			X				
195			X				
196	X	X	X				
198	X						
199			X	X		X	
200				X			
201		X	X		X		
202			X				

Pond Number	Striped Newt	Common Newt	Gopher Frog	Leopard Frog	Ornate Chorus Frog	Mole Salamander	Dwarf Salamander
CONTINUED							
203		X	X		X		
204			X				
205			X				
207				X	X	X	
208			X		X		
209	X		X		X		
211			X			X	
212					X		
213			X				
216			X				
218			X				
219			X	X	X		
220				X			
221			X	X	X		
228			X		X	X	
232			X			X	
238			X				
239			X				
244				X			
246			X		X		
247				X	X		
248				X			
249			X				
250	X						
251		X	X	X	X		
252			X	X			
253	X		X	X	X		
260			X		X		
263			X				
264			X	X	X		
265			X				
266		X			X		
267					X		
272						X	
∑∑ = 153	18	34	49	114	86	72	28

Discussion, Project 2.—The drought of 1999, followed by a long-term, persistent drought over the next 8 years, has affected the Striped Newt throughout the Munson Sandhills. Larvae of the Striped Newt, the best indicators of successful breeding (but not of successful recruitment into the terrestrial population), have not been found after 1999 in any of the 18 known ponds in which adults or larvae were found prior to the drought. Moreover, only a few adults have been found in any of the 18 ponds during the breeding season when adults are found in ponds.

Pond-breeding amphibians are well known for erratic breeding (Pechmann et al. 1991) but dipnetting of temporary ponds in the past two years has revealed that all the other species have been recovering from the drought (Table 4). The Gopher Frog,

especially, seems to have bred successfully, even recently. But the most significant result of this study is not being able to document any breeding of the Striped Newt, or even to find any adults in breeding ponds. Eight years is a long time for animals not to breed, even in ephemeral environments such as temporary ponds.

Overall Discussion

By the very ephemeral nature of their natal habitats, temporary pond-breeding vertebrates must be able to survive droughts. None of the 26 or more species that utilize the temporary ponds of the Munson Sandhills are aquatic throughout their lives. In fact, most of them spend, by far, the longest periods of their lives living in the adjacent longleaf pine uplands. Longevity, then, becomes a very important life history characteristic of these animals (Table 6). Most of the temporary-pond-breeding vertebrates of the Munson Sandhills do, indeed, live a long time. This is necessary to survive the long periods of unsuitable pond conditions. It is, after all, only necessary to get one offspring into the next generation in order to perpetuate the genes of one individual. Whether it takes one year or 20 makes little difference in the long term.

Following the severe drought of 1999-2000, all of the species known to breed in Munson Sandhills ponds and in Study Pond 1, with the exception of the Striped Newt, were found to have had successful breeding episodes when water was present in their normal breeding seasons. The Striped Newt, however, has not been found to breed in any of the 18 ponds in which it has been found over the years in the Munson Sandhills, even when aquatic conditions were favorable after the severe drought. In fact, only three adult specimens have been found in just two of those ponds. The lack of recovery of breeding activity in the Striped Newt cannot be due to a short life span. Snider and Bowler (1992) recorded one Striped Newt that lived almost 13 years in captivity (Table 6) and Linda LaClaire (personal communication) has kept a Striped Newt for 16 years. Among all the animals using temporary ponds in the Munson Sandhills, why has the Striped Newt, alone, not recovered? Some possible causes of the decline are discussed below.

Table 6. Longevity in captivity of some of the amphibians and reptiles that inhabit temporary ponds in the Munson Sandhills, from Snider and Bowler 1992.

Species	years	mo
Ambystoma talpoideum	3	7
Some other ambystomatids	20	6
Notophthalmus perstriatus	12	11
Notophthalmus viridescens	9	5
Some plethodontids	15-20	
Pseudacris species	2-4	
Rana capito	9	1
Rana pipiens	6	0
Scaphiopus holbrookii	12	4

Ecological succession as a possible cause of Striped Newt decline.--Study Pond #1 has been observed for more than 35 years and some dramatic changes have been noted in the limesink depression vegetation (Fig. 8). In 1970, the pond basin was dominated by grasses and forbs, with no woody component inside the 0.8-ha littoral zone (Fig. 8). As time progressed, slash pines and buttonbush (*Cephalanthus occidentalis*) slowly encroached into the basin. By 2007 the buttonbush zone had become a thick woody shrub zone around the normal water's edge of the two potholes. What impediments to movement or other effects the buttonbush shrubbery might have on the Striped Newt, if any, is unknown. The Common Newt also did not recruit new metamorphs into the adult population in the six years following the severe drought, but more adults moved in and out of the pond than the Striped Newt. Also, the Common Newt bred successfully in Study Pond 1 in the spring of 2005 because neotenes were dipnetted in March 2006. However, while neotenes might have been present in the pond, metamorphs might not have been able to emigrate from the pond into the longleaf pine uplands. Unfortunately, with the drift fence out of operation, there was no way to monitor the emigration of metamorphs.

The ecological succession that has taken place in Study Pond 1 basin was strictly due to the absence of fire sweeping through it. Buttonbush is highly sensitive to fire, which kills the plant when the duff at the base of it is burned. Likewise, young slash pines are killed by fires. Although at least 2 prescribed burns were done in the longleaf pine uplands adjacent to Study Pond 1 during the 10 years of drift fence operation, the fires did not sweep down into the basin. This was because efforts were made to prevent the silt screen drift fence from burning up.

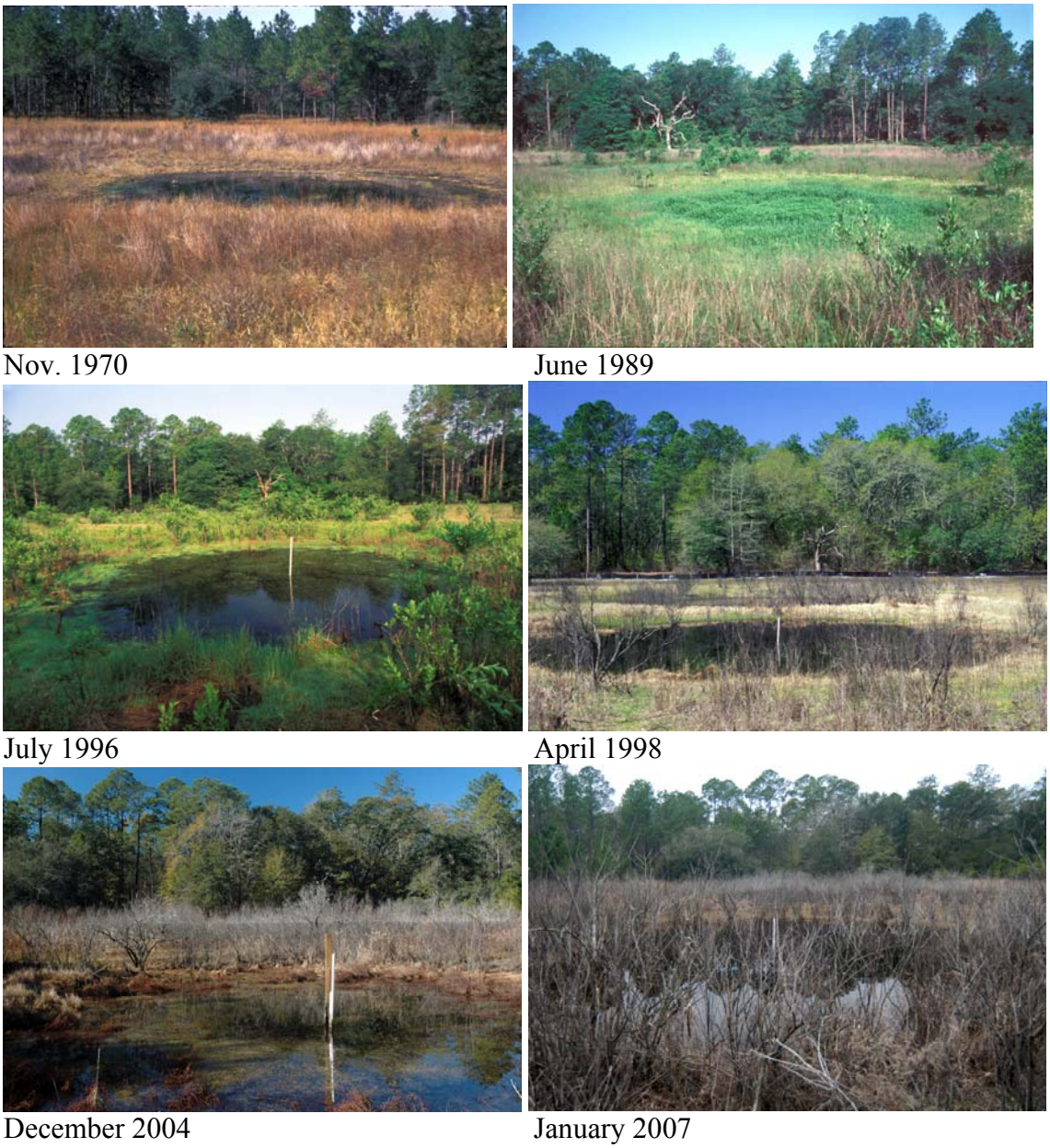


Figure 8. 37-year photographic record of Study Pond #1 showing invasion of buttonbush, *Cephalanthus occidentalis*, due to the absence of fire. The upper left image (November 1970) was photographed to the NW from the SE side of Pothole #1. All other images were taken towards the SW from the NE side of Pothole #1; note the standing dead liveoak tree in the background. The white PVC pipe in middle of Pothole #1 is a water depth gage.

Ecological succession has been taking place in the adjacent longleaf pine uplands, as well. The frequency of prescribed burns in these uplands (5+ years) is longer than the natural fire return frequency of 1-3 years (Means 1996a, Platt 1999). In the longleaf pine forest, turkey oak and other woody plants have increased in the midstory, shading the ground and changing the ecological conditions of the groundcover. This has been going on for a long time, since the clearcutting of the original old-growth longleaf pines in the 1930s. The prescribe burning regime that has been applied to the uplands surrounding

Study Pond 1 has been inadequate for restoring the open grassland savanna that once dominated the Munson Sandhills. One or two prescribe burns per decade since the 1930s has not been sufficient to restore the grassland aspect, and has allowed a hardwood midstory to develop. How this might have affected the Striped Newt and other vertebrates that live in the local sandhills is unknown. However, since both the ecological conditions of the pond basin and of the adjacent uplands have been slowly changing, ecological succession must be considered as a potential cause of Striped Newt decline.

The reduced fire-return interval over the years has enabled hardwoods (oaks, sweetgum, tree sparkleberry) to increase their presence, especially in the first 100+ feet of the tree zone surrounding the upper pond basin. The ecology of this zone has changed more dramatically than that of either the pond basin or the more distant uplands. This zone, once an open, grassy savanna, has become choked with hardwoods and the ground is now heavily shaded and deep in decomposing leaf litter. We do not know where most of the efts and terrestrial phases of the Striped Newt spend most of their lives, but if it is in this zone, then the dramatic ecological changes that have been taking place in it may be the principal reason for the Striped Newt decline.

Littoral zone destruction by off-road vehicles.—In the 12 years since the overall project began, impacts to breeding ponds have increased dramatically. The littoral zone is critically important habitat to the Striped Newt and many pond-utilizing vertebrates because it is the shallow water at the edge of ponds where most primary productivity takes place. The shallow water is warmer there and most of the pond invertebrates are concentrated there with tadpoles. It is in the shallow waters of temporary ponds where adults and larvae of the Striped Newt are mostly found, probably because that is where the prey of these carnivores is concentrated. Pond water levels are highly dynamic in response to local rainfall, or its absence, with the result that the critical littoral zone moves upslope and downslope as the volume of water in ponds waxes and wanes. Fig. 9 shows the healthy, vegetated littoral zone of Study Pond 1, and contrasts that with the bare soil conditions created by off-road vehicles (ORVs)(Fig. 9, 10). When the critical aquatic habitat of the Striped Newt lies over the bare sand, there is no cover for larvae or their invertebrate prey, making them vulnerable to wading birds. Little macrophyte primary productivity occurs in the shallow water over bare sand and the absence of rooted vegetation and presence of white sand makes insolation more severe. As a result, the critical habitat for the Striped Newt and other animals of temporary ponds in the Munson Sandhills has been severely impacted by ORV use.

Fortunately for assessing ORV impacts, but unfortunately for pond-breeding animals, study ponds are photographed on most survey rounds. Fig. 11 demonstrates how ORV presence in the littoral zone of Study Pond 6, the most important Striped Newt pond, has converted a healthy littoral zone with high primary productivity to a barren, sandy beach unsuitable for the Striped Newt. Likewise, ORV impacts have been severe in Study Pond 3 (Fig. 12). The impacts can be so severe that, in smaller, shallower ponds, the entire pond bottom can be obliterated (Fig. 13). There can be no doubt that ORV presence in temporary ponds in the Munson Sandhills is damaging to the critical aquatic habitat of the Striped Newts and ecologically negative overall, to the entire pond

Fig. 9.—Littoral zone of an undisturbed pond (Study Pond #1, top) versus ORV-impacted pond (Study Pond #4, below) on the Apalachicola National Forest during dry season. Vegetation of the fluctuating littoral zone is the critical habitat of pond larvae.

Fig. 10.--Aerial views of temporary ponds south of Tallahassee on Apalachicola National Forest. Littoral zone impacted by ORV traffic. Both photos taken November 1990.

Fig. 11.—Study Pond #6. Top photographed in May 1993, showing valuable littoral zone habitat of one of the best natural pond breeding habitats known for the Striped Newt and Gopher Frog. Middle = same view 5 years later in May 1998 with first ORV impacts. Bottom = same view in Feb. 2004 showing physical damage and nearly complete destruction of plants in the ecologically important littoral zone. Photos © D. B. Means.

Fig. 12.--Study Pond #3 (borrow pit) west of U. S. Hwy 319, a breeding pond of the Striped Newt and Gopher Frog. Top image taken May 1993 before severe ORV impacts. Bottom image taken February 2003, ten years later, showing ORV physical damage and loss of plant life in the important littoral zone. Person in top image stands where tire sits in bottom image.

Fig. 13.—Study Pond 26 showing massive ORV impacts in Apalachicola National Forest, April 1999. This is a proven breeding pond of the Striped Newt and Gopher Frog.

ecosystem. In 1994, 27 of 100 ponds were found to be damaged by off-road vehicles, including 3 of 18 Striped Newt ponds (Means et al. 1994b). By 2006, ORV impacts had been recorded for nearly every pond. In addition to a growing metropolitan human population in the nearby City of Tallahassee, demand for ORV riding areas increased tremendously in the 1990s when St. Joe Paper Company, the largest private landowner in Florida, rented out its lands to hunt clubs which immediately put locked chains across all access roads and posted the lands against any trespass.

Disease pathogens.—Dramatic declines in amphibian populations have been the subject of much attention in the scientific literature for nearly two decades (Blaustein and Wake 1990, Lannoo 2005). Most of the declines have involved frogs and, although many declines are due to habitat loss or overexploitation, other, unidentified processes threaten almost 50% of the rapidly declining species (Stuart et al. 2004). Declines due to

unidentified processes are called "enigmatic amphibian declines" because no obvious causative agent has been recognized. One of the most pernicious potential causes is disease pathogens, some of which have been identified recently as viruses, bacteria, and especially a chytrid fungus (Daszak et al. 1999, 2003). Mass mortality and population declines due to chytridiomycosis have been reported from North, South, and Central America, Australia, Europe, New Zealand, and Africa (Daszak 2003). Until the conclusion of this FDOT contract, there was little reason to expect that an enigmatic decline has taken place in the Striped Newt because catastrophic reproductive failure is common in pond breeding salamanders (Taylor et al. 2005). However, the 12-year study clearly demonstrated that in the first four years when water was present in Study Pond 1, the Striped Newt bred every year and successfully brought off metamorphs, and yet in the past 8 years there has been no evidence that reproduction has taken place in any of 18 potential breeding ponds. While some amphibian declines elsewhere in the southeastern US have been attributed to climate and not chytridiomycosis (Daszak et al. 2005), others are as yet unexplained (Dodd 1998, Means and Travis 2007). It would seem better to err on the side of caution and assume that something unusual is happening to the Striped Newt…that it is experiencing an enigmatic decline, the cause of which urgently needs determination.

Striped Newt decline may have been underway for decades.—Mention must be made of the possibility that the Striped Newt has been declining in the western part of its range for a long time. A number of facts can be marshaled in support of this hypothesis. First, is the present-day apparent isolation of the Munson Sandhills populations. Although Striped Newt temporary ponds suitable for breeding exist in the Gulf Coastal Lowlands east of the Munson Sandhills, no surviving Striped Newt populations are known east of the Munson Sandhills. To the south, suitable breeding ponds exist between the Munson Sandhills and the Gulf of Mexico because Campbell and Christman (1982) collected specimens by drift fences around ponds on the Panacea Unit of the St. Marks National Wildlife Refuge. Also, Paul Moler (personal communication) in 1971 found an eft of a Striped Newt crossing FH-13, a road in Wakulla County between the St. Marks NWR and Munson Sandhills sites. Despite drift fencing efforts made by herpetologists to re-confirm the presence of these populations in the past decade (Ken Dodd, unpublished), no Striped Newts have been found in either place again.

A disjunct population recently has been recorded in the Dougherty Plain of SW Georgia (LaClaire et al. 1995). It would seem reasonable that the Munson Sandhills populations could have been connected with the SW Georgia populations among breeding ponds in the Tallahassee Red Hills/Tifton Uplands. As a test of this hypothesis, the striped Newt once did exist the Tallahassee Red Hills (Means and Means 1998). The species was collected from a suitable pond in northern Leon County in 1971, but the pond was deepened and fish introduced into it, thus eliminating the Striped Newt (Means and Means 1998). Other records exist in museum collections from water bodies along Meridian Road north of Tallahassee and from Lake Miccosukee, both in the Red Hills. Since these records have not been reconfirmed, they are considered in doubt.

There are obvious reasons why the Striped Newt may be extirpated from at least two of these areas. East of the Munson Sandhills, the newt's longleaf pine terrestrial

habitat has been long ago converted to slash pine or sand pine plantations and completely rendered unsuitable for the salamander (Means and Means 1998, Means 2005). North of the Munson Sandhills, the same is true except that the agent of habitat destruction is agriculture, urban development, and suburban expansion of the City of Tallahassee. South of the Munson Sandhills, the upland habitat is second-growth longleaf pine savanna on both the Apalachicola National Forest and the St. Marks National Wildlife Refuge. Just as one would not expect the Munson Sandhills population of the Striped Newt to decline because its longleaf pine habitat is present, similar longleaf pine habitat persists on the St. Marks National Wildlife Refuge and in flatwoods along FH-13, which is in the Apalachicola National Forest just as where the newt has been recorded in 18 ponds in the Munson Sandhills. Although the longleaf pine ecosystem may be present in these places, it might not be in the ecological condition favored by the newt.

Aside from a disease pathogen, the one explanation that fits all these situations is habitat loss and alteration or degradation. In the western Munson Sandhills, where the longleaf pine ecosystem still exists, one would expect the Striped Newt to persist as does the Common Newt, Gopher Frog, and other pond-breeding amphibians. Unless a disease is responsible, the only other potential cause for its decline in what appears to be suitable habitat is that the habitat is becoming unsuitable. The Striped Newt could be extremely sensitive to slow ecological changes that have occurred—and are occurring—in response to an altered fire regime.

Recommendations

Because the 18 ponds in the Munson Sandhills from which the Striped Newt has been recorded are one of, if not the largest known, potentially connected, metapopulation of the Striped Newt, it is imperative that these ponds continue to be monitored for Striped Newt survival and reproduction. Aquatic stage, breeding adults have been found in December through April and larvae are normally found from April through November (Means et al. 1994a). Neotenes are found in ponds from November through April. A monitoring regime utilizing dipnetting should include sampling for breeding adults and neotenes in January – April, then a vigorous dipnetting survey for larvae in April – July. This depends, of course, on whether ponds have water.

Another very important and urgent study should be conducted to assess the presence of a chytrid fungus or other disease pathogens in museum specimens, and in living specimens.

The US Forest Service should make it a high priority to prescribe burn the longleaf pine uplands of the Munson Sandhills, especially around the 18 known Striped Newt ponds, on a short fire-return interval of one to three years. This should be instituted immediately and continued indefinitely in order to suppress the turkey oak/blackjack oak/bluejack oak hardwood midstory that has grown up in the longleaf pine uplands and the hardwood trees that are growing up around the upper margins of temporary ponds (including sand liveoak, water oak, laurel oak, sweetgum, tree sparkleberry, and others).

It is also important to insure that the pond basins be prescribe burned to eliminate woody species such as young pines, buttonbush, and hypericums and return the basins to a herbaceous flora.

A study to determine exactly where in the uplands the efts and adult metamorphed newts spend most of their time is crucial to understanding whether it is the upland component of the life history (Marsh and Trenham 2001) that is the Achilles heel in the survival of the Munson Sandhills metapopulation. This would be true if most of the Striped Newts lived in the zone of the first ring of forest vegetation around ponds, a ring of moister soils that hardwoods are changing from a groundcover dominated by a rich and open, herbaceous flora to one choked with dead litter and heavily shaded.

Acknowledgments

This study was initiated by the volunteer field work of David Printiss and Tom Ostertag who dipnetted the first 100 ponds on the Apalachicola National Forest (Means et al. 1994a, b). David Printiss constructed the 300-m drift fence around Study Pond #1 and checked the drop buckets for 5 months. Ryan C. Means checked the drop buckets for 17 months, constructed and ran the four upland drift fences, resurveyed ponds #1 – 100 twice, and dipnetted and seined ponds #101 - 265 (Means and Means 2001). Jim Eggert checked the drop buckets for 7 years. Other individuals who assisted the Principal Investigator in checking the drop buckets were Lilly Stinson, Angie Printiss, Kathy Steinheimer, Rebecca Meegan, and Tim Andrus.

Ryan C. Means set up rain gages and water level measuring devices in 25 ponds in the Munson Sandhills and ran the "pond water check" route every other day for 9 months. The pond water check route was run once a week for 12 months by Trisha Spears.

This study was initiated by volunteer field work in 1993 and 1994 during which period travel costs were funded by two small grants from the U. S. Fish and Wildlife Service. Over the next two years (1995-1997) the study was supported by a Challenge Cost-share Grant between the Apalachicola National Forest and the Coastal Plains Institute and Land Conservancy. In the past ten years, 1997-2007, the project was funded by contracts from the Florida Department of Transportation to principal investigators, D. Bruce Means and Joe Travis, in the Department of Biological Science, Florida State University. Miscellaneous funds for this long-term project were also provided by the Coastal Plains Institute and Land Conservancy.

Numerous individuals have helped and promoted this project. I thank Linda LaClaire for making it possible to replace the drift fence in its 7th year and for continued monitoring of the local populations of amphibians and reptiles that use Study Pond #1 during a transitional year when other funds were not available. I thank Andy Colaninno and Jim Ruhl of the Apalachicola National Forest, and Gary Evink and David Zeigler of the Florida Department of Transportation for their encouragement and assistance.

Literature

Ashton, R. E., Jr. and P. S. Ashton. 1988. Handbook of amphibians and reptiles of Florida. Part III. The amphibians. Windward Publ., Inc., Miami, FL. 191 p.

Bishop, S. C. 1941. Notes on salamanders with descriptions of several new forms. Occasional Papers of the Museum of Zoology, University of Michigan 451:1-21.

Bishop, S. C. 1943. Handbook of salamanders. Comstock Publ., Co., Inc. Ithaca, N. Y. 555p.

Blaustein, A.R. and D.B. Wake. 1990. Declining amphibian populations: a global phenomenon? Trends in Ecology and Evolution **5**:203-204.

Brooks, H. Kelly. 1981. Physiographic divisions, state of Florida. Inst. Food and Agr. Serv., Univ. Florida. Map.

Burke, V. J. and J. W. Gibbons. 1995. Terrestrial buffer zones and wetland conservation: A case study of freshwater turtles in a Carolina Bay. Conservation Biology 9(6):1365-1369.

Campbell, H. W. and S. P. Christman. 1982. The herpetological components of Florida sandhill and sand pine scrub associations. Pp. 163-171 in Norman J. Scott, Jr., ed. Herpetological communities. U. S. Fish and Wildl. Serv., Wildl. Res. Rep. 13.

Campbell, H. W., S. P. Christman, and F. G. Thompson. 1980. Geographic distribution, *Notophthalmus perstriatus* (Striped newt). Herpetological Review 11(1):13.

Carr, Archie F., Jr. 1940. A contribution to the herpetology of Florida. Univ. Florida Publ. Biol. Sci. Ser. 3(1):1-118.

Christman, S. P. and R. Franz. 1973. Feeding habits of the striped newt, *Notophthalmus perstriatus*. J. Herp. 7:133-135.

Christman, S. P. and D. B. Means. 1992. Rare Striped Newt. Pages 62-65 *in* Paul E. Moler, ed. Rare and endangered biota of Florida. Volume III. Amphibians and Reptiles. University Presses of Florida, Gainesville. 291 pages.

Conant, R., and J. T. Collins. 1998. A field guide to reptiles and amphibians: Eastern and central North America. 3rd ed., expanded. Houghton Mifflin, Boston.

Daszak, P., L. Berger, A. A. Cunningham, A. D. Hyatt, D. E. Green, and R. Speare. 1999. Emerging infectious diseases and amphibian populations declines. Emerging Infectious Diseases5:735-748.

Daszak, P., A. A. Cunningham, and A. D. Hyatt. 2003. Infectious disease and amphibian population declines. Diversity and Distributions 9:141-150.

Daszak, P., D. E. Scott, A. M. Kilpatrick, C. Faggioni, J. W. Gibbons, and D. Porter. 2005. Amphibian population declines at Savannah River Site are linked to climate, not chytridiomycosis. Ecology 86(12):3232-3237.

Dodd, C. K., Jr. 1992. Biological diversity of a temporary pond herpetofauna in north Florida sandhills. Biodiversity and Conservation 1:125-142.

Dodd, C. K., Jr. 1993a. Distribution of striped newts (*Notophthalmus perstriatus*) in Georgia. Report to the U. S. Fish and Widlife Service, Jacksonville, Florida. 52 pp.

Dodd, C. K., Jr. 1993b. The cost of living in an unpredictable environment: the ecology of striped newts *Notophthalmus perstriatus* during a prolonged drought. Copeia 1993(3):605-614.

Dodd, C. K., Jr. 1994. Drift fences encircling breeding sites. Pages 125-130 in W. R.

Heyer, M. A. Donnelly, R. W. McDiarmid, L. Hayek, and M. S. Foster, eds. Measuring and monitoring biological diversity. Standard methods for amphibians. Smithsonian Inst. Press, Washington, D. C.

Dodd, C. K., Jr. 1996. Use of terrestrial habitats by amphibians in the sandhill uplands of north-central Florida. Alytes 14(1):42-52.

Dodd, C.K., Jr. 1998. *Desmognathus auriculatus* at Devil's Millhopper State Geological Site, Alachua County, Florida. Florida Scientist 61(1):38-45.

Dodd, C. K., Jr. and B. G. Charest. 1988. The herpetological community of temporary ponds in north Florida sandhills: species composition, temporal use, and management implications. Pages 87-97 in R. C. Szaro, K. E. Severson, and D. R. Patton, tech. coords. Proc. Symp. Management of reptiles, amphibians, and small mammals in North America. U. S. For. Serv. Gen. Tech. Rep. RM-166.

Franz, R. 1991. Remember the drought? Florida Wildlife 45(6):10-12.

Franz, R. and L. L. Smith. 1994. Distribution and status of the striped newt and Florida gopher frog in peninsular Florida. Final Report of Project NG90-035 submitted to the Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program.

Franz, R., C. K. Dodd, Jr., and C. Jones. 1988. Life history notes: *Rana areolata aesopus* (Florida gopher frog). Movement. Herpetol. Rev. 19:33.

Godley, J. S. 1992. Threatened gopher frog. Pages 15-19 *in* P. E. Moler, ed. Rare and endangered biota of Florida. Volume III. Amphibians and Reptiles. University Presses of Florida, Gainesville.

Grogan, W. L., Jr. and D. Bystrak. 1973. Longevity and size records for the newts *Notophthalmus perstriatus* and *Notophthalmus v. viridescens*. Hiss News-Journal 1(2):54.

Harris, L. D. 1984. Bottomland hardwoods: Valuable, vanishing, vulnerable. Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.

Hendry, C. W., Jr. and C. R. Sproul. 1966. Geology and ground-water resources of Leon County, Florida. Florida Geological Survey Bulletin 47. Tallahassee, Florida.

Iverson, J. B. and C. R. Etchburger. 1989. The distributions of the turtles of Florida. Florida Scientist, Biological Sciences 52(2):119-144.

Jensen, J. B., J. G. Palis, and M. A. Bailey. 1995. *Rana capito sevosa* (Dusky gopher frog). Submerged vocalization. Life History Notes. Herpetological Review 26(2):98.

Johnson, S. A. 2002. Life history of the striped newt at a north-central Florida breeding pond. Southeastern Naturalist 1(4):381-402.

Kartesz, J. T. 1992. Preliminary counts for native vascular plant species of U. S. states and Canadian Provinces. Biodiversity Network News 5(3):6. The Nature Conservancy.

Kiester, A. R. 1971. Species density of North American amphibians and reptiles. Systematic Zoology 20:127-137.

LaClaire, L. V. 1992. Ecology of temporary ponds in north central Florida. M. S. thesis, University of Florida, Gainesville.

LaClaire, L. V. and R. Franz. 1990. Importance of isolated wetlands in upland landscapes. Pages 9-15 *in* M. Kelly, ed. Proc. 2nd Annual Meetings of the Florida Lake Management Society, Winter Haven, FL.

LaClaire, L.V., R. N. Smith, S. Smith, S., J. Palis. 1995. *Notophthalmus perstriatus*,

Herpetological Review (26):2.
Lannoo, M., ed. 2005. Amphibian declines, the conservation status of United States species. University of California Press, Berkeley, CA. 1094 pp.
Little, E. L., Jr. 1978. Atlas of United States trees, Vol. 5. Florida. United States Department of Agriculture Forest Service Miscellaneous Publication No. 1361.
Marsh, D. M. and P. C. Trenham. 2001. Metapopulation dynamics and amphibian conservation. Conservation Biology 15(1):40-49.
Means, D. B. 1990. Temporary ponds. Florida Wildlife 44(6):12-16.
Means, D. B. 1991. River bottomlands. Florida Wildlife 45(1):11-16.
Means, D. B. 1996a. Chapter 15. Longleaf pine forest, going, going.... Pages 210--229 *in* M. B. Davis, ed. Eastern old-growth forest: Prospects for rediscovery and recovery. Island Press, Washington, D. C.
Means, D. B. 1996b. A preliminary consideration of highway impacts on herpetofauna inhabiting small isolated wetlands in the southeastern U.S. Coastal Plain. Pages 1-11 in G. L. Evink, P. Garrett, D. Zeigler, and J. Berry, eds. Trends in addressing transportation related wildlife mortality. Proceedings of the Transportation Related Wildlife Mortality Seminar, 30 April-2 May, 1996, Orlando, FL. Florida Department of Transporation, Tallahassee, FL.
Means, D. B. 1999. The Effects of Highway Mortality on Four Species of Amphibians at a Small, Temporary Pond in Northern Florida. Pages 125-128 *in* G. Evink, P. Garrett, and D. Zeigler, eds. Proceedings of the Third International Conference on Wildlife Ecology and Transportation, September 13-16, 1999. Missoula, Montana.
Means, D. B. 2001a. Reducing impacts on rare vertebrates that require small isolated water bodies along U. S. Highway 319. Final Report to the Florida Department of Transportation. September 2001. 148 pages.
Means, D. B. 2001b. The value of dead tree bases and stumpholes as habitat for wildlife. Chapter 9. Pages 74-78 *in* Walter E. Meshaka, Jr. and Kimberly J. Babbitt, Eds. Amphibians and Reptiles Status and Conservation in Florida. Krieger Publishing Company, Malabar, Florida. 318 pp.
Means, D. B. 2005. Chapter 21. Pine silviculture. Pages 139-145 *in* Michael Lanoo, ed. Amphibian declines: The conservation status of United States species. University of California Press, Berkeley, CA. 1094 pp.
Means, D. B. 2006. Vertebrate faunal diversity in longleaf pine savannas. Chapter 6. Pages 157-213 *in* S. Jose, E. Jokela, and D. Miller (eds.). Longleaf pine ecosystems: Ecology, management, and restoration. Springer-Verlag, New York.
Means, D. B. and G. O. Grow. 1985. The endangered longleaf pine community. ENFO, Sepetember:1-12.
Means, D. B. and J. Travis. 2007. Declines in ravine-inhabiting dusky salamanders of the southeastern US Coastal Plain. Southeastern Naturalist 6(1):83-96.
Means, D. B., T. E. Ostertag and D. Printiss. 1994. Florida populations of the striped newt, *Notophthalmus perstriatus*, west of the Suwannee River. Contributions to life history, ecology, and distribution. I. Report under contract with the U. S. Fish and Wildlife Service, Jackson, MS, 57 pages.
Means, D. B. and D. Printiss. 1996. Use of a temporary pond by amphibians and reptiles in the Munson Sandhills of the Apalachicola National Forest with special emphasis on the striped newt and gopher frog, Year 1: September 1995 - September

1996. Final report under contract with the U. S. Forest Service, National Forests in Florida, Tallahassee, FL, 38 pages.
Means, D. B. and R. C. Means. 1997. Use of a temporary pond by amphibians and reptiles in the Munson Sandhills of the Apalachicola National Forest with special emphasis on the striped newt and gopher frog, Year 2: September 1996 - September 1997. Final report under contract with the U. S. Forest Service, National Forests in Florida, Tallahassee, FL, 23 pages.
Means, D. B. and R. C. Means. 1998. Red Hills survey for breeding pond habitat of the flatwoods salamander (*Ambystoma cingulatum*), gopher frog (*Rana capito*), and striped newt (*Notophthalmus perstriatus*) in the Tallahassee Red Hills of Leon, Gadsden, and Jefferson counties, Florida, and the Tifton Uplands of Thomas and Grady counties, Georgia. Report to the U. S. Fish and Wildlife Service, Jackson, MS, 23 pages. 1998.
Means, D. B. and R. C. Means. 1998. Distribution of the striped newt (*Notophthalmus perstriatus*) and gopher frog (*Rana capito*) in the Munson Sand Hills of the Florida panhandle. Final report to the U. S. Fish and Wildlife Service, Jackson, MS, for Order No. 43910-5-0077. 42 pages.
Means, D. B. and R. C. Means. 2004. Effects of sand pine silviculture on pond-breeding amphibians in the Woodville Karst Plain of north Florida. Chapter 7. Pages 56-61 *in* Walter E. Meshaka, Jr. and Kimberly J. Babbitt, Eds. Amphibians and Reptiles Status and Conservation in Florida. Krieger Publishing Company, Malabar, Florida. 318 pp.
Means, D. B., J. G. Palis, and M. Baggett. 1996. Effects of slash pine silviculture on a Florida population of flatwoods salamander. Conservation Biology 10(2):1-13.
Means, D. B., T. E. Ostertag, and D. Printiss. 1994a. Florida populations of the striped newt, *Notophthalmus perstriatus*, west of the Suwannee River. Contributions to life history, ecology, and distribution. I. Report under contract with the U. S. Fish and Wildlife Service, Jackson, MS, 57 pages. 1994.
Means, D. B., T. E. Ostertag, and D. Printiss. 1994b. Distribution, habitat ecology, and management of the striped newt, *Notophthalmus perstriatus*, in the Apalachicola National Forest, Florida. Report under contract with the U. S. Forest Service, National Forests in Florida, Tallahassee, FL, 30 pages. 1994.
Mecham, J. S. 1967. *Notophthalmus perstriatus* (Bishop). Catalogue of American Amphibians and Reptiles: 38.1-38.2.
Mecham, J. S. and Robert E. Hellman. 1952. Notes on the larvae of two Florida salamanders. Quarterly Journal of the Florida Academy of Sciences 15(3):127-133.
Moler, P. E. and R. Franz. 1987. Wildlife values of small, isolated wetlands in the Southeastern Coastal Plain. Pages 234-241 *in* R. R. Odum, K. A. Riddleberger, and J. C. Dozier (eds.). Proceedings of the 3rd S. E. Nongame and Endangered Wildlife Symposium. Georgia Department of Natural Resources, Atlanta, GA.
Murray, G.E. 1961. Geology of the Atlantic and Gulf Coastal province of North America. Harper and Brothers, New York.
Noss, R. F., E. T. LaRoe, III, and J. M. Scott. Endangered ecosystems of the United States: a preliminary assessment of loss and degradation. U. S. Department of Interior, National Biological Survey Biological Report 28.
Pechmann, J. H. K., D. E. Scott, R. D. Semlitsch, J. P. Caldwell, L. J. Vitt, and J. W. Gibbons. 1991. Declining amphibian populations: the problem of separating human impacts from natural fluctuations. Science 253:892-895.

Platt, W. J. 1999. Southeastern pine savannas. Pages 23-51 in R. C. Anderson, J. S. Fralish, and J. M. Baskin, eds. Savannas, barrens, and rock outcrop plant communities of North America. Cambridge Univ. Press.

Puri, H. S. and R. O. Vernon. 1964. Summary of the geology of Florida and a guidebook to the classic exposures. Fla. Geol. Surv. Spec. Pub. No. 5 (revised).

Reilly, S. M. 1990. Biochemical systematics and evolution of the eastern North American newts, genus *Notophthalmus* (Caudata: Salamandridae). Herpetologica 46(1):51-59.

Snider, A. T., and J. K. Bowler. 1992. Longevity of reptiles and amphibians in North American collections, second edition. Society for the Study of Amphibians and Reptiles Herpetological Circular No. 21:1-40.

Stuart, S. N., J. S. Chanson, N. A. Cox, B. E. Young, A. S. L. Rodrigues, D. L. Fischman, R. W. Waller. 2004. Status and trends of amphibian declines and extinctions worldwide. Sciencexpress/www.sciencexpress.org/145 October 2004/Page 1/10.1126/science.1103538.

Swanson, H., K. Kebart, A. Hatim, and T. Greene. 1992. Environmental physiography of Leon County, Florida. Leon County Department of Growth and Environmental Management, Tallahassee, FL.

Taylor, B. E., D. E. Scott, and J. W. Gibbons. 2005. Catastrophic reproductive failure, terrestrial survival, and persistence of the marbled salamander. Conservation Biology 20(3):792-801.

Telford, S. R., Jr. 1993. Breeding sites for the gopher frog and the striped newt in Ocala National Forest, and the discovery of a possible undescribed species of frog apparently restricted to the forest. Unpub. Report, Ocala National Forest. 13 p.

Thornbury, W.D. 1965. Regional geomorphology of the United States. John Wiley and Sons, Inc., New York.

U. S. Fish and Wildlife Service. 1980. St. Marks National Wildlife Refuge: Forestry management and non-game wildlife. Final Report. Gainesville, FL.

U. S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants: Animal candidate review for listing as endangered or threatened species, proposed rule. Federal Register 50 CFR Part 17, 59(217):58982-59028.

Ware, S., C. Frost, and P. D. Doerr. 1993. Southern mixed hardwood forest: the former longleaf pine forest. Pp. 447-493 in W. H. Martin, S. G. Boyce, and A. C. Echternacht, eds. Biodiversity of the southeastern United States. John Wiley & Sons, N. Y.

Wilbur, H. M. 1980. Complex life cycles. Annual Review of Ecology and Systematics 1980:67-93.

Wolfe, S. H., J. A. Reidenauer, and D. B. Means. 1988. An ecological characterization of the Florida panhandle. U. S. Fish & Wildlife Service Biological Report 88(12):1-277.

Appendix I.

10-year Drift Fence Data
for
Study Pond 1

Appendix I

Study Pond #1, **Year 1**: Vertebrates trapped in drift fence buckets over a one-year period, 9/6/1995 - 9/5/1996. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake.

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf
1995																										
9/6					0-1	1-0		6-0					85-8	2-1	1-2	3-0				0-1						
9/7						4-7		12-0	2-0				6-0							1-2		0-1				
9/8	0-1				1-0	5-22		10-18											0-1	0-3						
9/9	0-18	0-1	0-2			7-8		4-49										1-2		1-3	1-0					
9/11	1-4	0-3	0-2			23-2												2-0		0-1		0-1	1-0		1-0	0-1
9/12	0-1		0-1			3-3		5-5						0-1											0-2	
9/14	2-36	0-2	0-7		1-1			2-10	1-0									1-3			2-0					
9/15	1-19	0-3	0-9		0-1			0-6	0-1									1-0			2-1					0-1
9/16	2-3	0-1	0-4			3-2		2-1	2-0						0-1											0-2
9/18	1-94	0-5	0-14		1-0	0-2		0-17	0-1									3-2	1-0	1-0	5-1					
9/20	2-7	0-4	0-6		1-1	1-0		5-0	3-0									1-0	1-0		2-3					0-1
9/22	4-9	1-6	0-2		3-0	5-0		3-0	1-0					0-1							1-0					
9/24	1-26	0-4	0-7	1-0	1-2	0-1		3-4						0-1						0-1						0-1
9/26	2-4	0-1						1-2																		
9/27	0-29	0-1	0-2			1-0		2-10										0-1			5-0					
9/29	2-5	0-3	0-3		1-0	2-0														1-1	2-0				2-0	
10/2	0-7	0-1				0-1														0-2						
10/4	1-154	0-1	0-2			1-2		1-0	0-1											0-1		0-1				
10/5	1-127	0-4	0-6		0-1	1-1		0-7	0-1								0-1	3-1		1-1	2-0		0-1		0-1	0-1
10/7	3-5	0-7	0-7			1-0			1-0																	
10/9	0-6	1-0			0-1	2-0			3-0																	
10-11	4-344	0-5	0-3		3-1	1-4		1-0												0-1	1-1			0-1		0-3
10-13	9-18	0-7	0-3		1-0	1-0		0-1																		0-1
10-15	3-164	0-9	0-16					0-5										1-0		2-2	1-0					3-0
10-17	7-9	1-2	0-3					1-0	1-0												0-1					
10-19	3-7	0-1	0-2			1-0		0-1																	0-1	
10-21	1-9					2-0			13-0	2-0			1-0							0-1						
10-23	0-2	0-1	1-1						1-0																	
10-25	1-1		3-0					1-0	1-0																	
10-27	2-2	1-0							2-0													0-1				
10-29	3-587	0-5	0-22	1-0	2-0	0-3		0-2		0-1										0-2	1-0					
10-31	10-4	2-0	1-0			1-0																				

Appendix I

11-2	4-4	1-0	0-2			0-2																1-0				0-2
11-4	17-47	0-6	0-46		1-0	3-0		0-2		1-0												1-0				
11-6	1-8		1-10							1-0																
11-8	13-612	0-8	1-46		2-3			1-0		1-2									0-1		0-2					0-1
11-12	2-2		0-17																1-0							
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf
11-14	0-2	0-2	1-0																							
11-16			1-0																							
11-19	2-1	2-0								3-0																
11-21	7-205	0-4	0-26		1-0				1-0	2-0																0-1
11-23	41-3	1-0	1-0							0-1																
11-25	4-60	0-1	1-12							1-0																
11-27	0-1		0-2																							
11-29	6-1542	1-8	6-66		1-1	0-2				1-4															0-1	0-1
12-2	15-15		0-4							0-1																
12-4	2-5	1-1																								
12-7	8-177	0-8	5-55		1-3	0-1				3-0									0-1	2-2						0-1
12-10	29-427	5-1	12-11							5-0									0-1							
12-12	25-2		1-0																							
12-14	12-14		0-1																			0-1				
12-17	2-13	0-2	1-4							1-1								1-0			1-0					
12-18	2-5		7-0							1-1											0-1					
12-21	14-616	4-4	1-14		3-5	0-2				6-4								5-2			0-2					
12-27	36-9									1-1								0-1								
12-30	3-0																									
1996																										
1-1	16-166	3-0	7-12		2-2	1-0				9-0								3-1								
1-3	50-189	10-1	20-2		1-1					2-4							2-0	18-2			0-1	0-1				0-1
1-6	13-15	0-2	0-8							0-1							0-1	0-7								
1-7	14-43	8-0	3-0							9-0								2-0								
1-10	0-5		0-1															0-1								
1-14	0-5									0-2																
1-16																										
1-18																										
1-20	4-33	2-2	3-3							3-3																
1-22	6-2		0-1																							
1-24			1-1		0-1																					
1-27	1-4					0-1				0-1																
1-30	0-1																									
2-1	1-1		0-2			1-0				2-1											1-0					
2-3	6-24	1-3	1-5							6-11								6-2			2-0					
2-5	5-5		0-1							1-4								1-6								

Appendix I

2-7	0-1	0-1															1-1								
2-9	2-1	1-2	0-1						5-1																
2-11	3-0		1-0						2-0								2-0								1-0
2-13			0-1						2-0								0-1								
2-15	2-6	0-1							1-6								0-1								
2-17	1-2							1-0	1-1																
2-19	2-0							1-0	1-1										1-0						
2-21	8-30	1-0	3-6		1-0				2-2							1-0	9-1		1-0						
2-23	3-10	1-2	2-3		1-0				2-5								3-4		13-1	1-0					
2-25	1-2	0-1	1-1		1-1			0-1	1-0	0-5						0-1	4-3		4-0						3-0
2-27	2-0	1-0			1-0				1-0	0-2							1-0		4-0						
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf
2-29	2-14	0-2	0-4		19-1	2-1				3-6								1-12		1-2	1-0					
3-2	7-8	1-0	4-3		0-6					3-2								6-0			1-0					
3-5	0-2																			1-0						
3-7	0-2		0-1		1-8	5-1			0-1	0-3										4-0	1-0					
3-10	2-5					1-2				2-0																
3-13	1-1									1-0										1-0	1-0					
3-15																				1-0						
3-18	5-46		4-0		12-4	4-3				1-4	0-1						2-0	6-9	0-1	7-0	1-0			2-0?		1-0
3-20	2-6	1-1	2-2		0-7	8-2				5-1	0-1						0-1	6-0		1-2	0-1					
3-22	2-0				1-0	0-4			2-0	1-0								0-2								
3-25	2-1		0-1						0-1		0-1							2-0								
3-26	4-23	0-1	2-3		1-0	0-1			1-0	1-3								4-1								
3-28	10-22	1-0	4-0		5-1	5-0		3-1	0-1	2-1							1-0	1-1		5-1	1-0			1-0		
4-1	51-16	19-0	6-2		0-3	1-5		3-0		5-3	2-0						2-1	8-2		6-3	1-0	2-0		5-0		2-0
4-3	2-13							0-1		0-2								2-1		1-2		0-2				
4-6	0-6	1-0						1-0		1-2										1-1		1-0		2-0		
4-7	3-50	0-1								2-0										0-1		1-0				
4-9	2-0		0-1						1-0		0-1															
4-11									1-0																	0-1
4-14	2-3	1-0			2-0	0-2		14-0	1-0	0-4										0-1		1-1				
4-16	4-18		1-0			3-1		3-4	1-0									1-1		2-1		1-0		1-0		
4-18	0-4					0-1			1-0									1-0		1-1		1-0				
4-20	0-1					1-0			1-0											1-0						
4-22	3-2							1-0	2-0											1-0						0-1
4-24	2-1				1-0	2-0		18-0	3-0									0-1		1-0						0-1
4-26	0-2							7-0												1-0						1-0
4-29	3-3				0-1		2-0	1-0												3-1		1-0				
4-30	0-54				6-4	2-7	2-0	2-5		0-1							3-0	5-5		1-0	1-0	1-0				1-1
5-2	3-2							2-0	1-0									1-0								
5-4	0-2				1-2	1-1	1-0	6-1									0-2			0-1						

Appendix I

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	
5-7	0-2					2-1		14-2	1-0											4-0		2-1		1-0		0-1	
5-9	2-1					1-0	2-0	4-0	3-0													2-1		1-0?			
5-11	1-4				1-0		1-0	5-1												0-1							
5-13	4-1						1-0	6-0												0-1		1-0					
5-15	1-0							2-0																			
5-17	1-2					1-1		4-0							0-1												
5-19	3-3							8-4	3-0												1-0						
5-21	1-1					1-0		14-0												2-0							
5-23	2-0							5-4												1-1		0-2					
5-25	1-3					1-2		15-1												3-0		0-3					
5-27	4-2					1-0		10-3														0-1				0-1	
5-29	1-22		1-1			1-2	0-1	0-33		0-1										0-1							
5-31	0-1					2-1	0-1	0-16										1-1		0-1							
6-2		0-1				1-0	1-0	4-2													1-0				0-1		
6-4	1-0				1-0	3-0		5-2																			
6-6	1-3					1-0	0-1	3-3							0-1			1-0									
6-8		0-1				2-4	1-0	6-5																			
6-10	1-6				1-0	0-1		1-4																	0-1		
6-12					0-1			10-1																			
6-14	0-2					1-0		2-8												0-1				0-1		0-1	
6-16	0-2	0-2			1-1	1-0		15-8										2-0		0-3	0-4	0-1					
6-18	0-3	0-1						5-9										0-1				0-1					
6-20	0-1					0-3	5-16	20-6										1-1							1-0		
6-22	0-2	0-2				2-0	1-4	18-15										3-0				0-1			2-0		
6-25	0-1	0-1					0-1	9-15	3-0									2-0				1-1			0-1	0-3	
6-26	0-1					1-0	1-0	2-2																			
6-28		0-1	0-3			1-1	3-0	13-10										1-0		0-1							
6-30		0-2						0-6														0-1					
7-2	0-1					1-0	0-1	6-8										1-1									
7-4	1-0					1-0		20-5													0-2			0-1		1-8	
7-6			0-3		0-1	1-0		3-16										1-2		0-2	0-3			0-1		2-0	
7-8		0-1	1-1			0-1		7-3	0-2									2-1		0-1				0-1		1-1	
7-10			0-2			0-1		5-7	0-1									2-0							1-2	1-0	
7-12	0-1		0-1				1-0	4-12										0-2		0-1	0-2						
7-14		0-2						2-5										1-1									
7-18							0-1	1-3										0-2			0-1				0-1		0-1Pf
7-20			0-1					0-5	0-1									1-1									0-1Pf
7-22								3-5	1-0									1-1								0-1	0-2Pf
7-24		0-6	0-3					7-0	0-1											0-1					1-0	0-1	
7-27		0-10	0-10				2-0	31-5	0-2									3-1		1-0		0-1		0-2		0-1	
7-29		0-2	0-1		1-0			0-33	1-1																	0-2	

Appendix I

7-31							1-0	3-1	2-1									0-1							0-2	
8-2		0-2	0-1				0-1	14-5																		
8-5			0-2					8-10										2-0								
8-8		0-1	0-1					29-5																		1-0Pf
8-10								6-17										1-1		1-0						
8-12								1-4	1-1									1-1							0-5	
8-14								2-2										1-1						0-1	0-3	
8-16								0-3										0-1			1-0			0-1	1-8	
8-18		1-0				3-0		1-4										1-0						1-0	0-5	
8-20							1-0	7-2																	1-1	
8-22							1-0	12-6	1-0																1-3	
8-26			0-1				0-2	12-4																1-0		0-1Pf
8-28	1-0						0-2	1-12										2-0						0-1		
8-30							4-1	34-9	0-1									2-1		1-0	2-0			1-0	1-0	
9-1			1-0					12-7										3-0		3-0	2-0					
9-3					1-0		5-0	11-0										0-1		2-0	3-0	3-0				
9-5		0-1			1-0		0-2	3-8	0-1									9-0		3-0		1-0			3-0	2-0Pf
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	

Appendix I

Study Pond #1, **Year 2**: Vertebrates trapped in drift fence buckets over a one-year period, 9/6/1996 - 9/7/1997. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus*, cottonmouth; Cs=*Chelydra serpentina.* snapping turtle; Sp=*Seminatrix pygaea,* swamp snake..

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
1996																														
9-7					1-0			3-7										3-2		0-1	1-0						0-1			
9-9							0-1	5-13	0-1											0-1	1-0									
9-10		0-1					0-1	0-1														0-3				0-1				
9-13		0-1					1-0	0-4	6-0													0-1				0-1				
9-15								1-0	2-7																0-2					
9-17								0-2										0-1		0-3					1-0					
9-19								0-2	0-1									1-1							1-0					
9-21																														
9-23																														
9-25									1-0	1-0								1-0		0-1										
9-27																		0-1							1-0					
9-30							0-1	0-1		0-1								0-4		0-1		0-2								
10-1					1-0													4-0												
10-3																														
10-5																									1-0					
10-7									1-2									1-0												
10-9		16-0	13-0		23-0				0-2								34-0	10-0		4-0	1-0									
10-11		19-0	2-1		0-6				0-1									5-0												
10-13			1-0															0-1												
10-15			2-0		1-0				1-0								0-3													
10-17																														
10-19																				1-0										
10-24																														
10-27									1-0																					
10-29										2-0																				
10-31								1-0		2-0							1-0													
11-2																														
11-4																														
11-6																														
11-8					0-2		0-1										0-4	0-1							0-1					
11-10																														
11-12																														
11-14																	1-0													

Appendix I

11-16																														
11-18																														
11-20					1-0					0-1																				
11-22	3-0		4-0					0-1		2-0								0-1												
11-24			1-0		0-1					0-1								1-3												
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
11-26	29-0		9-0							1-1							0-2	1-2												
11-29	4-13		3-3							0-1																				
12-2	21-2		10-5		0-1					1-1							0-1	0-2		0-1										
12-4	4-0		6-0							1-0								1-0												
12-6	16-0		11-0																											
12-8	188-0		6-0		0-5					1-1							1-0	2-0												
12-10	11-0	1-0	1-0																											
12-12	8-17	1-0	13-1							3-1			1-0					1-0												
12-14	101-4	12-0	5-0							1-2								0-1		0-1										
12-16	3-0	2-0	1-1							1-0																				
12-19	57-13	1-0	1-1		0-2					5-0								1-0												
12-21	1-20		3-0																											
12-23	1-1	0-2	1-1							1-0																				
12-26	28-6		3-1		0-1					1-1																				
12-28	1-3		8-1		0-1																									
12-30	1-0	2-0	4-2																			1-0								
1997																														
1-2	2-0		10-2				0-1			1-0															1-0					
1-4	0-2	4-4																												
1-6	0-1		2-0																											
1-8	0-44		2-2							0-4																				
1-10	142-67	1-0	4-0		0-1					4-0																				
1-12	1-2																													
1-14																														
1-16	25-17		2-0		1-0				2-0	5-0																				
1-18	1-0		0-1																											
1-20			1-0																											
1-22			0-2							1-0																				
1-24			1-0																											
1-25	0-53	2-0	1-0		1-1					4-3										0-1										
1-27			0-1																											
1-29	0-1		3-0							1-1																				
1-30	1-5	1-0	2-0																											
2-1	1-0																													
2-3		3-0	2-0							0-1																				
2-5									1-0	1-0	0-1											1-0								

Appendix I

2-8	0-8																													
2-10	0-1																													
2-12																														
2-14	14-111		1-0		7-4					2-0									7-4											
2-15	31-2	4-0	2-0		0-5					2-1								7-0				1-0								
2-17		5-0	1-0							1-0								0-1					2-0							
2-19		4-0	1-0								2-0								1-0											
2-21		1-0				1-0					1-0							1-0			2-0		2-0							
2-24	7-45	2-0	1-0		2-3				0-1	0-1								3-1			5-0		1-0							
2-26	8-0	2-0	1-0							1-0																				
2-28		3-0	2-0		1-0	1-0																								
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
3-2	0-1	1-0			0-1		1-0										0-1			2-0		2-0								
3-4	0-12								1-0								0-5			2-0										
3-6	1-18									0-1							1-2			1-0		1-0				1-0				
3-8	0-2																													
3-10	0-1								1-0													1-0								
3-12																	1-0													
3-14	0-31				0-1		1-0										0-3	0-1		1-0		1-0								
3-16	1-1							1-0		0-1								1-0												
3-17					1-1	1-0		1-0	1-0	0-1								1-0		7-1	1-0				1-0					
3-18	1-9							1-0												1-0										
3-20	0-5																	0-1												
3-21	1-3				2-0															1-0					0-1					
3-24																														
3-26																						1-0								
3-28	0-2					2-0											0-1													
3-30	0-1						1-0										0-1	0-1		2-0		0-1								
4-1	0-12																	1-3				0-1								
4-3	0-1																	2-0												
4-5								1-0																						
4-7	0-2					2-0		4-0										0-8												
4-9									1-0									2-0												
4-11								0-1																						
4-12	2-5				1-0	1-0		2-0										1-19m		0-3										
4-13																		15-0												
4-15																		1-2												
4-17																		1-0												
4-20								1-0										0-1				0-1								
4-22						1-0												1-23				0-1								
4-23	0-4					2-1											0-9m	6-77m		2-1										
4-25	0-1		0-1			0-1		0-1									1-0	76-1												

Appendix I

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
4-27	0-3					7-0	4-0	1-0									1-59	4-239		3-0										
4-28	0-2				1-0	4-4	32-0	6-2									4-5	0-4		4-0		1-0								
4-30		3-0	1-0		0-1		42-0											2-0												
5-2							11-3										1-0					1-0								
5-4							10-0													1-0					1-0					
5-6							5-0	1-0									0-2													
5-8							2-1	2-0									0-4	1-1												
5-10							3-2	3-0																						
5-12						1-0	2-0																							
5-14	1-0					1-2		5-0									0-18	1-4												
5-16						1-1	1-18	4-1									1-109	0-28				1-0								
5-18						0-1	1-0										6-0													
5-20	0-1						1-9	0-1	0-1			0-1					0-150	0-224		0-1										
5-22							1-1										1-5	3-7		0-1										
5-24					1-0	2-0	101-1	8-0	0-1								0-2	0-1		1-1		1-0								
5-25		1-0				1-2	37-28	8-0									0-8	0-1		1-0										
5-26							25-13	7-0									0-5	1-0												
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
5-28							10-8	1-1												1-1										
5-30						0-1	0-3	5-1									0-10	2-2				1-0								
6-1					0-1	1-0	1-5	3-0	0-1								1-0			0-1										
6-3						0-1	1-0	2-0									0-8								1-0		1-0			
6-5	0-1						0-7	01									1-26	0-9												
6-7							1-2	0-1	0-2								0-2	0-1												
6-9									1-0								0-1													
6-11							1-0	3-0	1-0								0-28	0-1		2-0								1-0		
6-12					1-0		2-3	5-1									0-8	0-4				1-0								
6-14						1-0	13-9	42-13														1-0								
6-16							3-1	7-3	1-0								0-10	1-0												
6-18				0-1			0-1	14-6	0-5								0-1	0-2			1-0									
6-20							2-1	7-0	0-2									1-0		1-0										
6-23							1-1	19-4	0-1								0-20	1-21		1-0						0-1				
6-26							3-4	22-7	0-2								0-1	3-0		0-1		1-0								
6-28							1-1	9-5	0-2									1-1												
6-30							0-2	8-8	0-1								0-7	2-21		2-0										
7-2							0-1	18-5	0-2								0-13	3-18		1-0		1-0								
7-4							4-0	8-5										1-2												
7-6						2-0		1-6																						
7-8	1-0			0-1		1-1	0-2	2-2					0-1					0-3												
7-9						1-0												1-0												
7-11						3-1	0-1	3-2					1-0	0-1			0-2	1-1												
7-14						1-0		2-0	1-0											1-0										

Appendix I

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
7-17						0-2			0-1									0-1												
7-19																														
7-21						3-0	2-0	13-7									0-1	1-0		0-1	1-1									
7-23							1-0	0-2												1-0		1-0								
7-28							1-2	1-2	0-2								0-2	1-0		3-1										
7-31								0-2	0-1									1-0		2-0										
8-1						0-2		1-2	0-1									2-3		1-1										
8-3							1-2																							
8-5							5-0	1-0										0-1		2-0						0-2				
8-7							1-1	2-1										2-1								1-0				
8-9						2-0	2-0																							
8-11							0-2										0-1	1-3								1-0				
8-13																	0-1	0-2											1-0	
8-15																														
8-17								0-1										0-2												
8-19		0-1e						2-4					0-1				0-2	0-6												
8-21						2-0											0-4	1-2												
8-25								0-1																						
8-27						3-0		2-1									1-1													
8-29						0-1		0-30m														2-0								
9-1		0-1m				0-1	0-1	0-19m										1-4				1-0								
9-3		0-1m						5-1									0-1	1-0												
9-6				2-0		1-1		4-2	2-0				0-1					3-1													0-1

Appendix I

Study Pond #1, **Year 3**: Vertebrates trapped in drift fence buckets over a one-year period, 9/8/1997 - 9/4/1998. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
1997																														
9-8						1-1		13m-1					2-0					1-0												
9-11						3-0		21m-2					2-0					0-2								0-1				
9-14						1-2		8-3					1-2	0-1				1-3								1-0				
9-16		0-5m						1-20m					1-5m					1-10m												
9-18						1-0		24-1					0-1																	
9-19		0-1		1-0				15-0																						
9-22								16-2										0-2												
9-24		0-3		1-0			1-0	10-2	1-0					0-1				0-1												
9-25						0-1	0-1	6-3										1-0												
9-26		0-15						0-3	0-1									1-2			0-1									
9-29		0-6		1-0				7-1	3-0				1-0	0-1																
10-1		0-1		2-0			1-0	17-1	1-0				0-1	0-3																
10-4		1-0		2-0		1-0		17-0					1-0																	
10-6		1-1		2-0				5-0	1-0				1-0																	
10-8	2-0	6-5	0-1			2-0		5-2					1-0																	
10-11				1-0				8-0						0-1																
10-14		0-2						3-0										0-3	0-2											
10-15						1-0		7-1		1-0			1-0					2-1	1-0											
10-17						1-0		6-0							1-0															
10-19								1-0																						
10-21								1-0																						
10-23								4-0	1-0																					
10-26		0-71	0-3		1-0		0-3	0-3	0-1										0-1	0-1	0-1	0-9								
10-27		0-41	0-17		1-0	1-1	0-2	0-1	2-1									4-1			0-1	0-1								
10-29		1-1	1-14	1-0				0-1	1-0									1-0			1-0									
10-31		1-3	1-8				0-1		0-1										1-0	0-1										
11-1	1-5	0-32	0-36			0-2	0-1		1-2									14-4	1-0	1-0										
11-3		1-13	0-34		0-1		1-1		2-1									6-2	1-0											
11-5		1-0	0-4					0-1	1-0										1-0											
11-7	1-2	2-7	2-13	1-0																										
11-9			0-1																											
11-12			0-3											0-1								1-0								

Appendix I

11-13	24-8	0-9	1-24		0-1			0-3										7-1		0-1									
11-14	1-2	0-10	1-24		1-1	1-0		0-3	3-0									12-4	6-0			0-1							
11-17		3-3	1-8															2-0											
11-19	1-0		0-2					1-0	0-1																				
11-21		3-0	0-3																			0-1							
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
11-24	1-0	1-0	1-0					1-5												0-1		0-5							
11-27		1-0	0-1						1-0																				
11-30	20-9	3-6	5-10		1-0	0-1		0-3	0-2									1-0	2-0	0-4		0-1							
12-2	0-1	1-0	1-5																	0-1									
12-4	9-0		3-6		0-1																								
12-6	2-0	0-1	0-4																										
12-9	44-0		0-2						0-1	1-0																			
12-10	3-3	0-1	2-6				0-1												1-0										
12-12	1-0		3-1															1-0		0-1		0-1				0-1			
12-14	4-0																												
12-16	2-1																												
12-18																													
12-22	4-2	0-2	1-0		0-1	0-1	0-1		1-0					1-0				2-0		0-4	0-1	0-1							
12-24	26-4	0-6	2-2				0-1			2-1								3-1	1-0	0-3	0-1								
12-27	42-4	0-2	3-2					0-1		1-0								2-1	0-1										
12-29	1-0	1-0																1-0											
1998																													
1-1									0-1																				
1-4		1-1	1-0																1-0										
1-6		2-0	1-0					1-0	1-1	0-1								1-0		1-0	0-1	0-1							
1-7	4-23	1-4	1-2			1-0		0-1	1-2	0-1								0-2		0-1		1-0							
1-8	28-4				9-0	3-1	0-1		0-4	1-0							1-0	3-1		1-0									
1-12	4-3		1-1			0-2												1-1											
1-14	11-1	1-2								2-1								2-1											
1-15	29-4	0-1	1-0		0-5				0-1	2-0								4-1											
1-19	39-2	1-0	2-0							0-1								1-0											
1-21	0-2	1-0	1-0						2-0																				
1-23	41-14	1-0	0-1		0-1					3-0								3-0											
1-26	3-3	4-0	2-0						0-1	1-1								2-1											
1-27	14-5		1-0							0-1																			
1-30	3-1	1-0							1-0																				
2-3	126-53	6-0			3-2	1-0	0-1			10-0							12-0	5-0		1-0									
2-4	23-15	10-0	4-0		0-2				1-0	3-1							2-3	7-0											
2-6	1-2	1-0								0-1								0-1											
2-9	0-1		1-0						0-1																				
2-11	0-1	1-1	1-0							1-0							1-0												

Appendix I

2-13	0-2	4-0							0-1	0-1								2-0												
2-16	12-81	1-0						0-1	1-0	0-3							3-0	6-2		0-1										
2-17	35-28				0-2	0-1			2-0	1-0							11-4	11-4		2-2										
2-20	10-14	3-0								1-2							2-1	6-0												
2-23	37-24	2-0	2-0							1-1							0-3	1-0												
2-25	2-3								1-0									0-1												
2-27	9-95	2-0							2-1	0-3							1-6	5-10	1-0	3-0										
3-2	2-9					2-0	2-0		5-2	0-1							2-1	6-0		1-0					0-1	1-0				
3-4	0-2								1-1									1-0												
3-6	2-50							4-0	1-0								0-3													
3-8	9-39	1-1	1-0		3-0	0-2	0-1		2-2								2-7	1-6		1-0	1-0									
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
3-9	12-9				30-3	3-0		0-2	0-1								7-1	5-5	2-1	2-0		2-0								
3-11	3-1	1-0		0-1	1-26	1-1		0-1	0-1										1-0											
3-14					1-3				1-0				1-0																	
3-16		1-0				0-1			2-0									2-2												
3-19	3-33	1-0	2-0		0-6	11-1		0-2	0-5								0-4	3-4	1-0	1-0		1-0								
3-20	3-10		1-0		1-2	0-5		0-1									0-1	2-3				1-0								
3-22	2-2																	0-1				1-0								
3-23				0-1				0-2										0-1												
3-24	1-1					0-1														1-0		1-0								
3-27	0-7					3-1		1-0												1-0		3-0								
3-30	0-12					2-4		2-6	1-0								0-3			2-0		5-0								
4-1	7-6					2-1		2-1									3-1			2-0		3-0								
4-3	1-6					1-1		0-1	1-1								0-2	0-7		1-0		1-0								
4-6	1-5					1-1		0-1	1-0								0-1	1-1				1-0								
4-8	1-33				0-1	2-1		0-4	0-1									1-7	0-1	1-0	0-1									
4-10	1-7				1-0	0-1		0-1	1-0									1-2												
4-13									1-0																					
4-15	0-1																													
4-17	1-3							3-0										0-3		1-0										
4-20	0-17								1-0											0-1	1-0	0-3								
4-22	0-1							1-0									1-0													
4-24									0-1																					
4-27							2-0			1-0							1-0													
4-29						1-0			1-0	0-2																				
5-1						0-1				0-1										1-1										
5-4	0-2					1-0		1-0		0-4			1-0							1-1	1-0									
5-6	1-0						1-0	4-0										0-1		1-0										
5-8	1-3					3-1		2-0		0-1										1-0										
5-11	2-2							1-0												0-1		1-0								
5-13								1-0												1-0										

Appendix I

5-15	0-1							5-0		0-1	1-0															0-1			
5-18						0-1		4-0		0-2										0-2						1-0			
5-20	1-0							3-0											0-3										
5-22	0-1							1-1										1-0	1-0										
5-25								3-1						1-0					0-9										
5-27							1-0	3-0										1-0	5-3							0-1			
5-29								1-2						0-1					1-4										
6-1								3-0										0-3	1-12										
6-3								2-0						0-1				1-1								0-1			
6-5	1-0							5-0										1-5	0-2		1-0								
6-8	0-1						0-2	2-1	3-1		1-0							0-1											
6-10						1-1	0-1		1-0						1-0			0-6	0-1				1-0						
6-12	0-1						1-0	1-0										1-14	0-4			1-0							
6-15							1-0	2-0					1-0	1-0				0-1											
6-17								5-0						2-0				0-2											
6-19		0-4	0-2			1-0		1-82		0-1								0-9	3-57										
6-22		0-4	0-1				0-1	24-3	8-0									1-1	4-0										
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
6-24		1-4	1-1		1-0	0-1	1-0	0-35	1-6								0-2	2-44				0-1							
6-26	0-1	0-12	0-1				3-0	0-1	1-3											0-1		0-2					0-1		
6-29		0-13	0-14	1-1			2-1	5-4	1-14					1-1				0-4											
7-1		0-2	1-2				1-0	1-1	2-1									0-1											
7-3		0-5	0-5	1-0				2-0	0-4									0-10											
7-6			0-1				2-0															0-1							
7-8			2-0					2-0										0-1				0-2							
7-10	0-1	0-12	0-30				1-0	1-0									0-2	0-34		0-3		0-1							
7-13		0-15	0-18					1-5									0-1	3-1		0-1						0-2			
7-14		0-11	0-15			0-1	80-7	12-0	0-1									0-6				0-1							
7-16		0-19	1-46	0-2		0-1	21-56	6-7	0-2									0-3		1-1									
7-18		0-4	0-10	0-1			0-9	0-5	0-2								1-0	0-1								1-0			
7-20		1-12	0-11				1-7											2-8		0-1						1-1			
7-22	0-1	0-3	0-5															4-0		1-0									
7-24		0-16	0-22				0-2	1-1										0-10											
7-27		0-12	0-14				0-2	1-0	0-3													1-0							
7-29		1-6	0-11				2-1	3-4	0-1								0-2	0-11		1-1						0-1			
7-31		0-3	0-7	0-1			1-3	6-2	0-2									1-3		0-1	2-0	2-0							
8-3		0-1	0-1			1-0	0-1	0-3	0-1											1-0									
8-5			0-1			1-0		0-4																	0-1	0-1			
8-7																													
8-10		0-1	0-3				0-1	0-1										1-1											
8-13		0-1	0-1				0-1	1-1	1-0									1-0		0-1	1-0	1-0				1-0			
8-15		0-2	0-1			1-0			0-1									0-1											

Appendix I

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
8-17		0-1																1-2												
8-19		0-2						1-0										0-2								1-0				
8-21		0-3						0-1										0-2												
8-24																		2-0												
8-26						2-0	1-0																		0-1	0-1				
8-28							1-0	0-1																						
8-31		0-1		2-1				1-0																						
9-4		0-3			14-0	1-0		0-1										1-0		2-0										

Appendix I

Study Pond #1, **Year 4**: Vertebrates trapped in drift fence buckets over a one-year period, 9/7/1998 - 9/5/1999. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
1998																														
9-7		1-0			1-1	0-1		0-1										5-6	0-1			1-0								
9-9		0-1																3-2								0-1				
9-11		0-1	0-1																	1-0						1-1				
9-14																				1-0										
9-16																				1-0						0-1				
9-18																		0-4												
9-21		0-22	0-1		0-1		0-1											2-0		0-1										
9-23		0-14	0-2																		0-1									
9-25		0-5																0-1								1-0				
9-28		0-17																												
9-30		2-43	0-1																	0-1										
10-2		1-52	2-4														0-2			0-1						0-1				
10-5		0-140	0-11														0-1			1-0										
10-7		0-61	0-12														0-1	0-1												
10-9		1-31	0-6														1-0													
10-12		0-14	0-7																											
10-14		2-2	0-2																											
10-16		0-2	0-1																											
10-19		0-4																0-1												
10-21		0-1																				1-0								
10-23		0-1																												
10-26			0-1																											
10-28			0-1																											
10-30			1-0																											
11-2		0-1																												
11-4		0-1	0-6															0-6				0-1								
11-6			0-2																											
11-9																		0-1												
11-11		0-10	0-15															1-3												
11-13		0-301	0-583																											
11-16	0-6	1-113	5-298	0-1														0-3												
11-18	0-1	59-691	39-717														0-2													
11-20		0-15	1-170																											

Appendix I

11-23	0-3	0-3	1-75															0-1											
11-25	1-3	0-18	0-25															1-1											
11-27	0-1	0-2	0-36														1-0	0-1											
11-30	0-1		0-3														1-0	0-1											
12-2			0-4																										
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
12-4		0-2	0-5															1-0											
12-7			0-1																										
12-9	0-1	0-1	0-5																										
12-11	0-2	0-1	1-23			1-0																							
12-14	0-2	0-16	1-79														1-3												
12-16	0-1	0-1	0-12														0-1												
12-18		0-2	0-1																										
12-21		1-1	1-4														1-0					0-1							
12-23		0-2	0-4																										
12-25	0-37	0-29	0-158														0-1												
12-28	0-8	0-11	1-6																										
12-30	1-2	0-5	0-6																			0-1							
1999																													
1-1																													
1-4	2-14	0-7	0-1															0-1											
1-6	3-4	0-2	0-2																										
1-8	0-11	0-1	0-2															0-1		0-1									
1-11	0-5	0-2	0-4																	0-1									
1-13	2-3	0-3	0-1																	0-1		0-1							
1-15	2-2		0-5																										
1-18	0-2	0-1	0-1																	0-1						1-0	0-1		
1-20	0-2	1-5																											
1-27	1-6		0-2																										
1-29	1-1		1-0															0-1		0-1									
2-1	0-2		1-1															0-1											
2-3			1-1							1-0																			
2-5	1-0	0-1			1-0													0-2											
2-8																													
2-10	0-1							0-1																					
2-12								1-0												0-1		0-2							
2-15																		0-1											
2-17	0-1																	0-1											
2-19	0-32	0-3	0-18		1-0													1-1		0-1									
2-22	0-13	1-5																		0-1									
2-24	0-7	0-1	0-5																										
2-26	0-1																												

Appendix I

3-1	0-6		0-3															0-1	0-1			0-1							
3-3	2-6	0-1	0-2																										
3-5		0-1	0-1																										
3-8	0-2	0-14	0-27																										
3-0	0-2	1-7	3-54																										
3-12	0-4	0-4	0-22																										
3-15	1-104	0-7	0-21		0-1	1-0												0-1		1-2									
3-19	3-10	0-1	1-6															1-0							1-0				
3-22	4-1		2-1			1-0																							
3-24	0-2		0-2																										
3-26	3-3	0-3	2-2					1-0										0-1											
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
3-29	2-3	0-2	2-2					1-0																					
3-31	0-1	2-0	1-1				1-0																						
4-2		0-1	0-1																										
4-10		2-7	1-17					4-0	0-1		1-0									0-9	0-6	1-5			0-2	0-1	0-1			0-5
4-16		0-2	0-9																	1-5	0-3	0-3							
4-19		1-0	1-3			1-0														1-1									
4-21			1-2																	0-1	0-1								
4-23																			0-1			0-1							
4-26								1-0												1-2									
4-28																				0-1									
4-30	0-3	0-2	1-15					0-1												0-5	0-3	1-0				0-1			
5-3		0-2	0-9						0-4																				
5-5			0-1																	0-1									
5-7	0-1		0-13																	2-1									
5-10		0-1																											
5-12																					0-1								
5-14			0-1				0-1													1-2	0-1								
5-17																				1-0									
5-19																													
5-21																													
5-24																									0-1				
5-26																													
5-28																				1-1		1-0							
5-31								2-0	1-0																				
6-2						2-0														1-1	0-1								
6-4			0-1																	0-1		0-1							
6-7					1-0				0-1											3-1		0-1							
6-9								0-2												1-1									
6-14								2-1												0-4	0-2								
6-16								1-0												0-1									

6-18							2-2												1-0									
6-21							3-1													1-0								
6-23							1-0																					
6-25						0-3		0-1																					
6-28						3-0	2-0	4-0																					
6-30							4-0	6-0											1-0									
7-2								2-3											2-1									
7-5								3-3											3-1	0-1								
7-7								4-8																				
7-9								1-1											0-2									
7-12								1-2											0-1									
7-14								3-0																				
7-16						1-0		1-1																				
7-19								0-1																				
7-21						1-0													1-1	0-1								
7-23								0-5	0-1										0-1									
7-26								0-4																				
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
7-28								0-3											0-1						0-1			
7-30								0-1																1-0				
8-2								1-2											0-1					0-1				
8-4								2-1																				
8-6																												
8-9							0-1	0-28																				
8-11							0-1	0-5																				
8-13							0-1	0-11																				
8-16								0-3																				
8-18							0-2	2-1																				
8-20								0-4																	1-0			
2-23							0-1	1-0																				
8-25																												
8-27																												
8-30						1-0		0-1																				
9-1																												
9-3								1-0																				
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp

Appendix I

Study Pond #1, **Year 5**: Vertebrates trapped in drift fence buckets over a one-year period, 9/6/1999 - 9/6/2000. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
1999																														
9-6								0-1																						
9-8								1-0																						
9-10							0-1	0-9																						
9-13								1-0																						
9-15								1-0																						
9-17																														
9-20								0-2																						
9-22								0-1																						
9-24																														
9-27								0-1																						
9-29																														
10-1																														
10-4								0-1																						
10-6																														
10-8																														
10-11								0-2																						
10-13																														
10-15																														
10-18																														
10-20																														
10-22																														
10-25																														
10-27																														
10-29																														
11-1																														
11-3																														
11- 5																														
11-8																														
11-10																														
11-12																														
11-15																														
11-17																														
11-19																														

1-0

Appendix I

11-22																													
11-24																													
11-26																													
11-29																													
12-1																													
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
12-3																													
12-6																													
12-8																													
12-10																													
12-13																													
12-15					1-1																								
12-17																													
12-20			1-0		0-1																								
12-22			6-0																										
12-24			2-0																										
12-27																													
12-31																													
2000																													
1-3			1-0																										
1-5	1-0		4-0																										
1-7																													
1-10					1-0																								
1-12					1-0																								
1-14			1-0		1-0																								
1-17																													
1-19																													
1-21																													
1-24					1-0																								
1-26																													
1-28																													
1-31			1-0																										
2-2																													
2-4																													
2-7																													
2-9																													
2-11			1-0																										
2-14					6-2				1-0																				
2-16					2-0															1-0									
2-18																													
2-21					3-0																								
2-23																													

2-25																														
2-28																														
3-1																														
3-3																														
3-6																														
3-8																														
3-10																				0-1	0-1	0-1								
3-15																					1-0									
3-17					1-0																									
3-20					6-0															0-2		0-1								
3-24																														
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
3-27																														
3-29																														
3-31						1-0																								
4-3																														
4-5																														
4-7																						0-2								
4-10																														
4-12																														
4-14																														
4-17																														
4-19																														
4-21																														
4-24																									1-0					
4-26																														
4-28																														
5-1																														
5-3																														
5-5																														
5-8																														
5-10																														
5-12																														
5-15																				0-5		0-2								
5-17						1-0																								
5-24																														
5-26						1-0																								
5-29																														
5-31																														
6-2																														
6-5																														
6-7																														

Appendix I

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
6-9																														
6-12																														
6-14																														
6-16																														
6-21																														
6-23						2-0																								
6-26						2-0	1-0		0-1											0-1										
6-28								0-2																						
6-30						2-0	1-0											1-0												
7-3						4-0																								
7-5																														
7-7						1-0																								
7-10						2-0	5-0																							
7-12						1-0	3-0																							
7-14						1-0	2-1																							
7-17																														
7-19																														
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp
7-21																				2-0										
7-24						1-1		0-1												1-0										
7-26					1-0			1-2																						
7-28								0-1																						
7-31																														
8-2						0-1	1-0	0-2																						
8-4						1-0	1-0	1-0												0-1										
8-7						1-0	1-1	1-0														1-0								
8-9						0-1		1-0																						
8-11					1-0	1-0	1-0																							
8-14						2-0																								
8-16						7-0		2-0																						
8-18								2-1																						
8-21						1-0		1-2														0-1								
8-23						1-0		0-1																						
8-25								0-2																						
8-28						0-1																								
9-1					4-4																									
9-4					6-0																									
9-6					81-3															1-0										
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	Cs	Sp

Appendix I

Study Pond #1, **Year 6**: Vertebrates trapped in drift fence buckets over a one-year period, 9/8/2000 - 9/?/2001. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
2000																												
9-8					23-42	1-1														2-0								
9-11					0-22	0-4		0-1																				
9-13					0-13	3-0																						
9-15					0-8																							
9-18					1-13	11-0	1-0	3-6																				
9-20					0-2	0-1		0-2																				
9-22					54-8															2-0								
9-25					73-135												0-1			3-0		1-0						
9-27					0-7																							
9-29					3-52	1-0														1-0								
10-2					1-9															0-1								
10-4						1-0		2-0																				
10-9					1-1																							
10-11					0-1																	1-0						
10-13																												
10-16																												
10-18																												
10-20																												
10-23																												
10-26																												
10-27						0-1																						
10-30					0-2593																							
11-1					290-2680																							
11-3					553-2031																							
11-6					210-460																							
11-8					251-7546																							
11-10	1-0				2873-20400																							
11-11			0-1		260-437																							
11-13					526-174																							
11-14	20-0		4-0		389-11490-2			1-2																				
11-15	5-0				110-366																							
11-17	37-1				148-985																							
11-20	1-1		1-0		0-36																							

11-22			1-0																									
11-24					0-2																							
11-27	52-0				9-463	1-7		0-1										0-1										
11-29	5-0				0-1													1-0										
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
12-1	1-0																											
12-4																												
12-8																												
12-11	6-1				8-92													0-1				0-1						
12-13			2-0			0-20												2-0										
12-15	2-2		1-0			0-11													1-0	0-1								
12-18	3-6				1-3																							
12-20	0-3																			0-1								
12-22	1-0																											
12-29	8-4		1-0		0-3	0-1												1-0										
2001																												
1-1																												
1-3	0-2																											
1-5																												
1-8																		1-1										
1-10																												
1-12	0-2																											
1-15																												
1-17																												
1-19			0-1															2-0										
1-22	0-19				2-1	1-0												1-0										
1-24	0-4																											
1-26	0-1																	1-0										
1-29	1-0																											
1-31	1-2																	0-2										
2-2	0-1																											
2-5	0-3		0-1		0-1													0-2										
2-7	0-1																											
2-9					0-1																							
2-12			1-0																									
2-14	0-1																	1-0										
2-16	0-2							1-0										1-2		0-1								
2-19	0-8				0-1													1-0										
2-21	3-21		2-1		1-0	1-1												1-1	0-1									
2-23	0-14		1-3					0-1										0-3										
2-26	0-6																	0-1										
2-28	0-13		0-1		0-1	0-4		0-1												2-2								

3-2	0-9		0-1		2-0	0-1	1-0											0-1									
3-5	1-3					1-0																					
3-7																											
3-9																											
3-12	1-1					0-1												1-0									
3-14	3-0																										
3-16	2-2																0-1	0-1		0-1		1-0					
3-19	12-0																										
3-21	20-2	2-0															1-0			1-0							
3-23	5-0																1-0										
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
3-26	3-0	2-0																									
3-28	1-0		1-0																								
3-30	3-2		1-1				0-2																				
4-2	0-7					1-0																					
4-4	0-4					3-8											0-1			1-0		1-0					
4-6	0-4																										
4-9	0-3					0-3											0-2			1-0							
4-11	0-1				2-0	1-1														1-0							
4-16	0-2																			1-0							
4-18	0-1																										
4-20						0-1																					
4-23	0-1																										
4-25					1-0			2-0																			
4-27					1-0	0-1																					
4-30			0-1																								
5-2	0-1					1-0														0-1							
5-4								2-0																			
5-7																						1-0					
5-9								3-0																			
5-11						1-0		2-0																			
5-14						2-0												1-0									
5-16						1-0		1-0									0-1										
5-18																				1-1							
5-23								0-2														0-1					
5-30	1-0																										
6-1	0-1																	1-1		0-1							
6-4								1-0										0-2									
6-6								2-0										0-2									
6-8								0-4										1-2									
6-11								1-0																			
6-13					35-13	6-7	2-2	2-1										6-1		2-0		2-0					

Appendix I

6-15					0-4	4-10		3-2										42-1				1-0					
6-18					0-4	10-0		1-1										17-0				1-0					
6-20					1-0	22-1		2-0										52-0	2-0								
6-22					1-0	4-1		1-1										6-0									
6-25						2-2												13-0							0-1		
6-27						21-1		0-1										28-0									
6-29						27-1		1-0										6-0									
7-2						4-2		2-0										7-0									
7-4						2-4		0-1										5-1									
7-13						4-1																					
7-16						1-0																					
7-18						1-2												2-0									
7-20						0-1																					
7-23						0-2																				1-0	
7-25					0-1	2-0																					
7-27						1-1		2-0										2-1									
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
7-30					0-1	0-1		0-1										1-0									
8-1																		1-1									
8-3																		2-0									
8-6						1-2																					
8-8		1-0			6-8	13-22	2-7	14-7										7-3		1-0							
8-10					0-4	2-4	1-2	2-7										5-0									
8-13						0-3	1-1	7-22										1-1								1-0	
8-15					0-1	0-2	0-2	1-21							0-2			2-1		1-0							
8-17							2-1	4-41									1-0	5-0									
8-22						1-6		0-13										1-2									
8-24								0-5										0-1								1-0	
8-27						3-0												0-2								0-1	
8-29						1-0		1-0										2-0								1-0	
8-31						0-2		2-0										1-1									
9-3						0-4		0-2																			
9-5						0-7		0-5										0-1									
9-7						0-10		0-5																			
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap

Appendix I

Study Pond #1, **Year 7**: Vertebrates trapped in drift fence buckets over a one-year period, 9/10/2001 - 8/30/2002. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
2001																												
9-10						0-4												0-5										
9-12																												
9-14						1-0		0-2																				
9-19						2-2																						
9-21						1-1												1-1										
9-24																		0-2										
9-26														0-1m				1-6										
9-28						1-0								0-1m				1-0										
10-1														2-0m				1-0										
10-3						1-0								0-2m				1-0										
10-5						1-0		4-0						1-1m				0-2										
10-8						1-1		1-0						1-0m				4-5										
10-10														1-0m				6-0										
10-12						1-0												1-1										
10-15						0-2								1-0m				0-2										
10-17						1-0																						
10-19						1-0												4-1		1-0								
10-22						1-2												1-0							1-0			
10-24						6-0												4-3										
10-26																		2-10										
10-29														2-0m				6-2										
10-31																		2-2										
11-2						0-1												1-0										
11-5						3-1			1-0									2-1										
11-7						1-0												3-1										
11-9																		5-3										
11-12														1-0				0-1										
11-14								6-0										2-0							0-1			
11-16																		1-1										
11-19								3-0						1-0														
11-21								7m-0																				
11-23						0-1		0-2																				

Appendix I

11-26						0-2												0-1									
11-28						0-3												0-1									
11-30						0-2												0-1									
12-3																											
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
12-5						1-0																					
12-7																		1-0									
12-10																											
12-12																											
12-14	0-2		0-1			1-1																					
12-17	15-0					0-1												1-0									
12-19	2-0																	1-0									
12-21						0-1																					
12-24			1-0																								
12-26																											
12-28																											
12-31																											
2002																											
1-2																											
1-4																											
1-7																		0-2									
1-9	0-1																	0-1									
1-11	0-1																										
1-14																		1-0									
1-16																		1-1									
1-18	1-0								1-0									0-1									
1-21						1-0												1-0									
1-23	1-0																	0-1		0-2							
1-25										0-1																	
1-28	1-0	1-0								0-1								1-0									
1-30										1-0								2-0									
2-1								2-0										3-0									
2-4							1-0	1-0	3-0									0-1									
2-6						1-0																					
2-8	0-1					1-0												1-3				0-1					
2-11	1-1						1-0											0-1									
2-15	0-1																										
2-18						0-1		1-0										2-0									
2-20							1-0	1-0										0-1									
2-22	0-1					3-0		4-1										0-1							0-1		
2-25	0-1					0-2		0-1										1-0		0-1							
2-27									2-0																		

3-4	4-0				0-1	0-1												1-0										
3-6	1-0					1-1												0-1										
3-8						3-9																						
3-11	3-1					42-5		2-0	1-0																			
3-13	1-2					0-39		1-0										1-2										
3-15	2-3					0-3				0-1										0-1								
3-18						6-7		19m-0	0-1									0-1		1h-1		1-0						
3-20	0-4					1-5		2-0									0-1	0-2		0-1								
3-22	0-1					3-0		0-1										1-0										
3-25	0-10s					1-5		1-0										0-2		0-1								
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
3-27	1-2s					4-2		3-4										4-4										
3-29						0-2												3-1										
4-1	1-1					7-3		3-1	0-1									2-8										
4-3						0-3		0-3										0-4										
4-5					1-0	0-3											0-1	5-2										
4-8	0-1s					1-0											0-1	3-0	1-0									
4-10					2-0	1-0		8j-0										0-5										
4-12						2-0		8j-0										1-2										
4-15	0-1s					1-1												3-2										
4-17						0-2		0-6										0-2										
4-19						5-1		3-0										1-2		1-1								
4-22						2-4		0-2j										0-2		1-0								
4-24						2-0	1-0	7j-0																				
4-26					0-1	0-1		1-2										0-1										
4-29					0-1	1-0	1-0	31j-0										0-1	0-1									
5-1						1-1		10j-0										1-1										
5-3								23j-1										0-1										
5-27						3-0		0-1										0-4										
5-29						1-0		1-1										2-1										
5-31						1-0		3-0										0-7										
6-10	0-1m				1-0	0-1	0-1	0-1										0-1		1-0		1-0			1-0			
6-12																		0-1										
6-14						2-0		0-2										0-3		0-1								
6-19					1-0			1-0										1-4m										
6-21						1-0	1-0																					
6-24						0-1		0-2																				
6-28						0-1												1-0										
7-1					0-1	3-0		0-1										1-0										
7-5																												

7-8						0-1																					
7-10																											
7-12																											
7-15						1-0																					
7-17						3-0																					
7-19						0-2																			1-0		
7-22					1-0	2-0																					
7-24																											
7-26																											
7-28						0-1		1-0																			
7-31						0-1																					
8-2																											
8-5						0-1		1-0																			
8-7																											
8-9						1-0																			0-1		
8-12																											
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
8-14						0-1																					
8-16						0-1																					
8-19																											
8-21																											
8-23																											
8-26						0-1		1-1																			
8-28						1-0																					
8-30		site prescribe burned on this date; fences burned up for 6 weeks																									
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap

Appendix I

Study Pond #1, **Year 8.** Vertebrates trapped in drift fence buckets over a one-year period, 11/18/2002 - 09/05/2003. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
2002																												
11-18																												
11-20																												
11-22						1-0																						
11-25																												
11-27																												
11-29																												
12-2																												
12-4																												
12-6	1-0				1-1	1-0			3-0	0-1																		
12-9																												
12-11	2-0																											
12-13	1-0		1-2							1-0																		
12-16																												
12-18																												
12-20					0-2	0-2														0-1								
12-23	2-0				1-0																							
12-29			1-0		0-1													2-0										
2003																												
1-1	6-0		2-0		0-1													12-2									
1-4			1-0															3-1									
1-9			1-0								0-1																	
1-11																												
1-19																												
1-22																												
1-26																												
1-31								1-0		0-1								3-1										
2-2																												
2-4	1-0																	0-7										
2-7																	1-0	6-4										
2003																												

Appendix I

2-9																		1-0									
2-16	0-2		1-0		1-0	1-0				calling								1-3									
2-27	0-3				20-1	3-1											7-0	1-2		2h-0							
2-28	0-1				0-14	9-0		1-1									3-0	3-1									
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
3-1					0-1	0-7												1-0									
3-4	5-1		2-0		0-9	1-0											3-3s	2-1									
3-6	1-1		3-0		0-1	32-1		0-1										4-0		3h,1-1	1-0						
3-7	1-0				1-0	1-27		0-1									1-3s			3h,2-1h	1-0						
3-8						0-1												1-0									
3-10			1-0		0-3	2-4			1-0								2-2s+	1-0				1-0					
3-14	0-3					13-1		1-0	1-0								2-3			3h-0							
3-17	0-3		1-0			1-12		0-1	0-1								1-3	0-5									
3-19	0-1					1-3		1-1										2-1				1-0					
3-21	1-0		1-0			17-3												1-0		3h-0							
3-24						2-1	1-4													2-0							
3-26																											
3-28						3-0	1-0	1-0																			
3-31	0-1					0-2	7-1																				
4-2							2-0	1-0										0-1									
4-3						2-0																					
4-7						5-1	5-0	1-3																			
4-9						0-1		0-1										0-1									
4-11						1-2		1-2										0-5									
4-14								1-0										0-1									
4-16						2-1	0-1	1-0										2-2									
4-18						0-1		1-0										4-8									
4-21							1-2	2-1										6-29m		0-1							
4-23						0-1		3-0										7-35									
4-25							1-1	0-1										2-12m									
4-28																		4-9									
4-30						2-0												4-1									
5-2						0-2	3-1											0-115m									
5-5						1-2	2-0	1-0										0-3							0-1		
5-7							1-0	1-0										0-16m									
5-12						1-1												0-18m									
5-14						0-1		4-0										0-1									
5-16						2-0		2-0										0-34m									
5-17	0-1					1-7	0-3	0-1										2-80m									
5-19						4-1		1-0						0-1				49m-18		1-0							
5-21						0-1								0-2				49m-40m									

Appendix I

5-23	0-1					3-3	26-0	52-0									40-120m											
5-26	0-1					0-1	3-5	10-2						0-1			78-10		0-1									
5-28						0-1	3-0	12-8									19-9		0-1									
5-30							2-1	13-3						2-2			10-0											
6-2	0-2					1-1	1-0	13-2									0-1m/15-136m											
6-4	0-2						0-1	15-1	1-5								0-3m/42-114m											
6-6	0-1					1-0	1-0	17-0									0-21m/19-66m		0-1									
6-7	1-20m				1-0	1-1	16-1	111-3									0-19m/0-120m											
6-8	0-8m					4-1	96-11/299-15										1-36	13-393										
6-9	0-5					1-4	25-36/94-62/0-3										1-59	59-97										
6-11	0-4					2-2	0-19	10-22									2-149	67-32										
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
6-13	2-3					4-0	2-1	3-0						0-1			22-183/	78-15										
6-14	1-9					1-2	1-6	8-7	0-4								63-255/64-726											
6-16	1-4						0-2	2-0									14-206/70-167					0-1						
6-18	0-13					1-0	1-2	16-9									12-258/24-243											
6-19	all buckets full of water																											
6-20	0-19				1-0		65-0	30-0									2-144	20-92										
6-23	0-1				0-1		13-5	9-0									3-195	16-25								0-1		
6-25	0-1				1-0	1-0	1-0	0-4									11-146	13-0		1-0								
6-27						0-1	2-0										30-132	12-23										
6-30	0-6				0-1	1-1	1-3							0-1			29-194	1-224										
7-7	0-2					1-0	1-0	1-1									11-81	6-28										
7-9						1-0											0-57	25-11										
7-11	0-1																2-50	6-24										
7-14																	32-8	24-39							1-0			
7-16																	2-15	20-22		0-1					2j-0			
7-18																	0-20	3-46										
7-21								1-0									1-8	0-4							0-1			
7-23	0-1							1-0									0-4	0-24										
7-25	0-1																0-5	0-11										
7-28						1-0											0-6	7-7										
7-30																		2-1										
8-1								1-0									0-2	1-14m										
8-11	flooded buckets, water high																	1-1										
8-13																	0-1	0-5										
8-15								1-0										1-2										
8-18																												
8-20																		0-1										
2003																												

Appendix I

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
08-22																												
8-25																		2-2								1-0		
8-27						1-0												1-1										
8-29																		0-1										
9-1								1-0																				
9-3																												
9-5																		0-2										

Appendix I

Study Pond #1, **Year 9**: Vertebrates trapped in drift fence buckets over a one-year period, 9/8/2003 - 9/8/2004. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
2003																												
9-8																												
9-10																												
9-12																												
9-17																												
9-19																												
9-22																												
9-24																												
9-26																												
9-29																												
10-1																												
10-3																												
10-6																												
10-8	0-1																	2-0										
10-10																												
10-13	0-3																											
10-15																												
10-17																												
10-20	0-1																											
10-22																												
10-24																												
10-27	0-2																											
10-29	0-6																											
11-3																										1-0		
11-5	1-3																		1-0							0-1	5-0	
11-7																									1-0	1-1		
11-10																										0-2		
11-12																										1-0		
11-14																										1-0		
11-17																			3m-0						1-0			
11-19	0-3m					1-0											1-0	1-2		0-1						0-1		
11-21	0-2																											
2003																												
11-23																												

Appendix I

11-26																		0-1										
11-28	2-1					0-1																						
12-1	1-0		1-0																									
12-3	1-0																											
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
12-5																												
12-8																												
12-10	1-0										1-0							2-0										
12-12	1-0																											
12-15	1-0																											
12-17																												
12-19	3-0																											
12-22																		1-0										
12-24	3-5																	1-2										
12-26																												
12-29	1-2																											
12-31	2-1																	1-0								0-1		
2004																												
1-2																												
1-5	1-0																											
1-7																												
1-9																		1-0	1-0									
1-12																												
1-14																												
1-16																												
1-19	0-2									1-0										0-1								
1-21	0-1																											
1-23																												
1-26																				0-5					0-1			
1-28																				0-2								
1-30	0-7		1-0															2-0		0-3					0-1			
2-2	2-4																	2-0		0-1								
2-4	2-4																								0-1			
2-6	0-5																											
2-9	0-9																1-0											
2-13	0-35m									1-0							0-1	1-0										
2-11	1-55m									1-0																		
2-15	5-96m								1-0	3-0								1-0										
2-16	0-2									1-0																		
2-18	2-0									1-0																		
2004																												
2-20	0-2																	0-1										

2-23									6-1									1-0		2-0							
2-24	2-162m					1-0				0-7								1-1									
2-25	3-22m					6-0											2-0	8-0	0-1		1-0						
2-27																											
3-1	0-15m					0-2				1-1							1-0	2-0									
3-3	2-2		1-0			1-1			4-0	2-0							0-1	2-0		0-1							
3-5	0-4a					2-3												2-0	2-0							1-0	
3-8	1-7a					0-2											1-0	1-0			1h-0						
3-10	0-9a					1-0															1h-0						
3-12	0-1																0-1										
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
3-15	1-3																			1-0								
3-17	0-18a					1-1																					
3-19	0-2						1-0	0-1																		1-0		
3-22	0-2				0-1j			2j-0	2-0											1-0								
3-24	0-2									1-1																		
3-26	1-1							8j-0		1-0								1-0		1-0								
3-29	1-2					0-1		4-1	0-2											2-0						1j-0		
3-31	0-35					0-2		22j-0		0-1							0-1	1-10	0-10	1-0								
4-16	0-6					1-0		1-0										0-7	1-0									
4-19	0-1					0-1		1-0	0-2									1-2	1-0									
4-21						1-0		2-0											0-1									
4-23	0-2					0-1		0-1																				
4-26	0-2					2-0		14j-0																				
4-28	0-1							3-0										1-0	0-1	0-1								
4-30	1-7					2-0													1-1	2-2	0-1							
5-3	0-10		0-3			9-2		0-1										0-2		1-0								
5-12	1-2		0-1			0-3		2-0										2-0	0-1	0-1								
5-17	0-1							0-1										1-13	3-7	0-2		0-1				0-1		
5-19	0-1																	3-8	1-0									
5-21								1-0										3-5	1-1									
5-24						1-0		7j-0										4-1	1-1							1-1j		
5-26								2-0										1-1	0-1									
5-28																		1-1								0-1j		
5-31								8-1												0-2								
6-2	0-2		0-5			0-1		3-4											0-1	0-2						1a-0		
6-4	0-1		1-2				2-0	1-0												0-3								
6-7			0-3			2-0	3-0	2-0											2-0						0-2a			
2004																												
6-9						1-1	3-0	2-2																				

Appendix I

6-11						1-1	2-0	6-0											0-1				1-0				
6-14	0-1		1-0					4-0										1m-0	0-2								
6-16							72-1	65-0											1-0								
6-18							2-28	3-36										1-0	3-0				1-0				
6-21						1-0	3-3	6-18																			
6-23						1-1	2-3	1-4																			
6-25						9-4		3-1										1-0									
6-28			2-1			1-1	21-15	8-9											3-0								
6-30						0-3	2-15	22-27									1-0	1-1	2-0								
7-2						0-2	2-1	4-20									2-0		2-1	1-0							
7-5						0-1	1-2	2-0																			
7-7							1-2	0-3																			
7-9						1-0	0-1	2-1									1-0										
7-12						0-3		0-2																	0-2		
7-14						0-1	0-2	0-15										0-1							1-0		
7-16		1-3				1-1		0-3																			
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
7-19						0-1		3-1													0-1						
7-21						1-1		0-4													1-0					0-1		
7-23						1-1		0-1											0-1							1-2		
7-26			0-1			2-0		2-3																		0-1		
7-28						2-0		2-7																			
7-30						0-1		0-1																			
8-2																			0-1							0-2	
8-4																			0-2		1-0					1-0	
8-6								2-0																		1-0	
8-9								0-1																			
8-11																											
8-13																											
8-16						1-0		0-1												0-1							
8-18																				0-1	0-1						
8-20						0-1																					
8-23								0-1												0-1							
8-25						1-0																					
8-27						0-1		0-1																			
8-30								0-1																			
9-1								0-6												1-0							
9-3								0-6																			
9-6																											
9-8								1-1																			
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap

Appendix I

Study Pond #1, **Year 10**: Vertebrates trapped in drift fence buckets over a one-year period, 9/10/2004 - 5/11/2005. IN-migration data on left, OUT-migration on right. Species are At=*Ambystoma talpoideum*, mole salamander; Np=*Notophthalmus perstriatus*, striped newt; Nv=*Notophthalmus viridescens*, common newt; Eq=*Eurycea quadridigitata*, dwarf salamander; Sh=*Scaphiopus holbrooki*, spadefoot; Bt=*Bufo terrestris*, southern toad; Bq=*Bufo quercicus*, oak toad; Gc=*Gastrophryne carolinensis*, narrowmouth toad; Ag=*Acris gryllus*, cricket frog; Po=*Pseudacris ornata*, ornate chorus frog; Pc=*Pseudacris crucifer*, spring peeper; Lo=*Limnaoedus ocularis*, little grass frog; Hf=*Hyla femoralis*, pinewoods treefrog; Hg=*Hyla gratiosa*, barking treefrog; Hs=*Hyla squirella*, squirrel treefrog; Hc=*Hyla cinerea*, green treefrog; Rcp=*Rana capito*, gopher frog; Ru=*Rana utricularia*, leopard frog; Rct=*Rana catesbeiana*, bullfrog; Ks=*Kinosternon subrubrum,* mud turtle; So=*Sternotherus odoratus*, stinkpot; Dr=*Dierochelys reticularia*, chicken turtle; Af=*Apalone ferox*, eastern softshell turtle; Ps=*Pseudemys scripta*, pond slider; Ts=*Thamnophis sirtalis*, garter snake; Nf=*Nerodia fasciata*, banded water snake; Pf-*Pseudemys floridana*; Ap=*Agkistrodon piscivorus;* Cs=*Chelydra serpentina*; Sp=*Seminatrix pygaea.*

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
2004																												
9-10								0-1																				
9-13																			1-0									
9-15								2-0																				
9-17						0-1		0-2																				
9-20								0-1																				
9-22			1-0																									
9-24																												
9-27						0-1		0-3										0-1								0-1		
9-29								0-2																				
10-1								1-1																				
10-4																												
10-6																		2-1										
10-8																		2-0										
10-11								1-0										2-12										
10-13								1-0																				
10-15			0-1																									
10-18																												
10-20			0-1																									
10-22																												
10-25			0-1															0-2										
10-27			0-1																									
10-29																												
11-1			0-2															1-1										
11-3																												
11-5			1-0																									
11-8			0-1																									
11-10																												
11-12																		1-0										
11-15			0-1															0-1		0-1								
11-17																												
11-19																												
11-21																												

Appendix I

date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
11-24																												
11-26																												
11-28			0-1																									
12-1																		1-0		0-1								
12-3																												
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap
12-6																												
12-8	4-0		0-1															2-0										
12-10	13-1		2-1		0-1																							
12-13	2-0																											
12-15	2-0																			0-2								
12-17																												
12-20																												
12-22																												
12-24	4-0																	1-0										
12-26																		0-1										
12-27																												
12-29	0-2																											
12-31																												
2005																												
1-3	0-1		0-1																									
1-5																												
1-7																									0-1			
1-10	1-0																											
1-12	0-1																											
1-14	1-2																											
1-17																												
1-19																												
1-21																												
1-24																												
1-26			0-1																									
1-28																												
1-31	0-1																											
2-2																												
2-4																												
2-7																												
2-9																												
2-11																												
2-14																												
2-16																												
2-18																												
2-21																												

2-23																													
2-25	0-5		0-1		3-0			1-1												1h-0									
2-27																													
2-28	0-2neometa							1-0	1-0	1-0											1-1								
3-4	0-1a																												
3-8	1-1a				3+ -0				1-0									0-2										
3-12	1-2s																												
3-14	0-4m					2-0		2-0									1-1s	2g-0											
3-18																	1-0												
3-21	1-0		0-1																										
3-23	1-0					2-0		3-0										0-1											
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	
date	At	Np	Nv	Eq	Sh	Bt	Bq	Gc	Ag	Po	Pc	Lo	Hf	Hg	Hs	Hc	Rcp	Ru	Rct	Ks	So	Dr	Af	Ps	Ts	Nf	Pf	Ap	
3-25	0-2																			1-0									
3-28	1-0				2-0	2-0		1-0																	0-1j	1j-0			
3-30																													
4-1	0-1				2-0															1-0									
4-4	3-0				1-0																								
4-6																													
4-8						1-0																							
4-11																													
4-13								1-0																					
4-15																													
4-18	0-1																												
4-20																													
4-22																													
4-25	1-0							1-0																					
4-27	0-1																												
4-29					1-0																								
5-2								0-1																					
5-4																													
5-6					1-0																								

Drift fence burned on this date by USFS and not restored because I wanted to relax the drift fence pressure
5-11 on the animals.