HABITAT CHARACTERISTICS ASSOCIATED WITH WOOD FROG (*RANA SYLVATICA*) ABUNDANCE IN AN AGRICULTURALLY FRAGMENTED LANDSCAPE

By

KEVIN JAMES RAWLUSYK

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MASTER OF SCIENCE
in
ENVIRONMENT AND MANAGEMENT

We accept this thesis as conforming
to the required standard

....
Dr. Ray Allan, Red Deer College Faculty Member
Natural Sciences Division

....
Dr. Vivienne Wilson, MEM Program Director
Science, Technology & Environment Division

....
Dr. Paul Williamson
Worlds Herpetological Society

ROYAL ROADS UNIVERSITY

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Abstract

In Central Alberta, Canada, agricultural landscapes with scattered patches of fragmented wetlands are common. To investigate the relationship between wood frog (*Rana sylvatica*) abundance and wetland, woodlot, and landscape characteristics, twelve permanent fish free wetlands were intensively sampled. Pitfall arrays were used to capture wood frogs during June 21st to July 11th 2004 and July 21st to August 11th 2004.

Abundance numbers were examined for relationships between various biotic and abiotic characteristics. The characteristics were categorized into three groups that consisted of: wetland characteristics (circumference, water pH), surrounding wetland characteristics (woodlot circumference, proportion of woodlot circumference, average woodlot width, and woodlot area), and woodlot characteristics (CBH, DWM, litter depth, soil moisture, soil pH).

Results showed a strong correlation to all surrounding wetland characteristics. It was concluded that a woodlot circumference of 196 m, a proportion of woodlot to wetland circumference of 0.52 or 52 percent and a surrounding woodlot volume of 1768.4 m^2 were ideal minimums for maximizing wood frog abundance.

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CHAPTER 1 BACKGROUND AND RATIONALE

Introduction

The wood frog (*Rana sylvatica*) is an essential and key component to ecosystems in Central Alberta, as well as every ecotone that they inhabit. They are both a predator and prey with extreme sensitivity to stressors. This sensitivity makes them a valuable bioindicator species. Although the wood frog populations in Alberta are stable, there is limited knowledge of the habitat characteristics that are needed to maintain their abundance. This research probes to discover some habitat characteristics that are essential for the wood frogs survival in an agriculturally fragmented landscape.

In Alberta, woodlots surrounding wetlands are an integral part of the agricultural landscape. These habitats provide important and diverse areas for many different species of mammals, birds, reptiles, fish, insects, plants and amphibians. However, there are few regulations in place to protect these crucial habitats. The lack of regulations to protect habitats and the lack of knowledge of the habitat characteristic that are crucial to wood frogs survival may result in a decline in their population.

This research probed to answer the question of whether surrounding woodlots that are adjacent to wetlands influence wood frog abundance. In answering the research question, the following objectives were investigated:

i) what proportional circumference of surrounding woodlot adjacent to the wetland are ideal for wood frog populations;

ii) what is the minimum woodlot to wetland circumference ratio needed for wood frogs;

iii) what habitat do the wood frogs prefer (woodlot vs non-woodlot) and,

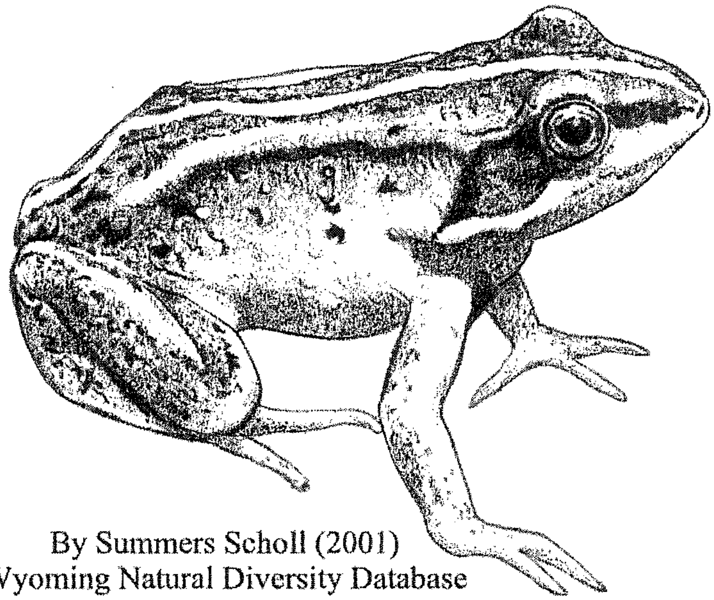
iv) what are other biotic and abiotic factors that influence wood frog abundance in an agriculturally fragmented landscape?

It was hypothesized that an increase in the proportional circumference of surrounding woodlot adjacent to the wetland would increase the local wood frog population. It was theorized that an increase in the percent of surrounding woodlot around the wetlands would provide the essential habitat characteristics needed for wood frogs, thereby influencing their populations. The characteristics that are needed include litter depth, soil moisture, downed woody material, tree circumference at breast height, average woodlot width, and woodlot area. Therefore, it was also hypothesized that an increase in these characteristics would positively influence wood frog populations, while an increase in soil pH and water pH would adversely influence wood frog abundance in an agriculturally fragmented landscape

Wood Frog Characteristics

Description

The *Rana sylvatica* is distinguishable from other frogs by its light tan, deep brown or grey body colour and its distinctive black mask, which covers the tympanum. The black mask contrasts against a white strip, which runs along the upper jaw (Green et al. 1998). The wood frog may have dark markings on the back or a bold white mid-dorsal strip that runs snout to vent (Figure 1.1). Their belly is white with dark flecks at the sides and on the throat occasionally extending onto the chest. The skin is smooth with scattered brown tubercles on the sides and glandular dorsolateral folds running down the sides of the back.



By Summers Scholl (2001)
Wyoming Natural Diversity Database

Figure 1-1: The physical characteristic of the wood frog (*Rana sylvatica*). This illustration exhibits the bold white mid-dorsal strip that runs snout to the vent
Source: Summer Scholl (2001) Wyoming Natural Diversity Database

Reproduction

The wood frog eggs are usually laid in temporary or permanent fish-free wetlands during a brief period of several days. In the Shenandoah Mountains, breeding adults were 100% faithful to the wetlands in which they first bred (Berven and Grudzien 1991). Eggs are laid in various months, with a mean date of breeding increase of 5.2 days per degree of latitude (Guttman et al. 1991). The hatching of the eggs occurs in about 1-2 weeks (Guttman et al. 1991). Larvae metamorphose occurs within a few months during the spring or summer, depending on locality. The period from fertilization to emigration from wetland varies depending on location but can range from 11 weeks to 16 weeks (Riha and Berven 1991). In Maryland, 20,262 juveniles emerged from a single wetland in one year (Berven 1988). Wood frogs sexually mature in 2-3 years (Berven 1988).

Migration

The wood frog can migrate up to several hundred meters between breeding wetlands and nonbreeding terrestrial habitats. The range of the wood frog usually remains in an area <100 m across after leaving the breeding wetland (Berven and Grudzien 1991). In the Shenandoah Mountains, dispersal data indicated that wetlands separated by a distance greater than 1000 m experience little gene flow (Berven and Grudzien 1991). This data is significant because if an area becomes extirpated, the time of recolonization may be extensive when a location is fragmented. However, in Minnesota, populations were very similar in allelic frequencies, even at distances greater than several kilometers (Squire and Newman 2002), which showed that migration of great distances might occur.

Ecological Importance

Amphibians are a crucial component to the diversity of ecosystems they inhabit as they serve numerous roles. Most amphibians live anywhere from a few months to several years in a larval stage prior to becoming pre-reproductive juveniles and reproductive adults. This is important because over their life history they can contribute to multiple levels within a trophic structure. As aquatic larvae, wood frogs serve as important herbivores as well as a valuable source of prey (Blaustein et al., 1994; Dickman 1968). Wood frog larvae eat algae, plant tissue, organic debris, and minute organisms in water and are capable of eating amphibian eggs, hatchlings and invertebrates (Petranka and Kennedy 1999). Metamorphosed frogs eat various small invertebrates, mostly terrestrial forms. It has also been suggested that they can comprise the majority of vertebrate biomass in some systems (Blaustein et al. 1994; Petranka et al. 1993; Wake 1991). As adults they can be the top carnivores, consuming insects and other invertebrates. Consequently, it is thought that a loss of amphibian populations could have a detrimental effect on many of the species that coexist with them.

Many believe amphibians serve as a bioindicator species, as they can give insight to the general state of the environments they inhabit (Wake 1991). This status is primarily due to their highly permeable skin. Wood frogs skin is their main organ of osmoregulation, which can readily uptake any contaminants from their surroundings (Ralph 1978). This uptake of contaminants is one of the reasons many amphibians are especially susceptible to even small changes in their local habitats or climates (Demaynadier et al. 1998). Wood Frogs high sensitivity to stressors makes them one of the first groups of organisms to exhibit a negative response to environmental stresses. An early detection of environmental stressors leads to an understanding of why amphibians apparent global decline has caused such alarm in the scientific community as well as the popular media.

Distribution and Status

The wood frog is widespread and abundant in many areas in North America (Figure1-2). The wood frog is distributed along eastern North America from the Appalachian Mountains to the Arctic Circle (Berven 1990). Wood frogs can be found in high latitudes such as Northern Alaska and Labrador (Chubbs and Phillips 1998). Wood Frogs are rare in Idaho. They have only been found in the two northernmost counties of Idaho (Nussbaum et al. 1983).

Figure 1-2: The shaded area depicts the distribution of the Wood Frog, (*Rana sylvatica*) in North America.

As a result of their abundance and distribution in North America, conservation is currently not of concern in the vast majority of the range. However, research has shown that many local populations have declined as a result of habitat alteration, resulting from agricultural and intensive timber harvesting practice. Table 1-1 illustrates the current conservation status of the wood frog in Canada and the United States of America (Natureserve 2003). The ranks represent a prioritization scheme used by the network of Natural Heritage Programs and Conservation Data Centers to determine the conservation status of a species. The rank is primarily based upon the number of known occurrences but other factors such as habitat quality, estimated population size and trend, range of distribution, and threats to species or habitat are also considered (Master 1991; Morse 1993).

Table 1-1: Conservation status Rank in the United States and provinces of Canada.

Wood frog Status Rank	**State/Province**
Secure	Connecticut, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, Wyoming, Alberta, British Columbia, Labrador (Newfoundland), Manitoba, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec
Apparently secure	Arkansas, Delaware, Georgia, Indiana, Saskatchewan
Vulnerable	Alaska, Colorado, Illinois, Missouri, South Carolina
Imperiled	Alabama, District of Columbia
Critically Imperiled	South Dakota
Possible Extirpated	Idaho
Unranked	Minnesota, Montana, North Dakota, Ohio, Oklahoma, Newfoundland, Northwest Territories, Yukon Territory

Secure - Common, demonstrably widespread and abundant
Apparently secure - Cause for some long-term concern; usually more than 100 occurrences or 10,000 individuals
Vulnerable - Rare or uncommon but not imperiled; typically 21 to 100 occurrences or 3,000 to 10,000 individuals
Imperiled - typically 6 to 20 occurrences or 1,000 to 3,000 individuals
Critically imperiled - typically 5 or fewer occurrences or 1,000 or fewer individuals

Management strategies

The challenge of protecting the wood frog from any decline stems from the lack of research and scientific studies that report on the conditions needed for their survival. Such data could then be used for the creation of management plans and regulations that are based on the specific needs of the wood frog and the unique habitats they occupy. In an agricultural setting, wood frogs breed in wetlands that are usually isolated or fragmented. Destruction of these locations may cause extirpation in that location as migration of travel is limited. As a result it is imperative to preserve these locations.

Wetlands are naturally occurring landscapes throughout areas of agricultural habitats. The breeding populations that they host are physically separated from one another. It is accepted that the structure of such fragmented populations is predicted by the theory of island biogeography. Island biogeography theory states that the equilibrium species number on an island should increase with island area and decrease with island distance to the source population (MacArthur & Wilson 1963, 1967). Island biogeography theory was developed through the study of oceanic islands but is applicable to any habitat "islands", meaning patches of suitable habitat separated from one another by uninhabitable areas (Wiggins et al. 2003). "Island" habitats can be extremely diverse with examples ranging from forest fragments, individual host flora and, as will be seen in this study, wetlands and woodlots in an agricultural landscape. Inherent within this theory is the concept that there is some degree of species turnover between habitat patches; meaning species may experience periodic local extinctions with the possibility of recolonization. Also, when a species becomes extirpated from a particular fragment, its recolonization by individuals from neighboring fragments is dictated by island biogeography theory. Hypothetically, the larger a recently extirpated patch is and the closer it is to occupied neighbors, the sooner it will be recolonized through immigration. However, there are many other factors that affect migration between islands, which may be species-, habitat- or case-specific. In the case of the wood frog, recolonization may be a slow process as their migration distance is limited due to their physiology.

Wetlands and woodlots can be seen as "islands" in Central Alberta. These areas are extremely important to the survival of the wood frog, however many people have traditionally viewed wetlands as wastelands despite the fact that wetlands reduce the impact of flooding, control erosion, purify water by removing sediment and nutrients and contribute to groundwater recharge. The woodlot riparian zone surrounding the wetland is also ecologically important. Naturally vegetated riparian areas reduce the amount of sediment and nutrients entering wetlands and streams and provide habitat benefits to fish and other wildlife. Sediment can damage fish spawning habitat and reduce food supplies for fish resulting in lower fish populations. Shoreline vegetation provides shade, reduces water temperature and improves habitat for fish.

Despite the vast importance of these areas for their multitude of functions, Alberta has limited regulations to preserve them. Alberta Agriculture Food and Rural Development 2003, suggest that landowners adopt and practice management activities to protect wetland and woodlots in their agricultural properties (Table 1-2). These actions are only suggestion with no legal recourse for those who do not obey. Losing these areas will have detrimental effect on the abundance of wood frogs in the area.

Table 1-2: Alberta Agriculture, Food, and Rural Development 2003 Management suggestion of Woodlots and Wetlands in Alberta
Source: Bozic Toso (2003) Alberta Agriculture, Food, and Rural Development.

Do not drain or fill any portion of a wetland.
Avoid forestry operations in riparian areas as much as possible. If necessary use singletree or small patch harvesting methods to reduce negative impact from any operations in the riparian zone.
Reestablish the vegetation in riparian zones by planting appropriate trees or shrubs.
Leaving snag trees, "wolf" trees and naturally fallen trees. These trees provide important habitat for many wildlife species.
Fence off wetlands and riparian areas to prevent livestock from using these areas for watering or grazing. Use remote watering systems to improve water quality for livestock.
Build proper bridges or use portable bridges for machinery or livestock stream crossings.
Avoid or minimize activities during the critical periods for wildlife. Consult local Fish and Wildlife personnel for critical time periods.
Control grazing intensity (the number of livestock and the duration of grazing) to reduce grazing impacts in the riparian zone.

CHAPTER 2 LITERATURE REVIEW

Introduction

The wood frog (*Rana sylvatica*) is the most extensively studied frog (Cowan and Storey 2001; Matutte et al. 2000) of the estimated 3125 species of amphibians found globally (World Resources Institute 1986). The studies performed however are not in an attempt to learn what habitat characteristics are essential for the wood frogs survival, instead the research attempts to understand the remarkable antifreeze properties of enzymes found in the skin of the wood frog. Studies that determine habitat characteristics for the preservation of *Rana sylvatica* populations are essential because amphibian populations have been declining steadily, and habitat alteration is one of the key factors contributing to their decline (Blaustein et al. 1994; Smith et al. 2000; Wake 1991).

A global concern

Attention has been drawn to the worldwide decline of amphibian populations during the past two decades. The initial point of interest in amphibian population and the possibility of a global decline occurred in 1989 at the First World Congress of Herpetology (Barinaga 1990). Increasing amounts of experimental evidence lead the Species Survival Commission (SSC) of the World Conservation Union (IUCN) to organize a workshop and subsequently form the Task Force on Declining Amphibian Populations (DAPTF) in 1990 (Wake 1998). DAPTF's preliminary reports, as well as numerous outside researchers, suggest amphibian populations to be unstable at best, with numerous species in decline and multiple documented extinctions (Kiesecker et al. 2001;

Wake 1998). A study of nineteen anuran species, spanning protected areas from Australia to South America, declared the observed population declines as "a serious global concern" (Berger 1998).

Multiple anthropogenic and natural factors have contributed to the amphibian populations decline and extinction. Those factors include parasite and disease (Carey et al., 1999), introduction of exotic species (Kiesecker and Blaustein 1997), ultraviolet radiation (Broomhall et al. 2000), environmental contamination (Davidson et al. 2001) and particularly, habitat loss and destruction (Petranka et al. 1993; Blaustein et al., 1994; Ash 1997). The most significant detrimental anthropogenic factor influencing amphibian population is habitat destruction (Blaustein et al. 1994; Smith et al. 2000; Wake 1991). Habitat loss and destruction is significant because it reduces canopy closure, under story vegetation, non-compacted forest litter, or coarse woody debris (moderately to well-decayed) in areas surrounding breeding sites (deMaynadier and Hunter 1999) all of which are factors needed for amphibian survival.

Factors

The declines in amphibian populations have been attributed to chemical, biological and physical stressors. These stressors alter natural conditions and are detrimental to amphibians. It can be assumed that these factors will influence the wood frogs although few specific studies have focused solely on the wood frog.

Chemical Stressors

Anthropogenic additions of chemical stressors to both terrestrial and aquatic habitats result in amphibian exposure during all phases of their life cycle. The amphibians' highly permeable skin makes them extremely sensitive to environmental toxin and changes in acidity compared to other vertebrates (Blaustein et al. 1990). Decreased acidity level has been linked to amphibian mortality in the embryonic and larval stages. The lower pH results in an incomplete absorption of the yolk plug, arrested development, and deformation of larva which are all mechanisms relating to their population decline (Beattie et al. 1992; Horne et al. 1994). Lowered pH levels also delay hatching (Horne et al. 1994), reduce larval body size (Bradford et al. 1992), disrupt swimming behavior (Andren et al. 1988), and slow growth rates resulting from reduced response to, and capture of, prey (Preest 1993). These physiological and behavioral changes result in a weakened population, as these organisms are easier prey and less effective predators.

Chemical stressors are also linked to indirect sub-lethal effects on tadpoles, as food sources are altered and hindered via increased or decreased levels of algal growth (Vertucci et al. 1993). Anthropogenically acidified habitats can shift the predator-prey relationships between predatory fish and invertebrates which indirectly affects amphibian populations (Henrikson 1990).

Biological Stressors

Biological stressors between amphibians and other organisms play a significant role in determining their distribution and population (Alford 1999). Amphibians that have evolved to coexist with aquatic predators have developed anti-predator mechanisms (Chovane 1992). However, introducing exotic predatory fish to ecosystems with native amphibian population increases amphibian mortality (Gamradt et al. 1996). The colonization of normally fish-free water bodies by predatory fish results in the expiration of amphibian assemblages (Fisher et al. 1996). Introduced predators may also have more subtle effects. Some *Rana muscosa* populations persisting in fish-free environments have become isolated from other populations by surrounding aquatic habitats containing introduced fishes. This may eventually lead to regional extinction by preventing migration among local populations (Bradford et al. 1993). Human consumption of frog legs has also had a devastating impact on frog populations. Prior to 1985, approximately two hundred million frogs were exported annually from Asia. By 1990, India was still illegally exporting approximately seventy million frogs each year, resulting in serious population declines (Oza 1990).

Physical Stressors

Human actions have lead to the depletion of stratospheric ozone and resultant seasonal increase of ultraviolet radiation to the earth's surface (Kerr et al. 1993). Studies have demonstrated that UV-B radiation reduces the survival or hatching success of amphibian embryos (Blaustein et al. 1997; Lizana et al. 1998). Synergistic interactions between UV-B and environmental stresses such as a lowered pH have been linked to embryonic mortality (Long et al. 1995).

Alterations in local weather conditions influence the ecological process of amphibians. Shifts in air and water temperatures alter amphibian-spawning patterns that correlate to the changing patterns of spring temperatures (Beebee 1995). Canadian amphibian populations have decreased because of lower summer precipitation levels and increased temperatures (Herman 1992).

There is mounting evidence that the most significant factor negatively affecting amphibian populations is habitat destruction (or alteration) by humans. This includes activities such as agriculture, deforestation and urbanization. Habitat modification is a well-documented cause of amphibian decline. Altering the habitat adversely affects the ecological process, which is detrimental to amphibians. Removing vegetation via clear-cutting has been linked to drastic modifications in the microclimate regimes (Ash 1997), and a reduction in habitat complexity (Welsh 1990). Habitat modifications along streams influence amphibian populations as the practice increases aquatic salinity (Corns et al. 1989).

The riparian buffer zones including those around wetlands play an important role in maintaining the integrity of the ecosystem as they provide the landscape with plant and wildlife habitat (Brosofske et al. 1997). These zones provide a unique habitat for wildlife as riparian buffer zones experience a lower frequency and intensity of disturbance by fire

(Suffling 1982; Denneler 1999) and have a higher nutrient input than upland forests (Naiman et al. 1997). An estimated 70% of all vertebrate species use riparian habitats in some way during their life span (Raedeke 1989).

Riparian buffer zones found in a forest along small streams have distinct riparian gradients for air temperature, soil temperature, surface air temperature, and relative humidity but no obvious gradient for solar radiation or wind speed (Brosofske et al. 1997). When logging occurs along streams and the riparian zone is removed stream temperatures have been found to increased by up to 3.2 degrees Celsius (Holtby 1988). These changes in the microclimate near watercourses resulting from harvesting can alter the integrity of the riparian buffer zone ecosystem. Amphibians may be particularly vulnerable because they rely on both the cooler temperatures, higher humidity, and reduced wind velocity of near-stream and wetland environments to prevent dehydration and allow for respiratory functions (Petranka et al. 1993; Dupuis et al. 1995).

Some amphibian species have been found to not significantly correlate with most microhabitat variables with the exception of rock and water. Salamander species show the greatest diversity and abundance in stands aged greater than 85 years (Ford et al. 2002). Salamander communities require 50-80 years for full recovery to pre-harvesting conditions following clear-cutting in the southern Appalachians (Petranka et al. 1993). Studies examining the effects that habitat modification has on amphibians in North America have shown mixed results. This fact can be contributed to the diversity of amphibians, forest types, and forestry practices (deMaynadier and Hunter 1995). Studies that have been conducted to evaluate birds' response to riparian buffers have shown that the greater volume of buffer strip contributes to a greater abundance of species (Stauffer and Best 1980; Johnson and Brown 1990; Keller et al. 1993; Darveau et al. 1995; Hannon et al. 2002). Amphibian abundance of the Canadian toad (*Bufo hemiophrys)*, western toad (*Bufo boreas)*, wood frog (*Rana sylvatica)*, and striped chorus frog (*Pseudacris triseriata)* did not change with varying riparian buffer widths in Alberta's boreal mixed wood forests around lakes (Hannon et al. 2002).

CHAPTER 3 RESEARCH METHODOLOGY

Study Site

Wood frogs (*Rana sylvatica*) were collected from twelve permanent (Table 3-1, Figure 3-2) fish free wetlands in Central Alberta (Figure 3-1). All twelve wetlands of similar size were isolated in an agriculturally fragmented landscape with grain crops growing in the fields adjacent to the wetlands. The wetlands were also free of any invasion from cattle grazing. The twelve wetlands differed by the amount of surrounding woodlot along the side of the water. The woodlot tree stands, consisted primarily of white poplar (*Populus alba*) as the canopy tree. There is minimal topographic variation within the study sites, with an elevation varying between 920 and 944 meters above sea level.

Field Data

Amphibian samples were taken in two distinct three-week periods during the summer month of 2003. The first sampling occurred during June 20th to July 11th and the second sampling occurred during July 20th to August 11th. Amphibians were collected every three days using pitfall arrays with collection also occurring on days of precipitation and extreme heat to prevent amphibian death. Other biotic and abiotic data was collected during both sample times.

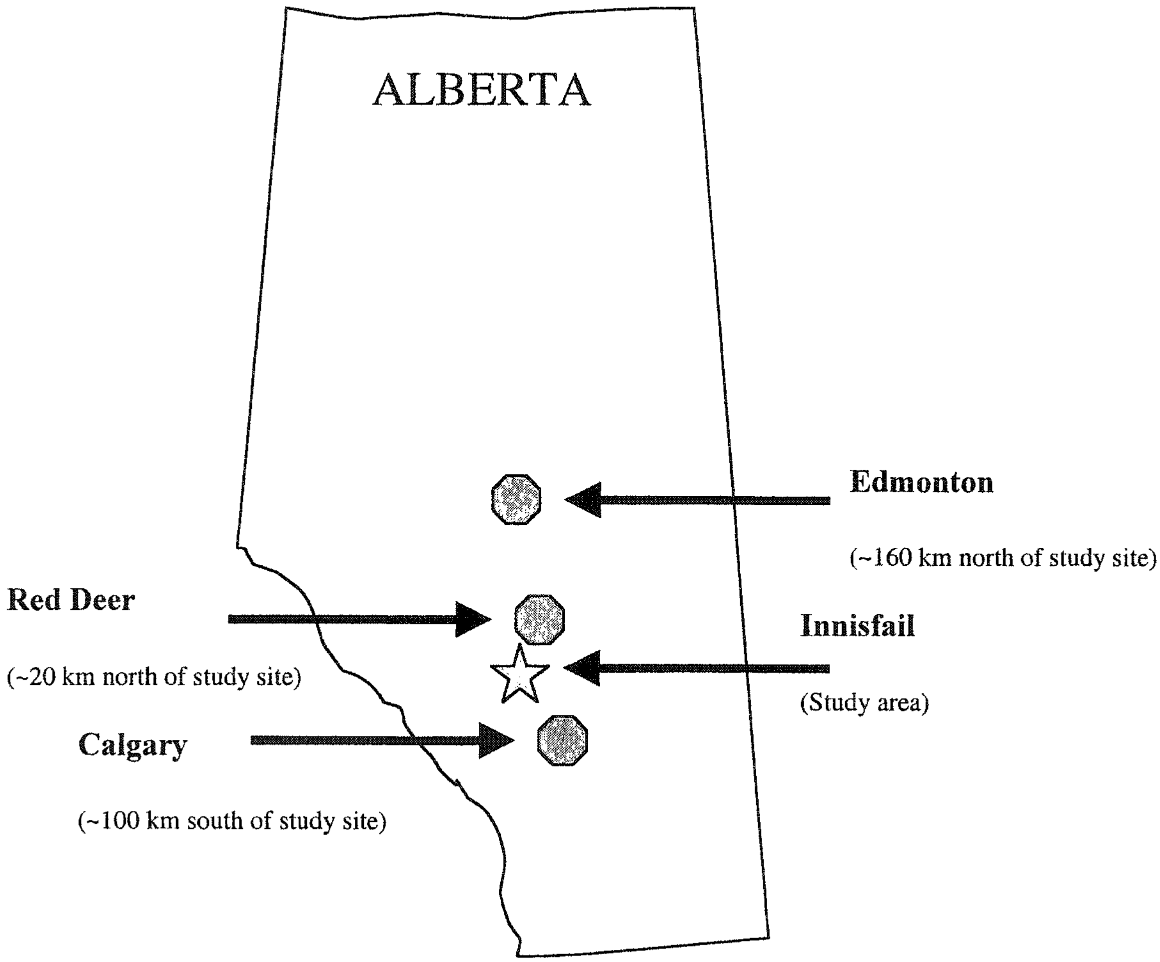


Figure 3-1: Location of study area in Central Alberta

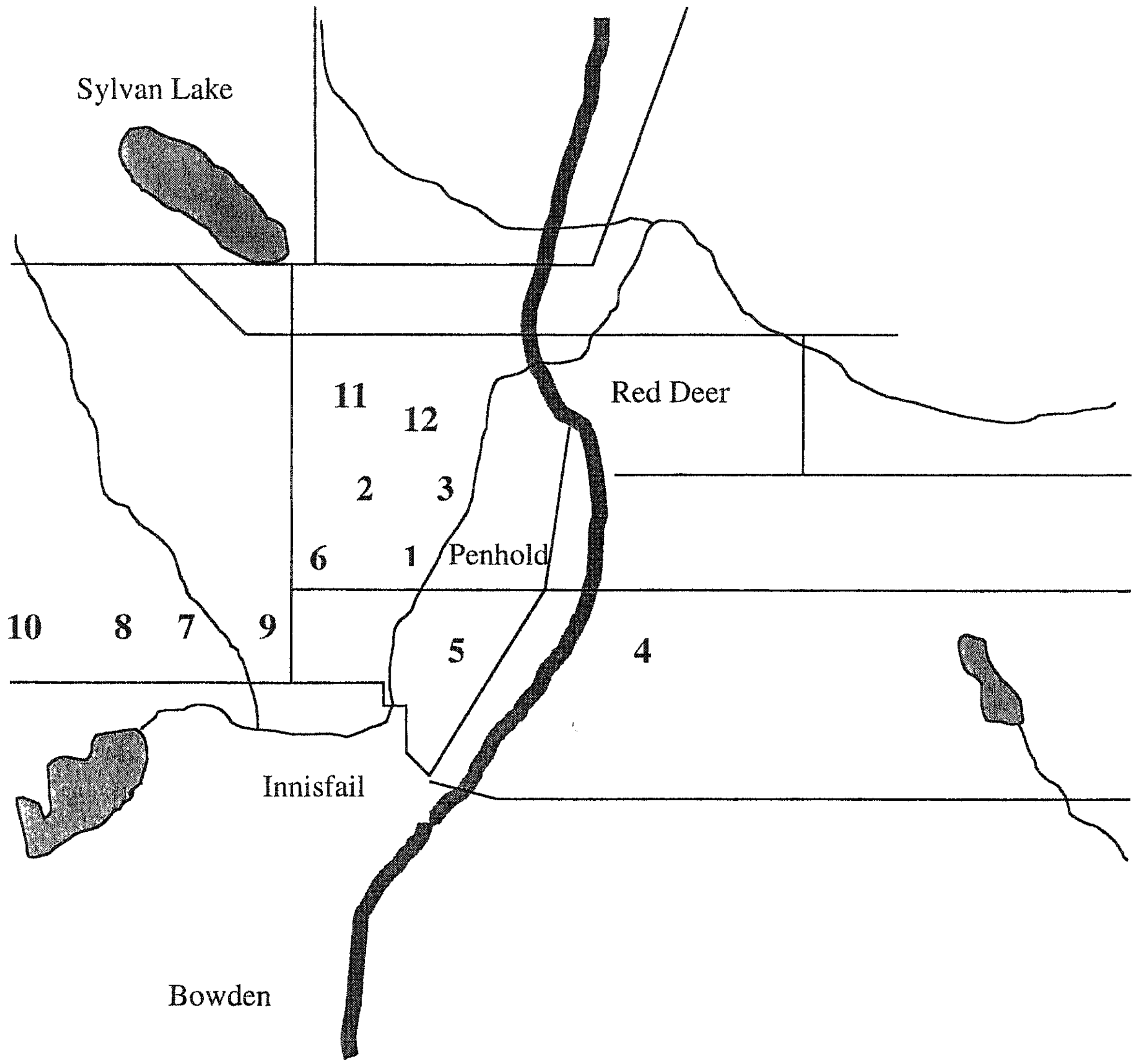


Figure 3-2: Location of 12 study sites

Table 3-1 : Global positioning site locations and altitude

Site	Location	Altitude (m)
1	N 52° 09.354 W 113° 54.874	907
2	N 52° 09.757 W 113° 54.533	908
3	N 52° 10.261 W 113° 53.110	904
4	N 52° 03.365 W 113° 53.668	942
5	N 52° 03.213 W113° 56.966	922
6	N 52° 09.465 W 113° 53.632	908
7	N 52° 02.107 W 114° 61.898	910
8	N 52° 01.905 W 114° 62.152	920
9	N 52° 02.438 W 114° 59.411	909
10	N 52° 01.774 W 114° 62.969	927
11	N 52° 10.645 W 113° 54.541	912
12	N 52° 09.958 W 113° 54.426	910

Sampling method

Wood frogs were collected via pitfall trapping because of its effectiveness in determining relative abundance (Heyer et al. 1994). Around each wetland two pitfall arrays were placed parallel to the wetland at a distance of five meters away from the water. One array was placed in the center of the woodlot section and the other in the center of the non-woodlot section.

The pitfall arrays consisted of two pieces of plywood, which acted as the drift fence. The plywood sheets had dimensions of 60 cm high X 2.74 meters in length. The drift fence was then covered with polyethylene plastic. The drift fence was then buried 10 cm below the soil surface to prevent specimens from going under the array (Ford et al. 2002). The drift fence was held into place by wood stakes (6.0 cm wide X 2.0 cm deep X 30 cm high) on either side of the fence. Four 8-inch holes were dug directly beneath the drift fence with a soil augur to position the four pitfall traps (buried metal containers, 20 cm wide and 25 cm deep). The containers were positioned at the ends and middle of the drift fence (Figure 3-3). Within each pitfall trap a dampened sponge was placed to reduce the possibility of desiccation (Greenberg 2001). Positioned on top of the capture containers a funnel was placed to prevent amphibians from escaping (Figure 3-4). The funnel had a diameter at the top of 21 cm allowing it to fit on top of the metal container and a diameter of 7.0 cm at the bottom.

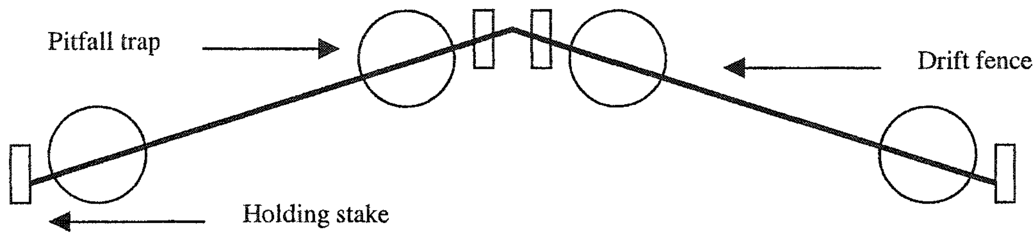


Figure 3-3: Diagram of the set-up for the pitfall array. Illustrated is the drift fence and the position of the pitfall traps

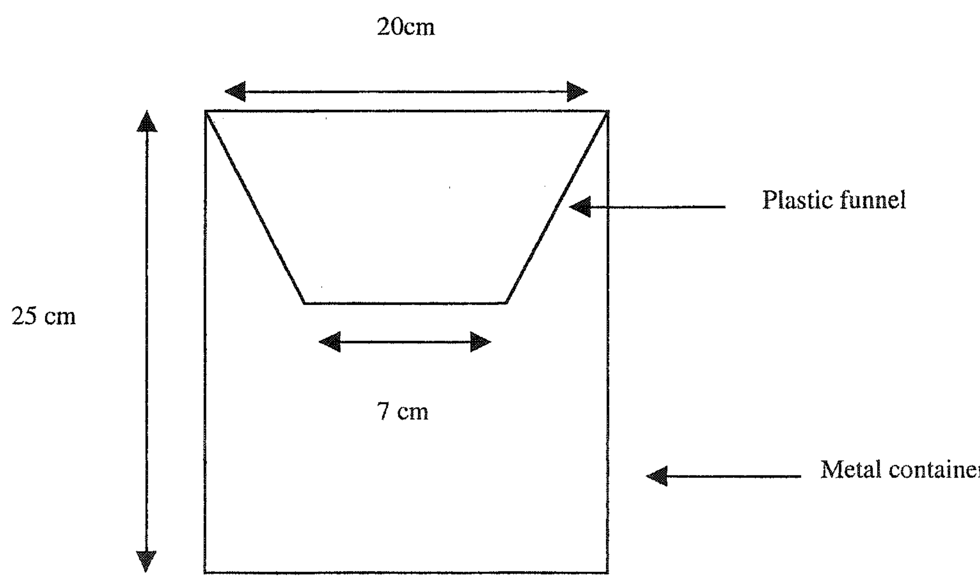


Figure 3-4: Diagram of the pitfall trap showing funnel position

With each collection, the amphibians were measured from their snout to tail using a measuring tape, weighted using a portable digital scale, individually marked by toe clipping and then released at point of capture (Appendix A, Appendix B). Most published reports of toe clipping in amphibians document few adverse effects (Donnelly et al. 1994; Clarke 1972; Reaser and Dexter 1996; Lemckert, 1996; Golay and Currer 1994).

The process of toe clipping involved cleaning the foot gently by spraying a stream of clean water over the skin and toes in order to remove mud and debris. The toe was then position by holding up the foot and toe in a position that is higher than the rest of the foot and vent by holding the animal vertically with the nose pointed to the ground and the toes pointed sky-ward in an attempt to prevent dirty water, feces and urine from running down the leg and contaminating the toe skin. The toe was cut using disinfected scissors. The scissors were disinfected by soaking them for 15 minutes in 70% ethanol, after use on each animal to prevent spread of diseases and build up of contaminants on the scissors. All attempts were made to cut through a joint (inter-phalangeal joint) between toe bones (phalanges). When excess blood (more than 5 drops) was produced from the stump the wound was sprayed with Bactine® and a sterile cloth, was applied to the stump to stem bleeding and enhance clotting. Bleeding was usually minimal and when the bleeding had ceased, the wound was sprayed with Bactine® just prior to release of the animal. The release was on land rather than water to prevent the water from immediately washing off the Bactine® and to prevent any bacteria and water molds to potentially infect the wound.

Site characteristic

Around each wetland the circumference was measured using a measuring tape (Table 3-2). The initial spot of measuring started at the edge of the woodlot riparian buffer zone and went around clockwise as close to the wetland as possible. As the circumference was measured stakes were placed every twenty-five meters. These intervals were used to measure the width of the riparian buffer zone (Appendix C). To measure the width o f the woodlot zone a tape measure was placed on the stake and stretched perpendicular to the wetland to the edge of the farthest tree. If the woodlot was not greater than twenty-five meters in length the measurements to calculate the average width occurred at the edges and in the middle of the forested section. The average width was used to calculate the volume of woodlot surrounding the wetland by taking the width and multiplying it by the length of the woodlot surrounding the wetland (Table 4-6).

Table 3-2. Circumference of wetland; circumference of wetland covered by woodlot; and the ratio of woodlot coverage per circumference

Site	Wetland circumference (m)	Circumference of wetland covered by woodlot riparian zone (m)	Proportion Woodlot circumference (woodlot / circumference)
1	428	0	0.00
2	459	13	0.028
3	345	17	0.049
4	421	38	0.090
5	502	102	0.20
6	543	224	0.41
7	376	196	0.52
8	397	234	0.59
9	474	317	0.67
10	498	428	0.86
11	562	533	0.95
12	512	512	1.0

Vegetation sampling

Vegetation samples were collected from two 4 x 4 m sampling stations (Figure 3-5). Each sampling station was 1 meter clockwise (left) to the pitfall array. Within these sampling quadrants a line transect was placed through the center to measure the diameter and length of the downed woody material (DWM) (Appendix D). Within each quadrant a sub quadrant (Figure 3-5) with dimension of 1 x 1 m was established and all trees (any woody species >5 m in height) were identified to species and the circumference at breast height (CBH) measured (Appendix E).

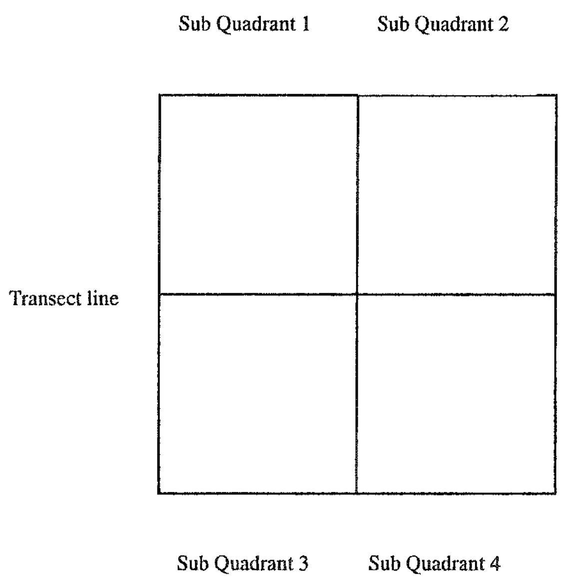


Figure 3-5: Sampling station diagram of quadrant, sub quadrant, and transect line.

Downed woody material

The downed woody material (DWM) that was in contact with the line was classified by species, decay class, and measured for diameter and length (Appendix D). The sum of the diameters divided by the total length of material surveyed was used to determine the percent cover for DWM (Hannon et al. 2002). Each piece of woody debris was then measured for the extent of decomposition using Maser et al. (1979) ranking system (Ford et al. 2002). This ranking system assigns a decay class (1 to 5) based on the majority condition of the entire piece (Figure 3-6). The five classes used to describe the condition of coarse woody debris were based primarily upon wood texture, and secondarily on other characteristics (Table 3-3). Decay class 1 consists of newly fallen materials with little or no decay where a decay class 5 includes completely decomposed material that is faded, soft, and powdery.

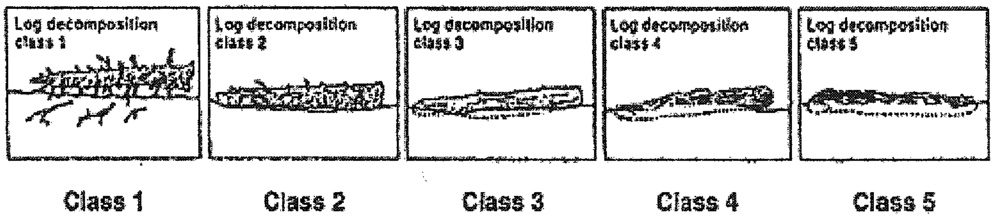


Figure 3-6: Illustration of decay classification and description for downed woody material
Source: British Columbia Ministry of Forests *Field manual for describing terrestrial ecosystems. no.25* 1998

Table 3-3: Physical characteristics of downed woody material use to classify class
Source British Columbia Ministry of Forests *Field manual for describing terrestrial ecosystems. no.25* 1998

	Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
Wood texture	Intact, hard	Intact, hard to partly decaying	Hard, large pieces, partly decaying	Small, blocky pieces	Many small pieces, soft portions
Portion on Ground	Elevated on support points	Elevated but sagging slightly	Sagging near ground, or broken	All of log on ground, sinking	All of log on ground, partly sunken
Twigs <3cm	Present	Absent	Absent	Absent	Absent
Bark	Intact	Intact or partly missing	Trace	Absent	Absent
Shape	Round	Round	Round	Round to oval	Oval
Invading roots	None	None	In sapwood	In heartwood	In heartwood

Tree Circumference at Breast Height (CBH)

Within each quadrant all trees (any woody species >5 m in height) were identified to species and placed in the following Circumference at breast height (CBH) classes: (1) <8 cm, (2) 8 – 15 cm, (3) 16 – 23 cm, (4) 24 – 28 cm, and (5) >28 cm (Hannon et al. 2002). While standing in proximity to the tree, a measuring tape was positioned around the tree at breast height, which in this case was 1.42 meters (Appendix E).

Litter depth

Litter depth was measured at four points along the line transect (Appendix F). At every one meter interval, litter depth was measured by brushing away any leaves in a small area and recording the height of the litter to the O layer with a ruler (demaynadier et al. 1998; Ford et al. 2002).

Abiotic Sampling

Other various abiotic factors were also collected from the 4 x 4 m sampling stations. These factors included soil moisture and pH levels, and water pH levels. These samples were all taken on July 12th.

Soil samples

Soil samples were collected from the centre of the sample quadrant by digging down from the surface level 3 cm and placing the sample in a Ziplock ® bag (Appendix G). The Ziplock ® bag was then kept in cold storage until analysis could be performed (Herbeck et al. 1999). Analysis to determine soil moisture levels involved weighing out a mass of 20 grams into a mortal of known mass. The samples were then allowed to air dry to remove the moisture. The samples were than re-measured to give moisture per gram ratio.

Soil pH levels were calculated using a digital pH metre in a soil water paste mixture (Appendix H). The paste was made by using one part (5 grams) of the dried soil with one part (5 grams) of deionized water (Nation Soil Survey Center 1996).

Water pH

Water pH levels were measured from samples taken from the wetlands on July 12^{th} (Appendix H). The samples were placed in sterile specimen containers and transported to the lab for analysis using a calibrated digital pH meter.

CHAPTER 4 RESULTS AND DISCUSSION

Results

A total of four hundred and twenty three wood frogs were captured during four thousand and thirty two pitfall trapping nights. One pitfall trapping night is determined by every twenty-four hour period, which a pitfall trap is used (deMaynadier et al. 1998; Ford et al. 2002; Hannon et al. 2002). This study consisted of 24 drift fence arrays of which each had four pitfall traps, and the traps where used for forty-two trapping nights (24 arrays x 4 pitfall traps per array x 42 trapping nights = 4032 pitfall trapping nights). Of the total wood frogs collected, sixty-three were recaptures (identified by toe clipping). These recaptured frogs were not included in total abundance numbers thereby resulting in a total of three hundred and sixty different wood frogs captured.

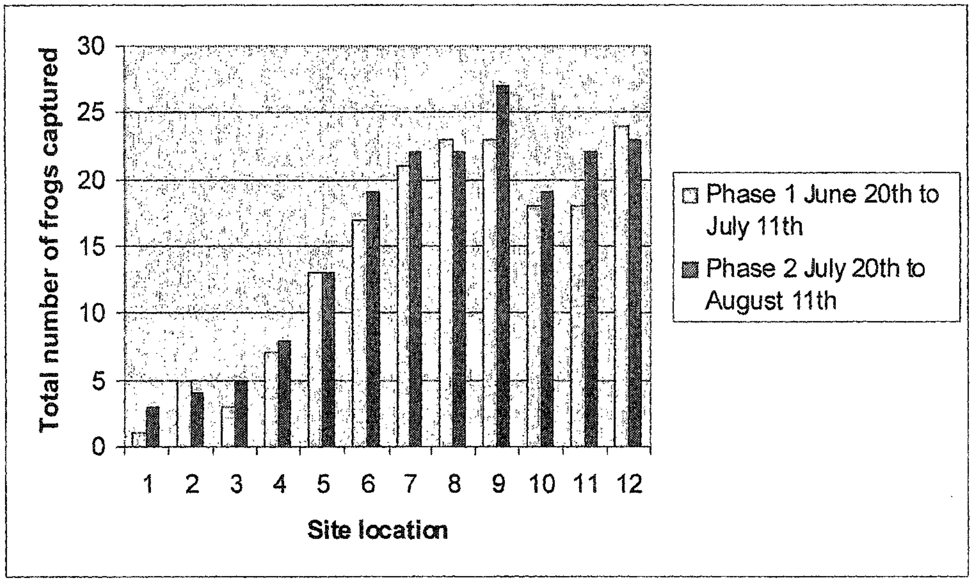
The first phase of the study (June 20th to July 11th) (Table 4-1, Figure 4-1a) captured one hundred and seventy three wood frogs (Appendix A), and the second phase of the study (July 20th to August 11th) (Table 4-1, Figure 4-1a) collected one hundred and eighty seven wood frogs (Appendix B). An F-test was performed to compare whether there was a difference between the two collection phases. The results illustrate that the two samples do not differ significantly ($F_{calc} = 0.963 < F_{0.05(2),11,11} = 3.47$) . A paired sampled t-Test assuming equal variance was also performed to determine if the mean value differed significantly between the two phases. The sample means did not differ significantly ($t_{calc} = 0.338 < t_{0.05(2),22} = 2.07$) therefore the two populations were treated as one for analysis.

Table 4-1: Wood frogs captured during the first phase (June 20th to July 11th) and second phase (July 20th to August 11th) of research. Total frog numbers does not include recaptured frogs

Site	Frogs captured in woodlot Phase 1	Frogs captured in woodlot Phase 2	Frogs captured in non woodlot Phase 1	Frogs captured in non woodlot Phase 2	Total frogs captured*
1	N/A	N/A	1	3	4
2	3	2	2	2	9
3	2	2	1	3	8
4	4	4	3	4	15
5	7	7	6	6	26
6	8	8	9	11	36
7	10	11	11	11	43
8	10	11	13	11	45
9	11	15	12	12	50
10	10	11	8	8	37
11	12	13	6	9	40
12	24	23	N/A	N/A	47

*Numbers do not include recaptured frogs (Those that have been toe clipped)

a)



b)

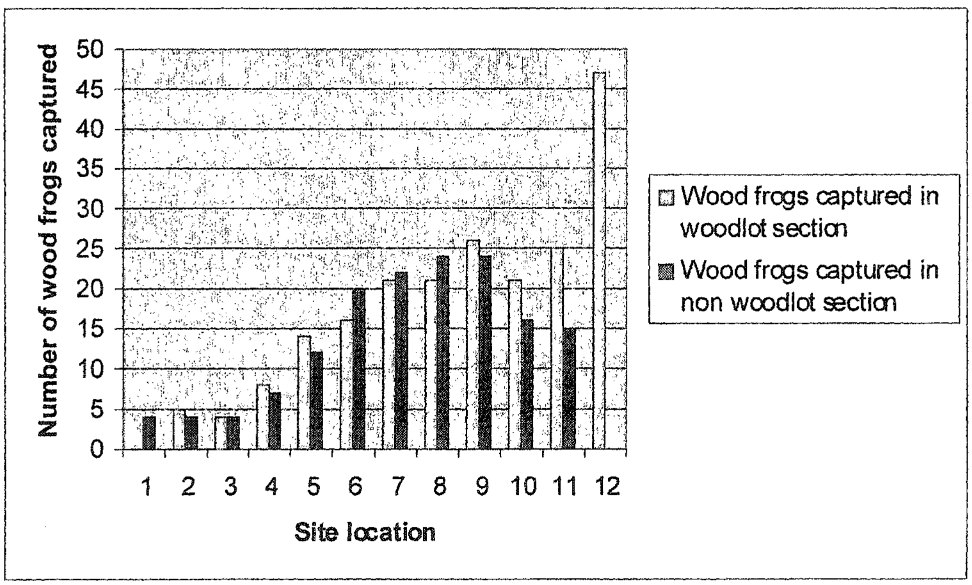


Figure 4-1 a) Comparison of *Rana sylvatica* captured at the twelve individual locations during the two phases of research. b) Comparison of *Rana sylvatica* captured in woodlot section and non-woodlot section surrounding wetland.

Analysis was also performed to determine if there was significant difference between wood frogs captured in the woodlot area (Table 4-1, Figure 4-1b) compared to the non-woodlot section (Table 4-1, Figure 4-1b) that surrounded the wetland. An F-test revealed that the wood frog captures between the two trapping sections did not differ significantly ($F_{calc} = 2.16 < F_{0.05(2),21,21} = 2.40$). A paired sampled t-Test assuming equal variance was also performed to determine if the mean value differed significantly between the two capture sites. The sample means did not differ significantly ($t_{calc} = 1.66 < t_{0.05(2),42} = 2.02$) therefore, the two collection sites are treated as one.

Graphical analysis and correlation coefficients were used to determine the habitat characteristics (Table 4-2) associated with wood frog abundance. The characteristics were categorized into three groups consisting of: wetland characteristics (circumference, water pH), surrounding wetland characteristics (woodlot circumference, proportion of woodlot circumference, average woodlot width, and woodlot area), and woodlot characteristics (CBH, DWM, litter depth, soil moisture, soil pH).

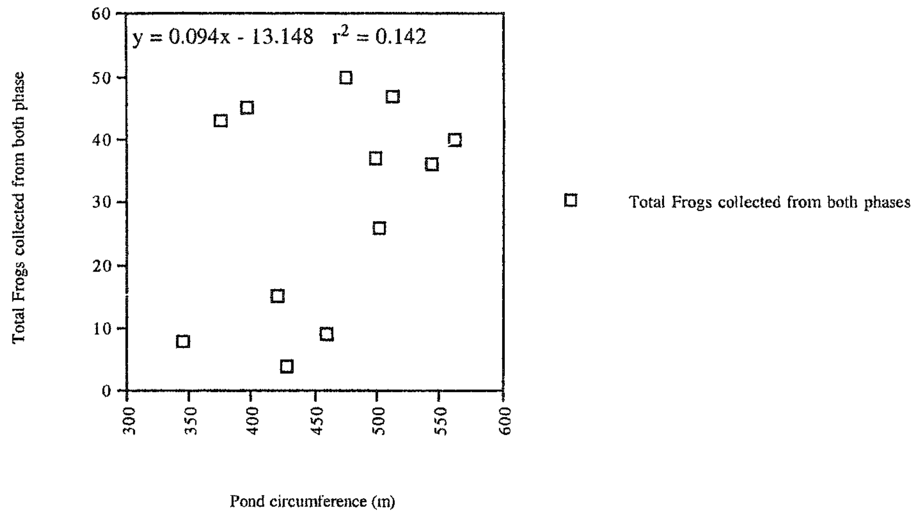
Wetland Characteristics

Wetland circumference size showed no correlation with wood frog abundance ($r^2_{calc} = 0.142$, $r^2_{0.05(2),12} = 0.587$) (Figure 4-2a). Water pH levels also showed no correlation to wood frog abundance at the various site locations ($r^2_{calc} = 0.013$, $r^2_{0.05(2),12} = 0.587$) (Figure 4-2b).

Table 4-2: Summary of site characteristics found around wetlands

Site	Wetland circumference (m)	Woodlot circumference coverage	Average Woodlot width (m)	Woodlot area (m^2	Percent DWM coverage	CBH (cm)	Woodlot average Litter depth	Non Woodlot average litter depth	Average Soil moisture	Soil pH	Water pH
1	428	0	0	0	0	0	N/A	3.56	.4326	6.82	6.74
2	459	12	5.63	73.2	4.58	14.7	1.40	7.22	.4751	6.80	6.77
3	345	17	5.90	100.3	16.77	6.7	1.55	6.78	.4799	6.80	6.69
4	421	38	6.97	264.7	7.77	7.8	1.95	6.10	.4953	6.83	6.70
5	502	102	6.78	691.6	8.36	52.3	1.90	5.63	.4842	6.79	6.73
6	543	224	11.1	2493.1	8.46	23.1	1.83	4.60	.4960	6.81	6.75
7	376	196	9.0	1768.4	7.19	41.6	1.88	7.05	.5285	6.80	6.77
8	397	234	13.2	3079.4	7.11	38.9	1.78	6.18	.5105	6.77	6.69
9	474	317	8.1	2575.0	8.92	34.0	1.78	6.55	.5451	6.82	6.73
10	498	428	9.2	3937.6	7.30	41.8	2.00	5.30	.5253	6.81	6.78
11	562	533	8.6	4605.6	7.16	24.7	1.95	4.15	.5018	6.79	6.75
12	512	512	10.8	5529.6	10.00	35.8	2.06	N/A	.5295	6.80	6.72

a)



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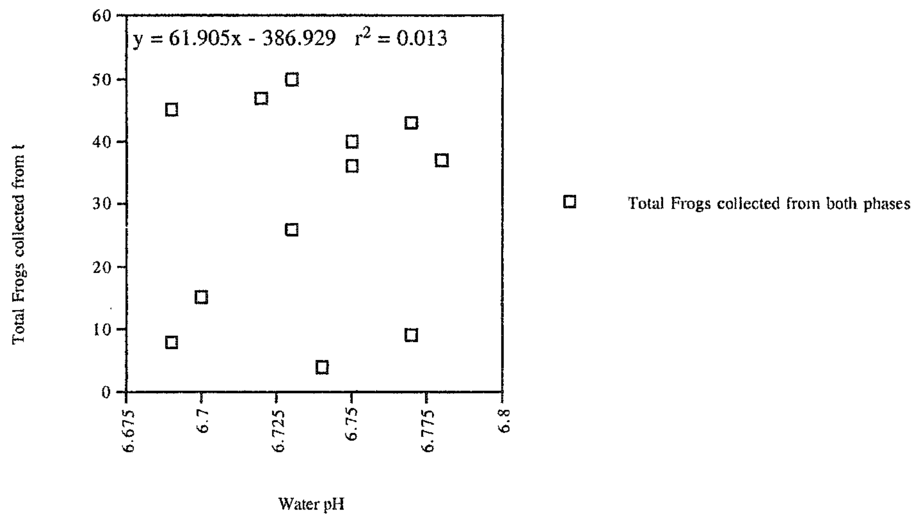
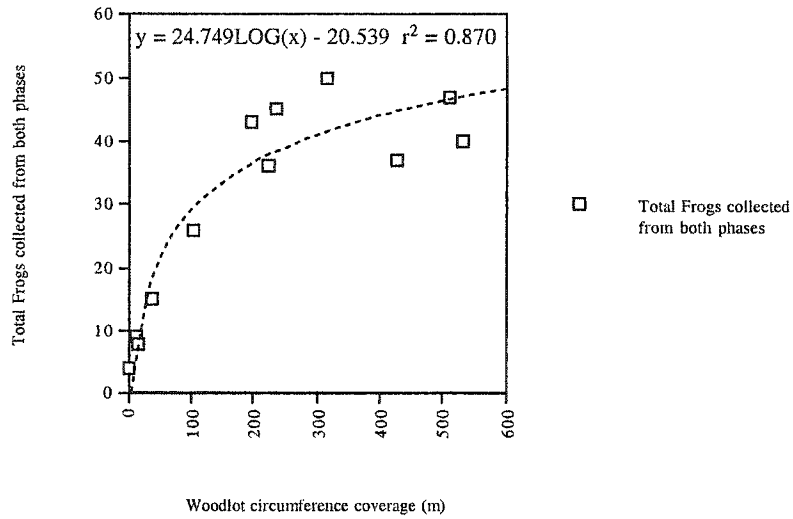


Figure 4-2 a) Illustration showing the insignificant relationship between pond circumference size and wood frog abundance at the various locations. b) Illustration showing the insignificant relationship between the different water pH levels and wood frog abundance at the various locations

Surrounding Wetland Characteristics

The adjacent wetland characteristics (woodlot circumference, proportion of woodlot circumference, average woodlot width, and woodlot area) surrounding the wetlands showed significant correlation to wood frog abundance. An increase in the amount of the wetland circumference that is covered by adjacent woodlot showed a strong logarithmic correlation to wood frog abundance ($r^2_{calc} = 0.870$, $r^2_{0.05(2),12} = 0.587$) (Figure 4-3a). The linear relationship was strong for the first seven locations in regards to woodlot circumference and wood frog abundance ($r^2_{calc} = 0.926$, $r^2_{0.05(2),7} = 0.786$) (Figure 4-3b). The proportion of woodlot coverage surrounding the wetland showed a strong logarithmic correlation to wood frog abundance. The results were similar to the amount of the wetland circumference that is covered by adjacent woodlot ($r^2_{calc} = 0.897$, $r^2_{0.05(2),12} = 0.587$) (Figure 4-4a). Average woodlot width surrounding the wetland showed exponential positive relationship correlations ($r^2_{calc} = 0.754$, $r^2_{0.05(2),12} = 0.587$) (Figure 4-4b). Woodlot area surrounding the wetland also showed a strong logarithmic correlation to wood frog abundance ($r^2_{calc} = 0.886$, $r^2_{0.05(2),12} = 0.587$) (Figure 4-5) .

a)



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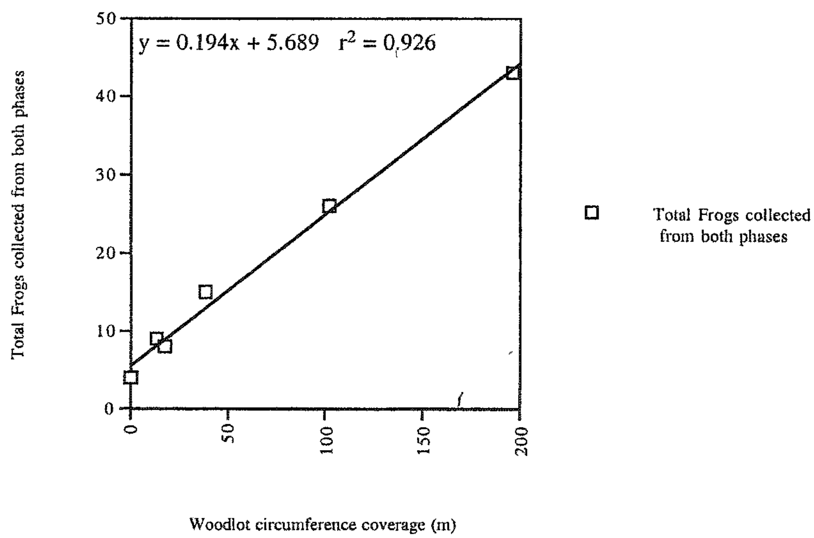
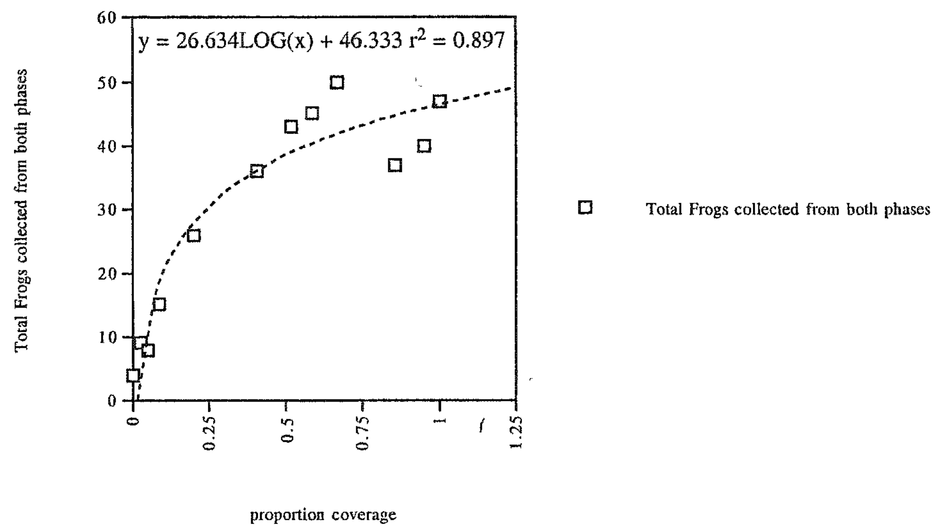


Figure 4-3 a) Illustration showing the significant logarithmic relationship between woodlot circumference surrounding the wetland and wood frog abundance at the various locations. b) Illustration showing the strong linear relationship between the woodlot circumference around the wetland for the first seven locations and wood frog abundance

a)



b)

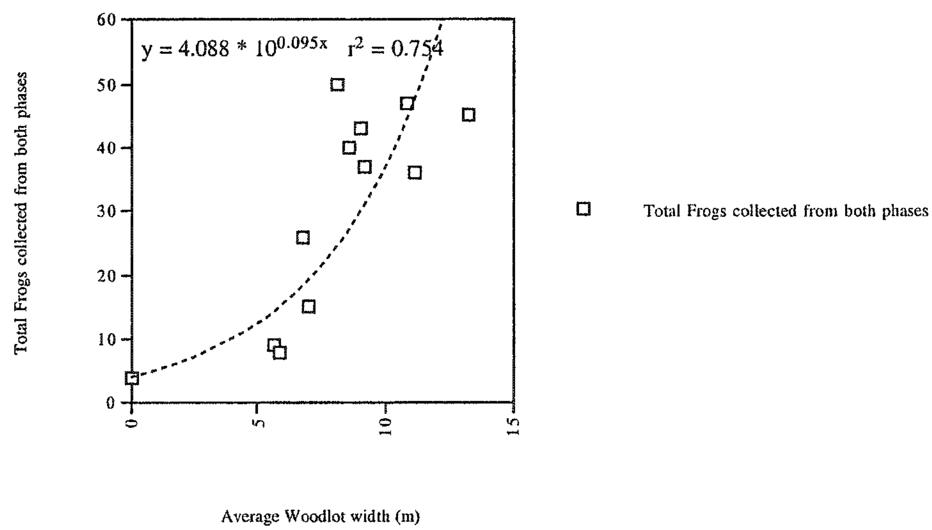


Figure 4-4 a) Illustration showing the significant logarithmic relationship between proportion woodlot circumference surrounding the wetland and wood frog abundance at the various locations. b) Illustration showing the significant exponential relationship between average woodlot width and wood frog abundance

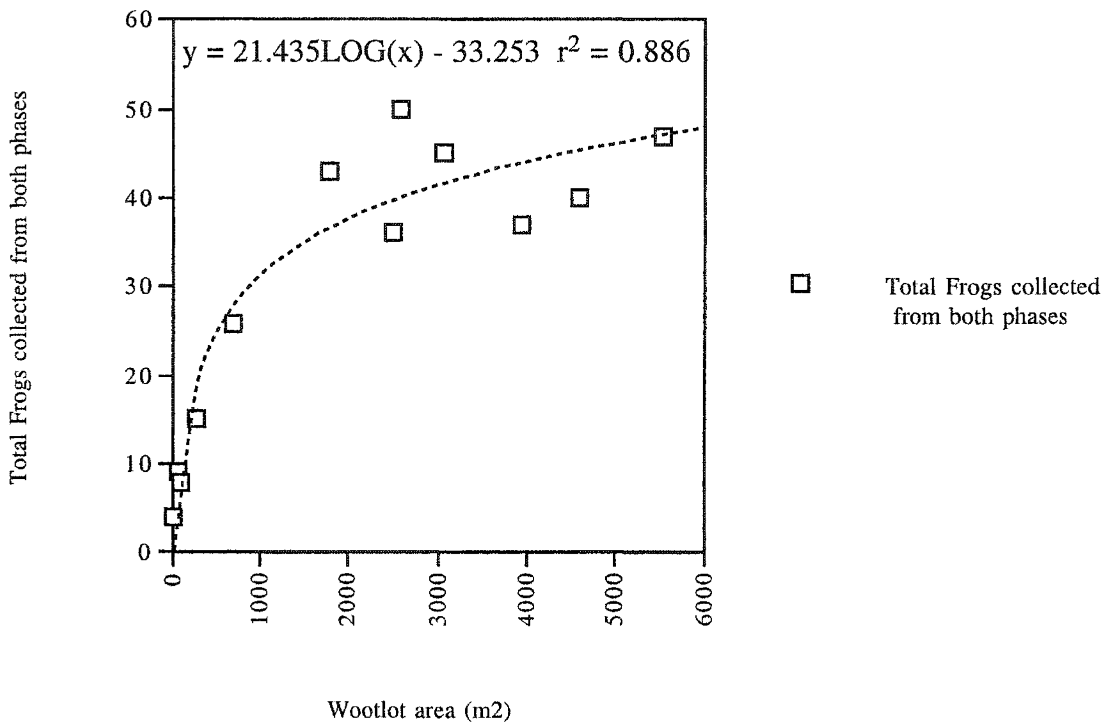
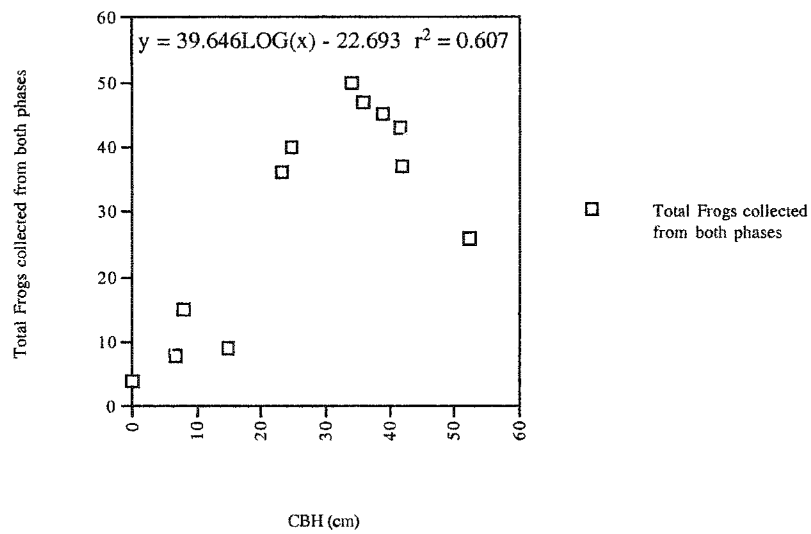


Figure 4-5 Illustration showing the significant logarithmic relationship between woodlot area surrounding the wetland and wood frog abundance at the various locations

Woodlot characteristics

The woodlot characteristics (CBH, DWM, litter depth, soil moisture, soil pH) showed mixed correlations to wood frog abundance around the wetland. Average tree circumference at breast height (CBH) and wood frog abundance showed no sign of significance for a logarithmic correlation ($r^2_{calc} = 0.607$, $r^2_{0.05(2),11} = 0.618$) (Figure 4-6a). The percent of downed woody material found at the various locations showed no linear correlation to the amount of wood frogs found at the location ($r^2_{calc} = 0.023$, $r^2_{0.05(2),11} = 0.618$) (Figure 4-6b). There is an exponential relationship between litter depth found in the woodlot riparian zone and the total number of wood frogs found at the wetlands ($r^2_{calc} = 0.634$, $r^2_{0.05(2),11} = 0.618$, $p < 0.001$) (Figure 4-7a). Soil moisture and wood frog abundance exhibited similar exponential relationships to litter depth ($r^2_{calc} = 0.634$, $r^2_{0.05(2),12} = 0.587$, $p < 0.001$) (Figure 4-7b). The final characteristic, soil pH levels, showed no linear relationship to wood frog abundance ($r^2_{calc} = 0.101$, $r^2_{0.05(2),12} = 0.587$, $p > 0.001$) (Figure 4-8).

a)



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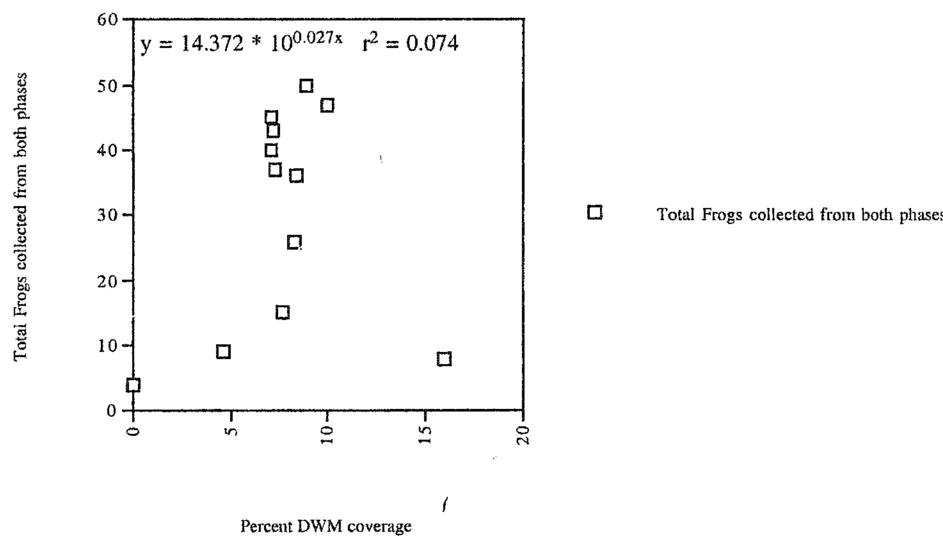
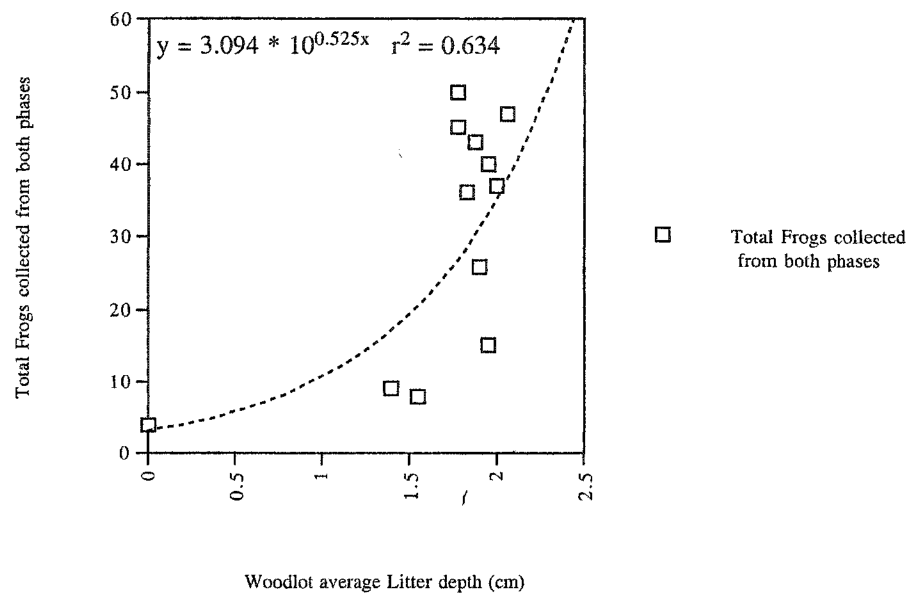


Figure 4-6 a) Illustration showing no relationship between tree circumference at breast and wood frog abundance at the various locations. b) Illustration showing no relationship between the percent downed woody material and wood frog abundance

a)



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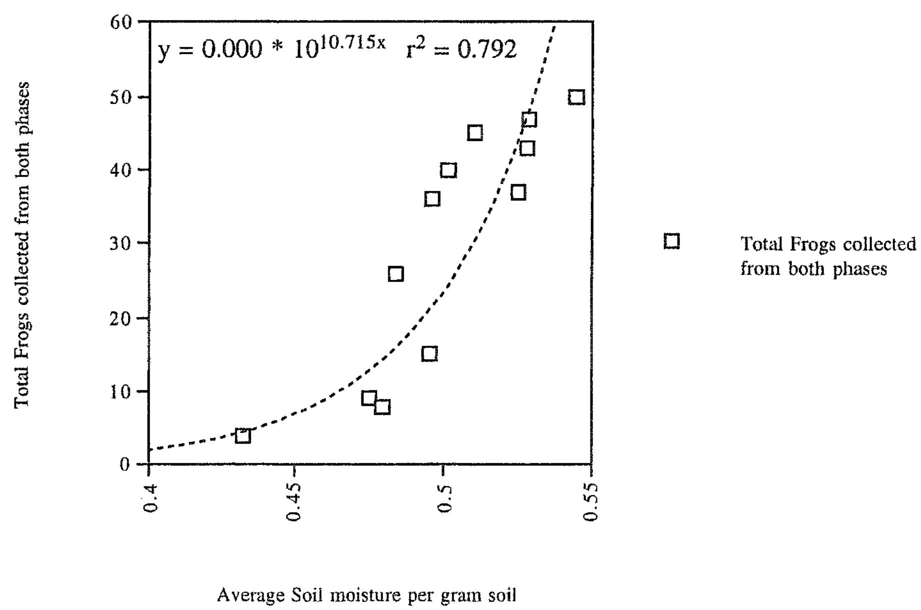

Figure 4-7 a) Illustration showing an exponential relationship between the average litter depth located in the woodlot section and wood frog abundance at the various locations. b) Illustration showing an exponential relationship between the average soil moisture per gram soil and wood frog abundance

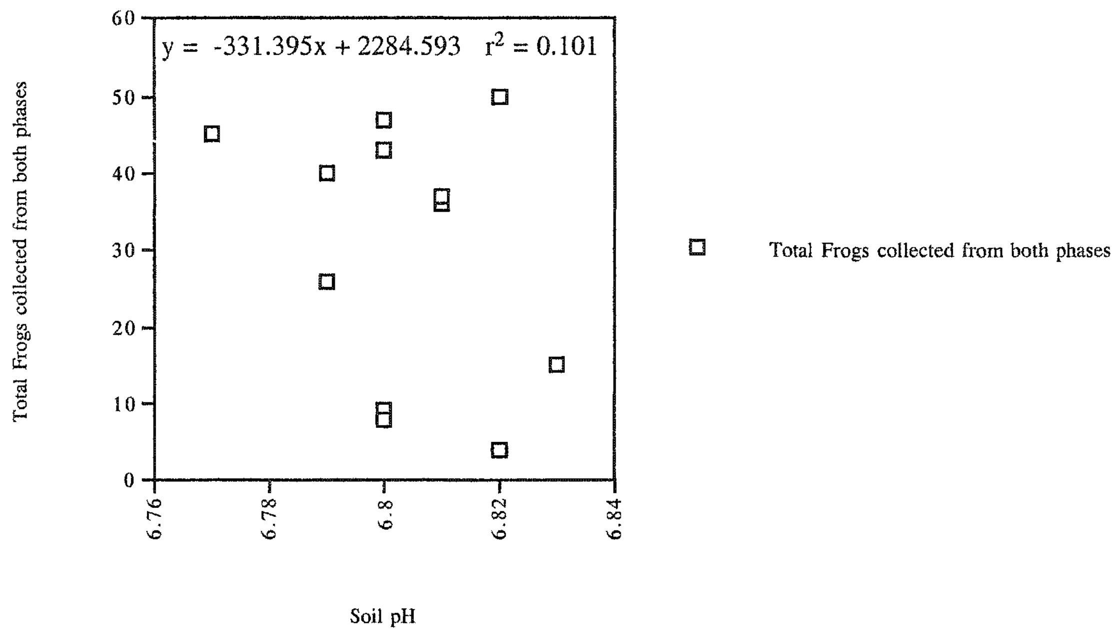

Figure 4-8 Illustration showing no linear relationship between the soil pH level and wood frog abundance at the various locations

Discussion

Analysis of the habitat characteristics that influence *Rana sylvatica* abundance revealed mixed results. There was a strong correlation with all of the surrounding wetland characteristics (woodlot circumference, proportion of woodlot circumference, average woodlot width, and woodlot area), few of the woodlot characteristics (litter depth, soil moisture) showed a strong correlation while others did not (CBH, DWM, soil pH) and the wetland characteristics (circumference, water pH) showed no relationship.

Wetland Characteristics

The wetland circumference and the wetland pH level did not show a relationship to wood frog abundance. Both of the variables (circumference and water pH) had narrow ranges, which may explain the poor correlation. The wetland circumference ranged from a low of 345 m (site 3) to a high of 562 m (site 11), which is only a difference of 117 m. The water pH levels also had a narrow range. The range for pH only varied from 6.69 to 6.78, for a difference of 0.09. This small difference contributes to the fact that this research does not support other studies that show that the acidity of aquatic habitats has major impacts on amphibian distribution (Freda and Dunson 1986; and Freda et al. 1991). This study's results may also differ because sensitivity to low pH varies among (Freda et al. 1991) and within (Pierce and Wooten 1992) species. It is also influenced by complex chemical interactions among pH and other factors, particularly aluminum concentration (Dunson et al 1992; Horne et al 1995; Portnoy 1990).

Surrounding wetland characteristics

The adjacent wetland characteristics (woodlot circumference, proportion of woodlot circumference, average woodlot width, and woodlot area) surrounding the wetlands showed significant correlation to wood frog abundance. The woodlot circumference around the wetland, the proportion of woodlot circumference surrounding the wetland, and the surrounding woodlot volume all exhibited similar results. Graphically (Figure 4.3a, 4.4a, 4.5) all showed a steady, almost linear increase (Figure 4.3b) for the first seven locations, after which the relationship reaches a plateau where an increase in woodlot circumference, proportion woodlot to wetland circumference, and surrounding woodlot area did not further influence wood frog abundance. The value where this plateau begins started at 196 m (site 7) where the proportion of woodlot to wetland circumference was 0.52 or 52 percent and the surrounding woodlot volume was 1768.4 m^2. There is no literature to compare this relationship between woodlot circumference, proportion woodlot to wetland circumference, and surrounding woodlot area, but it is documented that habitat loss does reduces amphibian abundance in the areas directly affected (Green 1997; Hecnar et al. 1996). The rational is that increasing the amount of woodlot surrounding the wetland provides a microhabitat climate that is essential to the wood frog. It is well documented that the removal or modification of vegetation during forestry operations has a rapid and severe impact on some amphibian populations (Ash 1988). Clear cutting of mature forests in the southern Appalachians reduced salamander populations by more than a quarter of a billion below the numbers that could be sustained in non logged forests (Petranka et al. 1993). The removal or lack of woodlot drastically altered microclimatic regimes (Ash 1997), and reduction in habitat complexity (Welsh 1990).

The average woodlot width exhibited an exponential relationship to wood frog abundance (Figure 4.4b). This disagrees with Hannon's 2002 study where she found that riparian buffer zone width did not significantly influence wood frog abundance around lakes. The difference being that Hannon's 2002 study was situated in a continuous forest setting where this study deals with fragmented locations.

Woodlot characteristics

Tree circumference at breast height, the percent of downed woody material, and soil pH levels did not show a significant relationship to wood frog abundance at these twelve locations, which supports Ford's 2002 study with salamanders in the Appalachian cove hardwood forests. One would expect however, that these factors would influence wood frog abundance. Increasing CBH for example would relate to increased canopy coverage, which is a well-documented factor, that influences amphibian abundance. Reducing canopy cover results in an increase in ultraviolet radiation exposure where numerous studies have demonstrated that ambient (Anzalone et al. 1998; Blaustein et al.

1995; Lizana et al. 1998) or enhanced (Ovaska et al. 1997) UV-B radiation reduces survival or hatching success of amphibian embryos thereby influencing population.

Litter depth and soil moisture per gram soil both showed to have a positive correlation to wood frog abundance. It can be inferred that the levels of litter depth and soil moisture are related to the amount of woodlot that is present. These two factors are also essential to the survival of the wood frog as the wood frog hibernates in the leaf litter over the winter months and the wood frog physiology requires a moist environment, so without them the population numbers would be lowered.

Recommendations

When drafting management plans and guidelines that allow for the destruction of habitat in an agriculturally fragmented landscape, it is important to attempt to preserve as much habitat as possible to maintain wood frog populations. Wood frogs are a species that breed in isolated habitats, and their range of migration is limited because of their physiology, so as much effort as possible is needed to preserve locations in which they are found.

The results of this study propose that wetlands in an agricultural landscape need to maintain a minimum of a 0.52 ratio of woodlot coverage surrounding the wetland-to-wetland circumference to have substantial population numbers. This ratio is based on wetlands with a circumference of 376 m and a woodlot circumference of 196 m. A surrounding woodlot volume of 1768.4 m^2 is also an ideal minimum for maximizing wood frog abundance.

Ideally, until more concrete generalizations of wood frog habitat requirements are made, including litter depth, soil moisture, DWM, and CBH, habitat destruction should be halted. It is realized that this may be impractical due to the time and cost of such a study, however, if removal of forest woodlots is going to occur, a level of fifty two percent woodlot coverage should remain.

The value of (fifty two percent) is making the assumption that all wood frogs are going to behave as they do in this relatively small geographical range as this study was. Making standardization requirements for all wetlands populated by wood frogs may lead to poor management decisions because results from this study are based on a small sample size and the results may only be applicable to the studied geographical area. Furthermore, although these sites appear very similar, they may actually offer very different breeding habitats for the wood frog. Natural histories of the wetlands in question as well as other landscape usage may influence abundance levels.

Maintaining sustainable levels of wood frog population will help the species survive catastrophic events such as climatic variation, introduction of invasive exotics, disease or pollution. Following catastrophic events that greatly reduce wood frog populations, the ability to re-establish wood frog abundance will be determined by the remaining habitat. For this reason it is proposed that management decisions on habitat regulation be carefully made to preserve habitat quality that maximize wood frog populations.

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Appendix A

Table A-1. Wood frog (*Rana sylvatica*) abundance for site #1 with a ration of 0.0 woodlot riparian buffer zone per circumference around wetland; trap 1 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
No frogs were captured at this location				
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	0	0	0 / 0	0 / 0

Table A-2. Wood frog (*Rana sylvatica*) abundance for site #1 with a ration of 0.0 woodlot riparian buffer zone per circumference around wetland; trap 2 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 3, 2003	5.0	4.2	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.0	4.2	1 / 0	0 / 1

Table A-3. Wood frog (*Rana sylvatica*) abundance for site #2 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 21, 2003	4.2	3.9	-	+
June 25, 2003	3.9	3.8	-	+
July 07, 2003	4.8	4.1	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	4.3	3.93	3 / 3	3 / 1

Table A-4. Wood frog (*Rana sylvatica*) abundance for site #2 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 29, 2003	21.4	6.0	-	+
July 11, 2003	3.8	3.9	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	12.6	4.95	2 / 0	2 / 0

Table A-5. Wood frog (*Rana sylvatica*) abundance for site #3 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 25, 2003	3.4	3.2	-	+
July 8, 2003	4.8	4.0	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	4.1	3.6	2 / 0	2 / 0

Table A-6. Wood frog (*Rana sylvatica*) abundance for site #3 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 30, 2003	4.5	4.0	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	4.5	4.0	1 / 0	1 / 0

Table A-7. Wood frog (*Rana sylvatica*) abundance for site #4 with a ration of 0.02903 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 24, 2003	2.3	2.1	-	+
June 29, 2003	4.4	4.0	-	-
July 04, 2003	4.6	4.2	-	+
July 11, 2003	3.8	3.9	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	3.78	3.52	4 / 0	3 / 1

Table A-8. Wood frog (*Rana sylvatica*) abundance for site #4 with a ration of 0.0903 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	3.9	4.0	-	-
June 29, 2003	5.3	4.1	-	+
July 11, 2003	4.4	4.0	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	4.53	4.03	3 / 0	1 / 2

Table A-9. Wood frog (*Rana sylvatica*) abundance for site #5 with a ration of 0.2969 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	4.5	4.2	-	+
June 24, 2003	5.2	4.6	-	+
June 26, 2003	6.8	4.6	-	+
June 29, 2003	3.9	3.8	-	-
July 03, 2003	4.0	3.9	+	+
July 03, 2003	8.8	4.7	-	-
July 06, 2003	4.2	4.2	+	+
July 08, 2003	6.0	4.4	-	+
July 11, 2003	5.1	4.6	+	+
July 11, 2003	4.5	4.4	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.3	4.34	10 / 3	8 / 2

Table A-10. Wood frog (*Rana sylvatica*) abundance for site #5 with a ration of 0.2969 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	8.7	4.8	-	-
June 24, 2003	4.3	4.0	-	-
June 26, 2003	3.8	3.9	-	+
June 29, 2003	5.8	4.6	-	+
July 03, 2003	4.5	3.9	+	-
July 06, 2003	6.8	4.8	-	+
July 08, 2003	6.5	4.4	-	+
July 11, 2003	5.9	4.7	+	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.79	4.39	8 / 2	5 / 3

Table A-11. Wood frog (*Rana sylvatica*) abundance for site #6 with a ration of 0.4125 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 21, 2003	4.2	4.0	-	-
June 21, 2003	2.7	2.5	-	+
June 25, 2003	3.9	4.0	-	+
June 26, 2003	15.5	5.2	-	+
June 29, 2003	5.5	4.0	-	-
July 03, 2003	3.8	3.9	+	+
July 03, 2003	4.5	4.0	-	-
July 06, 2003	6.8	4.5	-	-
July 08, 2003	7.8	4.8	-	-
July 11, 2003	5.8	4.2	+	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.05	4.11	10 / 2	5 / 5

Table A-12. Wood frog (*Rana sylvatica*) abundance for site #6 with a ration of 0.4125 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 21, 2003	10.7	4.9	-	+
June 25, 2003	3.9	4.0	-	-
June 25, 2003	4.5	4.1	-	-
June 25, 2003	5.4	4.2	-	+
June 26, 2003	6.8	4.8	-	+
June 29, 2003	5.5	4.0	-	+
July 03, 2003	4.2	3.8	+	-
July 03, 2003	9.9	5.0	-	-
July 06, 2003	4.5	4.2	+	-
July 11, 2003	3.9	4.2	-	+
July 11, 2003	5.6	4.2	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.9	4.31	11 / 2	6 / 5

Table A-13. Wood frog (*Rana sylvatica*) abundance for site #7 with a ration of 0.5213 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	8.7	4.3	-	+
June 24, 2003	3.7	3.1	-	-
June 26, 2003	2.3	2.7	-	+
June 29, 2003	3.6	3.2	-	+
June 29, 2003	4.8	4.0	-	-
July 03, 2003	7.4	4.5	-	-
July 06, 2003	5.5	4.3	-	+
July 06, 2003	4.2	4.0	+	-
July 06, 2003	7.6	4.8	-	+
July 06, 2003	4.2	3.8	-	+
July 08, 2003	6.8	4.5	-	-
July 11, 2003	2.8	3.0	+	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.13	3.85	12 / 2	6 / 6

Table A-14. Wood frog (*Rana sylvatica*) abundance for site #7 with a ration of 0.5213 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	3.0	2.8	-	-
June 24, 2003	12.3	5.0	-	-
June 24, 2003	9.2	4.2	-	-
June 24, 2003	2.7	3.0	-	+
June 26, 2003	2.5	2.4	-	+
June 29, 2003	2.6	2.4	+	+
June 29, 2003	8.7	4.2	-	-
July 03, 2003	11.7	4.8	-	-
July 06, 2003	4.6	3.4	-	-
July 08, 2003	10.8	4.7	-	+
July 08, 2003	5.5	3.9	-	-
July 11, 2003	5.5	3.9	+	-
July 11, 2003	2.7	2.5	+	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.29	3.63	13 / 3	5 / 8

Table A-15. Wood frog (*Rana sylvatica*) abundance for site #8 with a ration of 0.5894 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	6.6	4.3	-	+
June 24, 2003	2.7	3.0	-	+
June 26, 2003	3.5	3.2	-	-
June 29, 2003	3.8	3.4	-	+
June 29, 2003	11.2	4.8	-	+
July 03, 2003	14.7	5.5	-	-
July 06, 2003	4.0	3.5	+	+
July 06, 2003	3.1	3.1	-	-
July 08, 2003	8.9	4.6	-	+
July 08, 2003	5.5	4.2	-	+
July 11, 2003	12.2	5.0	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.6	4.05	11 / 1	7 / 4

Table A-16. Wood frog (*Rana sylvatica*) abundance for site #8 with a ration of 0.5894 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	2.9	3.0	-	+
June 20, 2003	8.9	4.5	-	-
June 24, 2003	3.1	3.0	-	-
June 24, 2003	2.1	2.4	-	+
June 26, 2003	3.0	3.3	-	-
June 29, 2003	2.3	2.9	-	+
June 29, 2003	2.3	3.0	-	-
July 03, 2003	4.7	3.4	-	-
July 03, 2003	4.0	3.2	-	-
July 06, 2003	8.9	4.2	-	+
July 06, 2003	11.2	4.6	-	+
July 06, 2003	5.5	4.1	+	-
July 08, 2003	5.9	4.4	-	+
July 11, 2003	7.4	4.7	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.16	3.62	14 / 1	7 / 7

Table A-17. Wood frog (*Rana sylvatica*) abundance for site #9 with a ration of 0.6688 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	8.6	4.2	-	+
June 24, 2003	10.8	4.9	-	+
June 24, 2003	8.7	4.6	-	+
June 26, 2003	7.9	4.0	-	-
June 29, 2003	8.7	4.2	+	+
June 29, 2003	4.2	3.7	-	-
July 03, 2003	6.3	4.5	-	+
July 03, 2003	3.4	3.7	-	-
July 06, 2003	5.5	3.8	-	-
July 06, 2003	8.9	4.3	+	+
July 06, 2003	14.8	5.6	-	+
July 08, 2003	4.4	3.8	-	-
July 11, 2003	1.5	2.2	-	-
July 11, 2003	6.5	4.6	+	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	7.15	4.15	14 / 3	8 / 6

Table A-18. Wood frog (*Rana sylvatica*) abundance for site #9 with a ration of 0.6688 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	8.8	4.4	-	-
June 20, 2003	8.3	3.9	-	+
June 24, 2003	4.5	4.2	-	-
June 26, 2003	4.2	4.0	-	+
June 29, 2003	7.9	4.2	-	+
June 29, 2003	8.9	4.4	+	-
July 03, 2003	1.2	2.1	-	-
July 03, 2003	4.7	4.5	-	+
July 06, 2003	10.4	4.7	-	-
July 06, 2003	4.7	4.3	+	+
July 08, 2003	1.5	2.0	-	-
July 08, 2003	6.7	4.2	-	-
July 11, 2003	2.2	2.1	-	-
July 11, 2003	9.5	4.8	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	4.89	3.84	14 / 2	6 / 8

Table A-19. Wood frog (*Rana sylvatica*) abundance for site #10 with a ration of 0.8594 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 21, 2003	5.5	4.0	-	+
June 24, 2003	3.2	3.0	-	+
June 24, 2003	4.1	3.7	-	-
June 26, 2003	3.3	3.5	-	-
June 29, 2003	8.7	4.1	-	+
July 03, 2003	18.9	5.8	-	+
July 03, 2003	3.7	3.5	-	+
July 06, 2003	4.7	4.1	-	-
July 06, 2003	4.4	3.9	+	-
July 08, 2003	6.5	4.5	-	-
July 11, 2003	5.7	4.2	+	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.25	4.03	11 / 2	6 / 5

Table A-20. Wood frog (*Rana sylvatica*) abundance for site #10 with a ration of 0.8594 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 21, 2003	2.7	2.9	-	+
June 24, 2003	6.7	4.6	-	+
June 26, 2003	4.8	4.2	-	-
June 26, 2003	3.9	3.8	-	-
June 29, 2003	2.8	2.9	+	+
July 03, 2003	7.8	4.7	-	-
July 06, 2003	6.9	4.6	-	-
July 06, 2003	10.8	5.0	-	-
July 08, 2003	3.9	3.9	+	-
July 11, 2003	4.9	4.3	+	-
July 11, 2003	5.8	4.0	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.55	4.08	11 / 3	4 / 7

Table A-21. Wood frog (*Rana sylvatica*) abundance for site #11 with a ration of 0.9484 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	5.5	3.9	-	-
June 22, 2003	10.8	5.1	-	+
June 24, 2003	13.0	5.2	-	+
June 27, 2003	4.5	3.7	-	-
June 29, 2003	3.8	3.7	-	+
June 30, 2003	8.7	4.3	-	-
July 03, 2003	7.5	4.0	-	-
July 05, 2003	5.5	4.8	-	+
July 06, 2003	2.2	2.8	-	-
July 06, 2003	2.5	2.9	+	-
July 08, 2003	7.9	4.1	-	+
July 09, 2003	4.8	3.9	-	+
July 11, 2003	6.8	4.8	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.42	4.09	13 / 1	7 / 6

Table A-22. Wood frog (*Rana sylvatica*) abundance for site #11 with a ration of 0.9484 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	8.7	4.8	-	-
June 24, 2003	4.3	4.0	-	-
June 26, 2003	3.8	3.9	-	+
June 29, 2003	5.8	4.6	-	+
July 03, 2003	4.5	3.9	+	-
July 06, 2003	6.8	4.8	-	+
July 08, 2003	6.5	4.4	-	+
July 11, 2003	5.9	4.7	+	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.79	4.39	8 / 2	5 / 3

Table A-23. Wood frog (*Rana sylvatica*) abundance for site #12 with a ration of 1.0000 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area; trap 1 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	11.2	5.1	-	+
June 20, 2003	5.5	4.0	-	-
June 24, 2003	6.8	4.6	-	+
June 24, 2003	7.2	4.9	-	+
June 26, 2003	4.5	4.5	-	-
June 28, 2003	4.0	4.1	-	-
June 28, 2003	4.2	3.9	+	-
July 01, 2003	9.7	5.0	-	+
July 03, 2003	6.2	4.6	-	-
July 06, 2003	15.2	5.3	-	-
July 06, 2003	6.5	4.5	-	+
July 06, 2003	5.5	4.0	+	-
July 08, 2003	6.0	4.3	-	+
July 08, 2003	4.8	4.4	-	+
July 11, 2003	4.3	4.1	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.77	4.49	15 / 2	8 / 7

Table A-24. Wood frog (*Rana sylvatica*) abundance for site #12 with a ration of 1.0000 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area. trap 2 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
June 20, 2003	4.2	4.0	-	+
June 20, 2003	5.5	4.5	-	-
June 20, 2003	3.8	3.7	-	-
June 24, 2003	10.2	4.8	-	+
June 26, 2003	8.8	4.7	-	+
June 28, 2003	6.8	4.8	-	-
July 01, 2003	12.8	5.2	-	+
July 03, 2003	5.5	4.5	+	-
July 06, 2003	6.3	4.1	+	+
July 08, 2003	4.4	4.0	+	+
July 11, 2003	5.6	4.3	-	+
July 11, 2003	9.3	4.8	-	-
July 11, 2003	6.1	4.3	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.87	4.44	13 / 3	7 / 6

Appendix B

Table B-1. Wood frog (*Rana sylvatica*) abundance for site #1 with a ration of 0.0 woodlot riparian buffer zone per circumference around wetland; trap 1 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 30, 2003	1.8	2.5	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	1.8	2.5	1 / 0	1 / 0

Table B-2. Wood frog (*Rana sylvatica*) abundance for site #1 with a ration of 0.0 woodlot riparian buffer zone per circumference around wetland; trap 2 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 15, 2003	2.2	2.4	-	-
Aug 4, 2003	7.5	4.8	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
			2 / 0	1 / 1

Table B-3. Wood frog (*Rana sylvatica*) abundance for site #2 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 20, 2003	3.2	3.0	-	-
Aug 09, 2003	3.9	3.8	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	3.55	6.4	2 / 0	1 / 1

Table B-4. Wood frog (*Rana sylvatica*) abundance for site #2 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 27, 2003	1.6	2.1	-	+
July 30, 2003	5.7	3.9	-	-
Aug 11, 2003	6.6	4.5	+	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	4.63	3.50	3 / 1	1 / 3

Table B-5. Wood frog (*Rana sylvatica*) abundance for site #3 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 14, 2003	4.2	4.1	-	+
July 27, 2003	3.2	3.5	+	+
Aug 8, 2003	6.6	4.4	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	4.67	4.00	3 / 1	2 / 1

Table B-6. Wood frog (*Rana sylvatica*) abundance for site #3 with a ration of 0.0283 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 27, 2003	3.5	3.1	-	-
Aug 03, 2003	18.3	5.5	-	+
Aug 11, 2003	5.5	4.3	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	9.10	4.30	3 / 0	1 / 2

Table B-7. Wood frog (*Rana sylvatica*) abundance for site #4 with a ration of 0.02903 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	3.3	2.6	-	-
July 29, 2003	6.5	4.3	+	+
Aug 04, 2003	4.4	4.1	-	+
Aug 07, 2003	7.8	3.9	-	-
Aug 11, 2003	5.8	4.3	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.56	3.84	5 / 1	2 / 3

Table B-8. Wood frog (*Rana sylvatica*) abundance for site #4 with a ration of 0.0903 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	2.3	3.0	-	+
June 23, 2003	6.2	4.7	-	+
Aug 04, 2003	4.0	3.6	-	-
Aug 11, 2003	7.7	4.7	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.05	4.00	4 / 0	2 / 2

Table B-9. Wood frog (*Rana sylvatica*) abundance for site #5 with a ration of 0.2969 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	2.2	3.0	-	+
July 23, 2003	3.6	3.1	-	-
July 27, 2003	10.4	5.0	-	+
July 29, 2003	4.0	3.7	+	-
Aug 02, 2003	5.3	4.3	+	+
Aug 02, 2003	8.8	4.7	-	-
Aug 05, 2003	5.5	4.3	-	+
Aug 07, 2003	9.8	5.0	-	-
Aug 11, 2003	4.3	4.6	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	5.99	4.19	9 / 2	4 / 5

Table B-10. Wood frog (*Rana sylvatica*) abundance for site #5 with a ration of 0.2969 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	6.7	4.3	-	-
July 27, 2003	2.5	3.1	-	+
July 27, 2003	9.4	4.9	-	+
July 29, 2003	3.8	4.0	+	-
Aug 02, 2003	7.5	4.4	-	-
Aug 02, 2003	8.8	4.8	-	+
Aug 07, 2003	6.5	4.4	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.46	4.27	7 / 1	4 / 3

Table B-11. Wood frog (*Rana sylvatica*) abundance for site #6 with a ration of 0.4125 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	8.2	4.2	-	+
July 23, 2003	5.7	4.5	+	-
July 27, 2003	13.9	5.1	-	+
July 27, 2003	5.5	4.4	+	+
July 29, 2003	3.0	3.1	-	-
Aug 02, 2003	9.4	5.1	-	-
Aug 05, 2003	13.8	5.1	+	+
Aug 05, 2003	4.5	4.0	-	-
Aug 07, 2003	5.1	4.5	-	-
Aug 11, 2003	7.8	4.8	-	-
Aug 11, 2003	5.8	4.2		-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	7.52	4.45	11 / 3	4 / 7

Table B-12. Wood frog (*Rana sylvatica*) abundance for site #6 with a ration of 0.4125 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	2.2	2.9	-	-
July 23, 2003	5.0	4.0	-	-
July 23, 2003	8.5	4.6	+	+
July 27, 2003	6.6	4.4	-	+
July 27, 2003	3.9	3.4	-	-
July 30, 2003	10.5	5.2	-	+
Aug 02, 2003	7.7	4.6	-	-
Aug 02, 2003	4.2	3.8	+	-
Aug 05, 2003	8.5	5.0	-	+
Aug 07, 2003	6.2	4.6	-	-
Aug 07, 2003	4.0	4.2	-	+
Aug 07, 2003	8.8	4.8	-	+
Aug 11, 2003	5.3	4.2	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.26	4.28	13 / 2	7 / 6

Table B-13. Wood frog (*Rana sylvatica*) abundance for site #7 with a ration of 0.5213 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	5.7	4.3	-	+
July 25, 2003	2.7	3.0	-	-
July 27, 2003	2.9	2.9	-	+
July 30, 2003	6.6	4.2	-	-
July 30, 2003	5.1	4.1	-	+
Aug 02, 2003	8.1	4.5	-	-
Aug 02, 2003	16.5	5.3	-	+
Aug 05, 2003	14.2	5.0	-	+
Aug 05, 2003	4.6	4.2	-	-
Aug 07, 2003	4.2	3.8	-	+
Aug 11, 2003	8.8	4.5	+	-
Aug 11, 2003	6.2	4.0	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	7.13	4.15	12 / 1	7 / 5

Table B-14. Wood frog (*Rana sylvatica*) abundance for site #7 with a ration of 0.5213 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 23, 2003	2.5	2.8	-	+
July 25, 2003	6.6	4.6	-	-
July 25, 2003	4.1	4.2	-	+
July 27, 2003	4.4	3.9	-	+
July 27, 2003	9.4	4.9	-	-
Aug 02, 2003	3.5	3.0	-	-
Aug 05, 2003	5.2	4.2	-	-
Aug 05, 2003	3.6	3.0	-	-
Aug 05, 2003	14.6	5.4	-	-
Aug 07, 2003	10.3	4.7	-	+
Aug 07, 2003	5.5	3.9	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.34	4.05	11 / 0	4 / 7

Table B-15. Wood frog (*Rana sylvatica*) abundance for site #8 with a ration of 0.5894 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	6.8	4.3	-	+
July 24, 2003	12.5	5.0	-	+
July 26, 2003	6.5	4.2	-	+
July 26, 2003	4.8	3.9	-	-
July 29, 2003	1.2	2.0	-	+
Aug 01, 2003	4.7	4.5	-	-
Aug 01, 2003	13.0	5.1	+	+
Aug 04, 2003	6.6	4.4	-	-
Aug 06, 2003	6.9	4.6	-	-
Aug 06, 2003	5.5	4.2	-	+
Aug 11, 2003	7.2	4.4	-	-
Aug 11, 2003	5.5	4.6	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.77	4.27	12 / 1	6 / 6

Table B-16. Wood frog (*Rana sylvatica*) abundance for site #8 with a ration of 0.5894 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	3.9	3.3	-	-
July 26, 2003	4.3	4.0	-	-
July 26, 2003	13.1	5.1	-	+
July 26, 2003	12.1	5.4	-	+
July 29, 2003	6.3	4.3	+	-
July 29, 2003	3.0	3.0	-	+
Aug 01, 2003	12.3	5.4	+	+
Aug 04, 2003	6.9	4.5	-	-
Aug 04, 2003	5.5	4.3	-	+
Aug 04, 2003	7.3	4.6	-	+
Aug 06, 2003	4.4	4.2	-	-
Aug 11, 2003	9.2	4.6	-	-
Aug 11, 2003	5.5	4.1	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	7.22	4.37	13 / 2	6 / 7

Table B-17. Wood frog (*Rana sylvatica*) abundance for site #9 with a ration of 0.6688 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	18.6	5.2	-	-
July 24, 2003	3.8	4.0	+	+
July 26, 2003	5.7	4.6	-	+
July 29, 2003	2.9	3.0	-	-
July 29, 2003	9.2	5.2	-	+
July 29, 2003	5.1	4.7	-	-
Aug 01, 2003	3.3	3.5	-	-
Aug 01, 2003	7.4	4.7	-	-
Aug 01, 2003	15.5	4.8	-	-
Aug 04, 2003	3.9	4.0	-	-
Aug 06, 2003	4.8	4.6	-	-
Aug 06, 2003	6.1	4.7	-	+
Aug 06, 2003	12.4	5.0	-	-
Aug 06, 2003	3.0	3.0	-	+
Aug 11, 2003	8.4	4.5	-	-
Aug 11, 2003	5.9	4.5	+	+
Aug 11, 2003	4.4	3.8	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	7.08	4.34	17 / 2	7 / 10

Table B-18. Wood frog (*Rana sylvatica*) abundance for site #9 with a ration of 0.6688 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	8.8	4.4	-	-
July 26, 2003	4.5	4.2	-	-
July 26, 2003	2.2	2.8	-	+
July 29, 2003	17.9	5.2	-	-
July 29, 2003	3.4	4.0	-	+
Aug 01, 2003	11.2	5.1	-	-
Aug 01, 2003	5.2	4.5	-	+
Aug 04, 2003	10.4	4.7	+	-
Aug 04, 2003	6.6	4.6	+	+
Aug 06, 2003	4.9	4.0	-	-
Aug 06, 2003	6.7	4.2	-	-
Aug 06, 2003	7.9	4.8	+	+
Aug 11, 2003	3.5	3.4	-	+
Aug 11, 2003	8.2	4.8	-	-
Aug 11, 2003	6.1	4.6	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	7.17	4.35	15 / 3	6 / 9

Table B-19. Wood frog (*Rana sylvatica*) abundance for site #10 with a ration of 0.8594 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	5.5	4.0	-	+
July 26, 2003	13.2	5.0	-	+
July 26, 2003	3.1	3.4	-	-
July 26, 2003	7.3	4.5	-	+
July 29, 2003	3.3	3.5	-	-
July 29, 2003	3.7	3.4	-	+
July 29, 2003	10.9	5.4	-	+
Aug 01, 2003	4.2	4.1	+	-
Aug 01, 2003	5.7	4.7	-	-
Aug 01, 2003	4.4	3.9	+	-
Aug 04, 2003	7.5	4.5	-	-
Aug 06, 2003	4.9	4.2	+	+
Aug 11, 2003	8.1	4.9	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.29	4.27	13 / 3	7 / 6

Table B-20. Wood frog (*Rana sylvatica*) abundance for site #10 with a ration of 0.8594 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	7.7	4.9	-	+
July 26, 2003	4.8	4.2	-	+
July 29, 2003	2.9	3.2	-	-
July 29, 2003	6.8	4.9	-	-
July 29, 2003	7.8	4.7	-	-
Aug 01, 2003	6.9	4.6	-	-
Aug 01, 2003	10.8	5.0	-	-
Aug 04, 2003	3.9	4.1	+	-
Aug 06, 2003	6.8	4.3	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.49	4.43	9 / 1	3 / 6

Table B-21. Wood frog (*Rana sylvatica*) abundance for site #11 with a ration of 0.9484 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	15.5	5.3	-	-
July 24, 2003	3.8	4.1	+	+
July 26, 2003	3.0	3.2	-	+
July 26, 2003	8.4	4.7	-	+
July 26, 2003	6.8	4.7	+	-
July 29, 2003	8.7	4.3	-	-
July 29, 2003	4.2	3.9	-	-
Aug 01, 2003	13.5	5.0	-	-
Aug 01, 2003	3.6	4.0	-	-
Aug 01, 2003	6.9	4.7	-	+
Aug 04, 2003	3.4	3.8	-	-
Aug 06, 2003	6.1	4.1	-	+
Aug 06, 2003	9.3	4.9	-	+
Aug 06, 2003	3.8	4.2	-	-
Aug 11, 2003	5.3	4.3	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.82	4.35	15 / 2	7 / 8

Table B-22. Wood frog (*Rana sylvatica*) abundance for site #11 with a ration of 0.9484 woodlot riparian buffer zone per circumference around wetland for trap in the non woodlot area.

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	13.8	5.2	-	+
July 24, 2003	5.7	4.3	-	+
July 24, 2003	2.8	3.0	-	-
July 26, 2003	7.3	4.6	-	+
July 29, 2003	6.2	4.6	-	-
July 29, 2003	3.0	3.2	+	-
Aug 01, 2003	7.2	5.0	-	+
Aug 06, 2003	4.7	4.3	-	+
Aug 06, 2003	10.4	5.2	-	-
Aug 11, 2003	5.4	4.3	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.65	4.37	10 / 1	5 / 5

Table B-23. Wood frog (*Rana sylvatica*) abundance for site #12 with a ration of 1.0000 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area; trap 1 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	4.2	4.1	-	+
July 26, 2003	16.8	5.6	-	-
July 29, 2003	3.5	3.5	-	-
July 29, 2003	4.0	4.1	-	-
Aug 01, 2003	14.2	5.2	-	+
Aug 01, 2003	6.2	4.6	-	-
Aug 04, 2003	5.6	4.3	-	+
Aug 06, 2003	6.5	4.5	-	+
Aug 06, 2003	6.0	4.3	-	+
Aug 06, 2003	7.8	4.6	+	+
Aug 11, 2003	7.3	4.5	-	+
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	7.46	4.48	11 / 1	7 / 4

Table B-24. Wood frog (*Rana sylvatica*) abundance for site #12 with a ration of 1.0000 woodlot riparian buffer zone per circumference around wetland for trap in the woodlot area. trap 2 of 2

Date	Body Mass (g)	Body Length (cm)	Recapture	Dorsal strip
July 24, 2003	7.2	4.5	-	-
July 26, 2003	3.5	3.4	-	-
July 26, 2003	13.8	5.7	-	+
July 26, 2003	9.2	4.8	-	+
July 26, 2003	3.8	3.7	-	-
July 29, 2003	4.3	4.7	-	+
Aug 01, 2003	3.0	3.1	-	+
Aug 01, 2003	6.9	4.5	-	-
Aug 04, 2003	10.4	5.2	-	+
Aug 04, 2003	5.2	4.5	+	-
Aug 06, 2003	7.1	4.7	-	+
Aug 06, 2003	6.9	4.8	-	+
Aug 06, 2003	3.9	4.3	-	-
Aug 11, 2003	7.4	4.5	-	-
	Mean body mass (g)	Mean body length (cm)	Capture / recapture	Strip / No strip
	6.61	4.46	14 / 1	7 / 7

Appendix C

Table C-1. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #1 with a 0.0 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement	Type of Riparian Buffer zone	Width of Riparian buffer zone
0	Non woodlot	5.7
25	Non woodlot	4.9
50	Non woodlot	7.3
75	Non woodlot	3.6
100	Non woodlot	4.7
125	Non woodlot	7.5
150	Non woodlot	6.0
175	Non woodlot	5.3
200	Non woodlot	11.4
225	Non woodlot	12.4
250	Non woodlot	10.6
275	Non woodlot	7.4
300	Non woodlot	6.0
325	Non woodlot	6.8
350	Non woodlot	7.5
375	Non woodlot	5.9
400	Non woodlot	6.1
425	Non woodlot	5.4

Table C-2. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #2 with a 0.0283 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement	Type of Riparian Buffer zone	Width of Riparian buffer zone
0	Woodlot	5.4
6	Woodlot	6.2
13	Woodlot	5.3
25	Non woodlot	4.5
50	Non woodlot	3.9
75	Non woodlot	6.9
100	Non woodlot	8.3
125	Non woodlot	7.5
150	Non woodlot	7.1
175	Non woodlot	5.2
200	Non woodlot	5.9
225	Non woodlot	2.6
250	Non woodlot	4.8
275	Non woodlot	7.9
300	Non woodlot	10.4
325	Non woodlot	9.2
350	Non woodlot	5.3
375	Non woodlot	4.9
400	Non woodlot	5.8
425	Non woodlot	6.3
450	Non woodlot	5.1

Table C-3. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #3 with a 0.0493 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	5.6
8	Woodlot	5.4
17	Woodlot	6.7
25	Non woodlot	5.5
50	Non woodlot	10.5
75	Non woodlot	12.8
100	Non woodlot	11.2
125	Non woodlot	7.4
150	Non woodlot	5.3
175	Non woodlot	4.2
200	Non woodlot	4.7
225	Non woodlot	5.9
250	Non woodlot	3.9
275	Non woodlot	3.1
300	Non woodlot	4.0
325	Non woodlot	4.8

Table C-4. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #4 with a 0.0903 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	6.6
19	Woodlot	7.3
38	Woodlot	7.0
50	Non woodlot	6.4
75	Non woodlot	7.1
100	Non woodlot	5.3
125	Non woodlot	4.9
150	Non woodlot	4.8
175	Non woodlot	3.7
200	Non woodlot	6.2
225	Non woodlot	5.9
250	Non woodlot	7.1
275	Non woodlot	7.9
300	Non woodlot	4.5
325	Non woodlot	3.0
350	Non woodlot	4.9
375	Non woodlot	5.2
400	Non woodlot	5.8

Table C-5. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #5 with a 0.2032 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	6.7
25	Woodlot	7.2
50	Woodlot	5.8
75	Woodlot	7.3
100	Woodlot	6.9
125	Non woodlot	5.4
150	Non woodlot	6.9
175	Non woodlot	3.3
200	Non woodlot	4.8
225	Non woodlot	6.6
250	Non woodlot	7.3
275	Non woodlot	5.3
300	Non woodlot	10.9
325	Non woodlot	12.2
350	Non woodlot	8.5
375	Non woodlot	5.5
400	Non woodlot	4.9
425	Non woodlot	4.8
450	Non woodlot	3.7
475	Non woodlot	4.2
500	Non woodlot	5.7

Table C-6. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #6 with a 0.4125 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone (m)	Width of Riparian buffer zone (m)
0	Woodlot	6.9
25	Woodlot	7.4
50	Woodlot	5.8
75	Woodlot	14.8
100	Woodlot	22.6
125	Woodlot	17.4
150	Woodlot	15.4
175	Woodlot	7.5
200	Woodlot	6.6
224	Woodlot	6.9
250	Non woodlot	6.0
275	Non woodlot	4.4
300	Non woodlot	5.7
325	Non woodlot	6.9
350	Non woodlot	3.5
375	Non woodlot	4.9
400	Non woodlot	7.4
425	Non woodlot	6.3
450	Non woodlot	5.2
475	Non woodlot	6.0
500	Non woodlot	7.2
525	Non woodlot	6.9

Table C-7. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #7 with a 0.5213 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	10.4
25	Woodlot	8.6
50	Woodlot	9.9
75	Woodlot	6.4
100	Woodlot	10.4
125	Woodlot	9.8
150	Woodlot	11.4
175	Woodlot	7.5
196	Woodlot	6.8
225	Non Woodlot	5.1
250	Non woodlot	4.8
275	Non woodlot	6.4
300	Non woodlot	9.4
325	Non woodlot	6.3
350	Non woodlot	4.3
375	Non woodlot	6.1

Table C-8. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #8 with a 0.5894 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	8.7
25	Woodlot	12.5
50	Woodlot	15.9
75	Woodlot	22.9
100	Woodlot	20.1
125	Woodlot	18.6
150	Woodlot	10.5
175	Woodlot	8.5
200	Woodlot	7.9
225	Woodlot	6.0
250	Non woodlot	6.2
275	Non woodlot	5.4
300	Non woodlot	5.9
325	Non woodlot	6.0
350	Non woodlot	5.3
375	Non woodlot	6.9

Table C-9. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #9 with a 0.6688 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	5.7
25	Woodlot	6.2
50	Woodlot	5.9
75	Woodlot	7.1
100	Woodlot	8.6
125	Woodlot	9.0
150	Woodlot	10.5
175	Woodlot	12.5
200	Woodlot	10.6
225	Woodlot	9.5
250	Woodlot	7.3
275	Woodlot	6.6
300	Woodlot	6.1
325	Non woodlot	7.2
350	Non woodlot	5.5
375	Non woodlot	4.9
400	Non woodlot	3.0
425	Non woodlot	5.9
450	Non woodlot	6.0

Table C-10. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #10 with a 0.8594 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	6.9
25	Woodlot	7.2
50	Woodlot	8.4
75	Woodlot	5.0
100	Woodlot	6.2
125	Woodlot	9.9
150	Woodlot	12.5
175	Woodlot	10.6
200	Woodlot	7.3
225	Woodlot	6.4
250	Woodlot	9.2
275	Woodlot	6.9
300	Woodlot	10.5
325	Woodlot	18.5
350	Woodlot	16.0
375	Woodlot	8.6
400	Woodlot	7.4
425	Woodlot	8.1
450	Non woodlot	7.5
475	Non woodlot	5.3
500	Non woodlot	7.3

Table C-11. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #11 with a 0.9484 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	5.5
25	Woodlot	6.2
50	Woodlot	6.8
75	Woodlot	5.4
100	Woodlot	7.9
125	Woodlot	10.5
150	Woodlot	17.4
175	Woodlot	19.9
200	Woodlot	16.4
225	Woodlot	16.0
250	Woodlot	7.4
275	Woodlot	6.4
300	Woodlot	5.2
325	Woodlot	8.3
350	Woodlot	6.3
375	Woodlot	7.4
400	Woodlot	6.0
425	Woodlot	5.8
450	Woodlot	6.0
475	Woodlot	7.3
500	Woodlot	5.8
525	Woodlot	6.2
550	Non woodlot	6.9

Table C-12. Width and type of riparian zone measured from the edge of water to the beginning of field characteristics surrounding wetland for site #12 with a 1.0 ratio of woodlot coverage to non woodlot coverage

Distance from initial measurement (m)	Type of Riparian Buffer zone	Width of Riparian buffer zone (m)
0	Woodlot	8.4
25	Woodlot	9.4
50	Woodlot	15.9
75	Woodlot	14.7
100	Woodlot	6.9
125	Woodlot	12.5
150	Woodlot	18.5
175	Woodlot	20.2
200	Woodlot	21.0
225	Woodlot	18.5
250	Woodlot	17.7
275	Woodlot	6.7
300	Woodlot	8.4
325	Woodlot	5.9
350	Woodlot	6.3
375	Woodlot	5.2
400	Woodlot	5.4
425	Woodlot	4.8
450	Woodlot	5.8
475	Woodlot	6.7
500	Woodlot	7.9

Appendix D

Table D-1. Downed woody material (DWM) at locations that intersect the transect line; measurements of diameter, length, and classification of class.

Site	Diameter (cm)	Length (cm)	Class (1-5)	Percent Cover of DWM
1	0	0	N/A	0
2	4.5	137.9	1	4.58
	2.3	10.5	1	
3	5.4	8.7	1	16.77
	4.9	55.4	2	
4	6.9	204.1	1	7.77
	10.1	59.0	1	
	9.5	78.1	3	
5	3.5	174.3	1	8.36
	13.5	110.9	2	
	6.5	40.5	1	
	4.6	10.6	4	
6	6.4	225.6	1	8.48
	5.5	48.0	2	
	12.8	98.2	2	
	8.4	19.3	1	
7	14.3	159.3	2	7.19
	9.5	99.3	1	
	13.9	349.4	2	
	4.5	39.2	2	
	5.1	10.4	4	
8	13.8	128.4	2	7.11
	7.7	15.4	2	
	25.3	530.5	1	
	3.3	30.4	3	

Table D-1. continued

Site	Diameter (cm)	Length (cm)	Class (1-5)	Percent Cover of DWM
9	4.4	128.5	2	8.92
	19.4	320.4	1	
	8.5	29.5	1	
	20.5	12.5	5	
	7.7	187.3	2	
10	14.1	382.3	1	7.30
	4.4	100.4	1	
	6.2	44.3	2	
	14.3	30.2	3	
	5.4	50.8	2	
11	10.2	349.2	1	7.16
	9.3	70.5	2	
	5.5	109.5	1	
	14.9	28.2	3	
12	16.2	251.4	2	10.00
	14.4	77.3	2	
	8.3	103.2	2	
	9.3	99.8	3	
	10.3	53.2	1	

Appendix E

Table E-1. Tree Circumference at breast (CBH) height at site location #1

Sub-quadrant	Circumference (cm)	Class (1-5)	Species
1	0	N/A	N/A
2	0	N/A	N/A
3	0	N/A	N/A
4	0	N/A	N/A

Table E-2. Tree Circumference at breast (CBH) height at site location #2

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	15.1	3	Populus alba
	23.9	4	
2	14.4	2	Populus alba
3	9.6	2	Populus alba
4	10.7	2	Populus alba

Table E-3. Tree Circumference at breast (CBH) height at site location #3

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	5.8	1	Populus alba
2	9.8	2	Populus alba
	6.1	1	
3	10.3	2	
4	4.6	1	Populus alba
	3.8	1	Populus alba

Table E-4. Tree Circumference at breast (CBH) height at site location #4

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	10.8	2	Populus alba
2	4.4	1	Populus alba
3	3.9	1	Populus alba
	5.8	1	Undeterminable
4	6.4	1	Populus alba
	4.9	1	Populus alba
	18.3	3	Populus alba

Table E-5. Tree Circumference at breast (CBH) height at site location #5

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	62.1	5	Populus alba
	54.5	5	Populus alba
	74.5	5	Populus alba
2	55.4	5	Populus alba
	70.2	5	Populus alba
	4.5	1	
3	52.1	5	Populus alba
	48.1	5	Populus alba
	64.9	5	Populus alba
4	77.4	5	Populus alba
	48.1	5	Populus alba
	15.4	3	Populus alba

Table E-6. Tree Circumference at breast (CBH) height at site location #6

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	22.3	3	Populus alba
	35.8	5	Populus alba
2	19.2	3	Populus alba
	40.3	5	Populus alba
	6.1	1	
3	15.9	2	Populus alba
	30.4	5	Populus alba
4	27.4	4	Populus alba
	10.6	2	Populus alba

Table E-7. Tree Circumference at breast (CBH) height at site location #7

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	64.0	5	Populus alba
	62.4	5	Populus alba
	74.9	5	Populus alba
	78.3	5	Populus alba
2	52.4	5	Populus alba
	66.1	5	Populus alba
	45.4	5	Populus alba
3	10.1	2	Populus alba
	8.8	2	Populus alba
	12.1	2	Populus alba
	11.4	2	Populus alba
4	15.4	3	Populus alba
	68.4	5	Populus alba
	24.6	4	Populus alba

Table E-8. Tree Circumference at breast (CBH) height at site location #8

Sub-quadrant	Circumference (cm)	Class (1-5)	Species
1	44.5	5	Populus alba
	34.1	5	Populus alba
	4.5	1	Populus alba
2	27.6	4	Populus alba
	74.3	5	Populus alba
3	60.2	5	Populus alba
	59.3	5	Populus alba
	16.2	3	Populus alba
4	38.4	5	Populus alba
	29.4	5	Populus alba

Table E-9. Tree Circumference at breast (CBH) height at site location #9

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	5.1	1	
	7.0	1	Populus alba
	6.3	1	Populus alba
	7.4	1	Populus alba
	8.0	2	Populus alba
	120.3	5	Populus alba
2	79.3	5	Populus alba
	98.1	5	Populus alba
	5.5	1	Populus alba
	54.8	5	Populus alba
3	59.5	5	Populus alba
	4.4	1	
	7.6	1	Populus alba
	8.0	1	Populus alba
	4.6	1	
	7.4	1	Populus alba
4	105.2	5	Populus alba
	4.1	1	
	79.4	5	Populus alba
	8.5	2	Populus alba

Table E-10. Tree Circumference at breast (CBH) height at site location #10

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	66.2	5	Populus alba
	40.2	5	Populus alba
	15.2	2	Populus alba
2	102.2	5	Populus alba
	8.5	2	Populus alba
	4.4	1	Populus alba
3	69.3	5	Populus alba
	45.2	5	Populus alba
4	88.2	5	Populus alba
	14.2	2	Populus alba
	6.4	1	Populus alba

Table E-11. Tree Circumference at breast (CBH) height at site location #11

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	4.4	1	
	6.4	1	Populus alba
	9.3	2	Populus alba
	17.3	3	Populus alba
2	44.5	5	Populus alba
	35.3	5	Populus alba
3	67.4	5	Populus alba
4	40.3	5	Populus alba
	15.1	2	Populus alba
	7.3	1	Populus alba

Table E-12. Tree Circumference at breast (CBH) height at site location #12

Sub-quadrant	**Circumference (cm)**	**Class (1-5)**	**Species**
1	58.3	5	Populus alba
	40.3	5	Populus alba
	4.7	1	
2	73.1	5	Populus alba
3	15.2	2	Populus alba
	40.3	5	Populus alba
	33.1	5	Populus alba
4	6.6	1	Populus alba
	50.2	5	Populus alba

Appendix F

Table F-1. Litter depth in woodlot and non woodlot riparian zones measured along the transect line at one meter intervals

Site	Section	Litter depth at interval 1	Litter depth at interval 2	Litter depth at interval 3	Litter depth at interval 4
1	Non Woodlot	3.3	3.9	3.5	3.3
	Non Woodlot	4.0	3.6	3.9	3.0
2	Woodlot	1.3	1.5	1.4	1.4
	Non Woodlot	7.4	5.0	8.3	8.2
3	Woodlot	1.5	1.6	1.6	1.5
	Non Woodlot	6.7	7.0	6.5	6.9
4	Woodlot	1.8	2.0	1.9	2.1
	Non Woodlot	5.8	6.3	6.4	5.9
5	Woodlot	2.1	2.0	1.7	1.8
	Non Woodlot	5.5	4.9	6.3	5.8
6	Woodlot	2.1	1.7	1.6	1.9
	Non Woodlot	4.4	4.9	4.1	5.0
7	Woodlot	2.0	1.9	1.9	1.7
	Non Woodlot	7.2	6.9	7.1	7.0
8	Woodlot	1.7	1.6	2.0	1.8
	Non Woodlot	6.6	6.0	6.2	5.9
9	Woodlot	1.8	1.9	1.7	1.7
	Non Woodlot	6.7	6.8	6.4	6.3
10	Woodlot	2.1	2.0	1.9	2.0
	Non Woodlot	5.5	5.0	5.4	5.3
11	Woodlot	1.9	1.8	2.0	2.1
	Non Woodlot	4.4	4.7	4.5	3.0
12	Woodlot	2.0	2.1	2.0	1.7
	Woodlot	2.1	2.5	2.0	2.1

Appendix G

Table G-1. Soil samples taken for transect line to measure moisture per gram soil

Site	Section	Initial mass of soil (g)	Final mass of dried soil (g)	Moisture per gram of soil
1	Non Woodlot	20.35	11.42	0.43882064
	Non Woodlot	19.88	11.20	0.42653563
2	Woodlot	19.94	9.95	0.50100301
	Non Woodlot	20.06	11.35	0.43419741
3	Woodlot	20.12	9.85	0.51043738
	Non Woodlot	19.94	10.98	0.44934804
4	Woodlot	20.08	8.99	0.55229084
	Non Woodlot	20.03	11.25	0.43834249
5	Woodlot	19.35	9.21	0.52403101
	Non Woodlot	19.78	10.99	0.44438827
6	Woodlot	20.05	9.65	0.51870324
	Non Woodlot	20.03	10.55	0.47329006
7	Woodlot	19.92	8.54	0.57128514
	Non Woodlot	19.87	10.22	0.48565677
8	Woodlot	20.08	9.10	0.54681275
	Non Woodlot	20.20	10.62	0.47425743
9	Woodlot	19.82	8.21	0.58577195
	Non Woodlot	20.11	9.98	0.50372949
10	Woodlot	20.07	9.11	0.54608869
	Non Woodlot	19.96	9.89	0.50450902
11	Woodlot	20.01	9.03	0.54872564
	Non Woodlot	19.85	10.82	0.45491184
12	Woodlot	19.87	8.87	0.55359839
	Woodlot	20.26	10.02	0.50542942

Appendix H

Table H-1. Soil and water pH level found a study locations

Site	Soil pH	Water pH
1	6.82	6.74
2	6.80	6.77
3	6.80	6.69
4	6.83	6.70
5	6.79	6.73
6	6.81	6.75
7	6.80	6.77
8	6.77	6.69
9	6.82	6.73
10	6.81	6.78
11	6.79	6.75
12	6.80	6.72