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Habitat Comparison of Pseudacris f. feriarum and Pseudacris c. crucifer with Emphasis on Associated Plant Communities and Distribution of Clemmys guttata and Pseudacris f. feriarum in West Virginia

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by
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Abstract

Habitat Comparison of *Pseudacris f. feriarum* and *Pseudacris c. crucifer* in West Virginia with Emphasis on Associated Plant Communities and Distribution of *Clemmys guttata* and *Pseudacris f. feriarum* in West Virginia

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Upland Chorus Frogs (*Pseudacris f. feriarum*) are a rare species in West Virginia. They occur in aquatic habitats across parts of the eastern and southern U.S. *Pseudacris f. feriarum* collection records in West Virginia suggest that their distribution is limited to the eastern panhandle and Ridge and Valley region where they are very rare and imperiled. Distribution information is needed for future management strategies. To help conserve this rare species, key life history habits were identified through the investigation of plant communities that are associated with them. Data on *Pseudacris f. feriarum* distribution in West Virginia was determined by conducting auditory surveys at historic sites as well as potential new sites in order to gain a better idea of where populations exist in the state. Vegetation analysis and water quality tests were conducted wherever *Pseudacris f. feriarum* were found. Similar data were also gathered from areas where *Pseudacris c. crucifer* (Northern Spring Peeper) were found so that these wetlands can be compared to wetlands where the *Pseudacris f. feriarum* were located. This comparison has shown the importance of plants associated with each *Pseudacris* species in its aquatic habitats. The result of this undertaking has been a clearer understanding of the distribution of *Pseudacris f. feriarum* and its association with wetland plants and *Pseudacris c. crucifer*. Spotted Turtles (*Clemmys guttata*) are a species of special concern in West Virginia. Trapping and haphazard searches were conducted during spring of 2007 and 2008 in order to learn more about the species distribution so that successful management strategies could be implemented. During this project historical sites were searched, as well as new potential habitat where found. The results were that only two turtles were found, both at Altona Marsh. It is very possible that this species now resides at only two or three locations in West Virginia.

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There are two individuals who deserve the most thanks in helping me get to this point. The first is Zachary Loughman who at some time during the winter of 2006 said to me, "Why don't you go to Marshall?" Zac and I had been discussing my intentions of attending graduate school. At that time my intentions hadn't evolved into action, but it was Zac who encouraged me to contact Dr. Pauley and to send in the admissions application. Once I was accepted and was working on my research, I knew that I could always call Zac with any questions and he would give me his two cents. (Zac's two cents on field research are invaluable.) I talked to Zac when I was setting my project up, when I was in the field, and when I was writing my thesis. I talked to Zac when during moments when I was feeling discouraged and he always gave me the pep talk that I needed. For anyone doing biological field work, Zac is a good man to know. I am truly blessed to call Zac my friend.

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Part One:
Distribution of Spotted Turtle (*Clemmys guttata*) in the eastern panhandle of West Virginia

Scott Albaugh

Abstract

Spotted Turtles (*Clemmys guttata*) are a species of special concern in West Virginia. They are virtually unknown from all but a few locations in the eastern panhandle of the state where the western edge of its eastern range in the U.S. enters West Virginia. Trapping and haphazard searches were conducted during spring of 2007 and 2008 to learn more about the species' distribution so that successful management strategies could be implemented. During this project historical sites were searched, as well as new potential habitat where found. Haphazard searches were conducted at four historical sites with traps set at two of those sites. Four additional new sites were also searched and trapped. The results were that only two turtles were found, both at Altona Marsh. It is very possible that this species now resides at only two or three locations in West Virginia.

Introduction

Spotted Turtles (*Clemmys guttata*) are listed by the West Virginia Natural Heritage Program as an S1 species (WVDNR 2001). *Clemmys guttata* are declining throughout much of their range (Ernst et al. 1994, Garber and Burger 1995, Tyning 1997, USFWS 2000) (Figure. 1). It is listed as special concern, threatened, or endangered in some states while stable in others (Levell 1997.)

Clemmys guttata are small black turtles with small, round yellow spots on the smooth, keelless, and unserrated carapace which can be up to 12.5cm (Ernst, Lovich, & Barbour 1994). The amount of spots may be extremely variable in number (Conant & Collins 1998). Males have brown eyes, tan chins, a plastron that is slightly concave, a long, thick tail with the vent beyond the carapacial rim. Females have shorter tails with

the vent beneath the posterior marginals, and yellow chins, orange eyes, and a flat or convex plastron and are on average larger than males (Ernst, Lovich, & Barbour 1994).

Clemmys guttata are found in a variety of shallow wetland habitats. These habitats include swamps, bogs, fens, marshes, wet pastures, the edges of ponds, and small woodland streams (Ernst, Lovich, & Barbour 1994).

Clemmys guttata are known from three counties in West Virginia (Figure 2.) Recent studies on *C. guttata* have been conducted by Marshall University graduate students Ariana Breisch from 2001 to 2003 at Edward's Run WMA, and by Jeff Humphries from 1999 to 2001 in Jefferson County. The Breisch study focused on a specific population of turtles within a limited area, while the Humphries study was a survey of historical sites and records as well as a study at Altona Marsh.

The primary resource for this study was Humphries 2002 paper on the distribution of *C. guttata* in West Virginia. Humphries stated that the turtles are restricted to valleys in Jefferson and Hampshire Counties, and that historical records exist from Berkeley County. He also stated that there are five known populations of *C. guttata* in West Virginia. Humphries reported capturing and marking turtles at Altona Marsh, Harewood Marsh, and Blue-Grey Marsh in Jefferson County, and at Edward's Run in Hampshire County. The fifth known population was undisclosed in his report. Humphries did not locate *C. guttata* at six additional historical sites, and was unable to locate another two historical sites (Table 1). He also briefly described the habitat quality for each site that he visited.

Methods

The strategy of this study was to visit some of the sites from the Humphries report and to explore areas for additional habitat. Habitat was located by driving around and looking for bottom lands and marshes.

Binoculars were used to search for basking turtles during foot searches. Traps were placed in shallow water so that the top of the trap was above the water. I placed the traps in between the vegetation where there was evidence that animals had been moving. Bait was not used in any traps.

The first trapping and searching for *C. guttata* began in May of 2007. Four areas were visited and haphazard searches were conducted during that time. The areas visited were Altona Marsh and Leetown Fish Hatchery in Jefferson County, Sleepy Creek WMA in Berkeley County, and Edward's Run WMA in Hampshire County. In 2008 Altona Marsh and Edward's Run WMA were revisited. Bullskin Run in Jefferson County, Stouffer's Marsh and Michael's Farm Airport in Berkeley County, and 5 sites in Morgan County were also searched in 2008 (Table 2).

Permission had not been granted to go into the marsh at Altona, so all searching was conducted from the railroad tracks that run through the marsh. Binocular searches were conducted there for approximately 8 man hours on 11 May, 2007 and again on 25 March, 2008 for 5 hours.

Permission was granted by USGS personnel to trap and search the Blue-Grey Marsh at the Leetown Fish Hatchery in May of 2007. The habitat at the marsh was poor due the draining of the wet land by government employees (Figures 5 & 6).

Approximately 4 man hours were spent searching the area on foot. Two traps were placed in the remaining wet areas of the marsh for 48 hours.

A search consisting of 5 man hours was conducted of Edward's Run WMA in May of 2007. Four man hours were spent conducting haphazard searches in the area on 7 March, 2008.

Sleepy Creek WMA was visited on 12 May, 2007. I searched the south end of Sleepy Creek Lake where the steam enters the lake. Although the habitat was good, no turtles were found in 6 man hours of searching.

Stouffer's Marsh and the Michael's Farm in Berkeley County were briefly searched for *C. guttata* in March of 2008. Both of these sites are in the drainage of Back Creek. Approximately one hour was spent at each site. Both sites are privately owned and require permission from the land owners to enter.

Much time was spent in Morgan County in March of 2008 in suitable habitat for *C. guttata*. Four locations consisting of marginal to good habitat were searched thoroughly (Table 1.2). The first site was at the corner of 28/1 and 38/6. The second was on county road 13/3. The third was on county road 38/8. The forth was on county road 28/1. All 4 sites were located in the Sleepy Creek drainage and approximately 8 man hours were spent at each. Seven traps were placed at the fourth site along Sleepy Creek for 48 hours (Figure 7).

The landowner at Cool Springs Farm along Bullskin Run gave me full access to her property. Approximately 10 hours were spent searching the area on foot on 24 and 25 May, 2008. I set out 12 traps for 48 hours. Three traps were placed in the area of the spring house outflow. One trap was placed near the edge of a pond on the property.

Eight traps were placed between Bullskin Run and a pond so as to capture any turtles moving between the stream and pond (Figures 13 – 16).

Results

Two *Clemmys guttata* were found during the study. Both were found at Altona Marsh. Eighty man hours were spent searching and 1008 hours trapping. Results are summarized in Table 2.

Approximately 13 man hours were spent at Altona Marsh during 2007 and 2008. A single male turtle was found near the rail road tracks on 11 May, 2007 (Figures 3 & 4). The turtle was found in a parallel running ditch directly adjacent to the rail road tracks. A second male was found along the tracks again on 25 March, 2008.

Four man hours were spent at Blue-gray Marsh. Traps were placed in the marsh for 96 trap hours. No turtles were caught or seen in the marsh or surrounding areas. On 19 June, 2007 a government ecologist found a single *Clemmys guttata* near the area were that was trapped and searched the previous month.

Edward's Run WMA was searched for 9 man hours in 2007 and 2008. No turtles were found.

No turtles were found at Sleepy Creek WMA in 2007.

Five locations in Morgan County were searched for 34 man hours. All 4 sites were located in the Sleepy Creek drainage. Trapping was conducted for a 48 hour period at one site along Sleepy Creek (Figure 7). No *Clemmys guttata* were found in Morgan County.

Stouffer's Marsh and the Michael's Farm in Berkeley County were searched for two man hours in March of 2008. No turtles were found at either location.

No turtles were found at Bullskin Run in Jefferson County. Total man hours of searching were approximately 10 and 576 trapping hours.

Discussion

Prior to my study *Clemmys guttata* was known to occur at five locations in West Virginia. I visited three of the five locations and found two turtles at one of those three sites. I also visited 8 additional sites and found no turtles at any of those locations.

Two turtles were found at Altona Marsh. Humphries reported finding and marking 103 *C. guttata* during his study conducted from 1999 to 2001. He estimated the total population of the turtles in the marsh to be 187.

Altona Marsh is a large area of excellent habitat for this species (Humphries, 2002). It is located 1.5 km west of Charles Town along Evitt's Run in Jefferson County, West Virginia. The marsh is under a conservation easement and is managed by the Nature Conservancy (Humphries, 2002). A rail road track runs through the marsh and is the only means of accessing the area without permission from the landowners or the Nature conservancy.

Based on Humphries research and the fact that I only found *C. guttata* here, Altona likely supports the highest population in West Virginia. The reason that I only found two was most likely because I only searched from the rail road tracks and did not

have permission to access the rest of the marsh. Nearly all of Humphries study was at the marsh and he was able to search the whole area.

Briesch (2006) studied *Clemmys guttata* at Edward's Run WMA from March 2001 to April 2003 and found 21 turtles. In 9 man hours of searching during the 2007-2008 study, no turtles were seen. Briesch did not disclose the exact location of her study and although suitable habitat was searched during the 2007-2008 study, it is possible that I did not locate her exact site. Since Briesch found 21 turtles just five years ago, it is reasonable to expect that *C. guttata* are still located at Edward's Run.

Humphries (2002) marked five *C. guttata* at the Leetown Fish Hatchery in Jefferson County during his 1999 to 2001 study. The turtles were found at the marsh that is located at the Hatchery known as the Blue-Grey Marsh. Humphries described the habitat as "good; very small area of marsh available." According to Humphries, *C. guttata* were released in the mid1980's by the WVDNR at this site. In his survey, Humphries located five turtles that were not a part of the WVDNR release program. Upon visiting the marsh in 2007 it was found to be mostly drained. Government workers at the site had removed a beaver dam that was helping to create the marsh (Figures 5 & 6). In June of 2007 a government ecologist at the site located a single *C. guttata* and notified Dr. Pauley. It is now known that they exist at the site, but their future is in peril if wetlands continue to be drained and habitat is not managed appropriately for their survival.

I searched three locations in Berkeley County, but these were limited in effort. Stauffer's Marsh is a private wetland that lies along the Back Creek drainage. This marsh was briefly surveyed using binoculars but no turtles were seen basking. Michaels Farm

also along the Back Creek drainage. A limited amount of effort was spent at this location also. Near the back of the farm across from the run way was a sizable pool within a wooded edge. Wet ditches were adjacent to this area. This area merits a greater amount of searching. Both of these locations were to be re-visited, but unforeseen circumstances during this project made this impossible. The south end of Sleepy Creek Lake was also searched in Berkeley County. This area consists of wet woods where Sleepy Creek flows into the lake. About 6 man hours were spent here with no turtles found.

I searched Morgan County thoroughly to try and fill the gap in the range between Jefferson and Hampshire. Five sites were visited in Morgan County. Two of the sites were flooded agricultural fields with adjacent wet meadows and woods. A land owner at one of these sites reported seeing a "small black turtle with yellow spots" on the farm sometime within the "last 10 years." A small pool was located near the back of this farm that looked like a suitable location for Spotted Turtles (Figure 7). Six traps were set at this location for 48 hours and no turtles were caught. One site consisted of a wet over-grown meadow and adjacent wet woods with a series of ditches. The Ridge State Fish Hatchery was searched. A final location with poor habitat was also searched. No *Clemmys guttata* was found in Morgan County.

Humphries described the habitat quality along Bullskin Run ½ mile W/NW of Wheatland in Jefferson County as excellent with a "large area of high quality of habitat." (Figures 8 – 12.) This location was privately owned and was called "Cool Springs Farm". The landowner was very interested in the prospect of finding *C. guttata* on her property and gave full access to the area. The property contained fencerows, fields, an abandoned orchard, small pond, as well as the marsh that exists beside Bullskin Run

(Davis, 2006). This marsh is roughly 8.7 acres and runs along the stream for nearly 1/3 mile (Davis, 2006). Vegetation surveys were conducted at the marsh several times between 2004 and 2006. 182 species of vascular plants were found to occur in the marsh with 18 of those rare in WV (Davis, 2006).

Many hours were spent at the Cool Springs marsh in search of *C. guttata*. Wet areas on the farm consisted of a spring house with a sizable outflow area, a small pond, a wet meadow and Bullskin Run itself. The banks of the pond teemed with Eastern Painted Turtles (*Chrysemys picta picta*). No *C. guttata* were seen basking around the pond. Eight traps were placed between the pond and the stream, however, on the chance that *C. guttata* were moving back and forth between the pond and the stream. A total of 12 traps were set out for 48 hours and no turtles were seen (Figures 13 – 16). In nearly 10 hours of haphazard searching no *C. guttata* were seen.

Table 1: Results of Humphries 2002 Distribution Study

Site	**Site Located**	**Habitat Quality**	***C. guttata* observations**
Altona Marsh	Yes	Excellent	103 marked
Harewood Marsh	Yes	Very Good	9 marked
Blue-Grey Marsh	Yes	Good	5 marked
Edward's Run WMA	Yes	Very Good	4 marked
Lake Louise	Yes	Poor	None
Town Marsh/Morgan Spring	Yes	Very Good	None
Bullskin Run (½ mile W/NW of Wheatland)	Yes	Excellent	None
Bullskin Run (between Wheatland and Norfolk Southern Railroad crossing)	Yes	Marginal	None
Kearneysville	Yes	Marginal	None
Tuscarora Creek	Yes	Marginal	None
North Fork Bullskin Run	No	X	X
Unnamed Marsh near Martinsburg	No	X	X

Table 2: Locations and Effort for Spotted Turtle Searches

Location	County	Date	Man Hours	Trap Hours	Turtles Found
Altona Marsh	Jefferson	11 May, 2007	8	0	1
Altona Marsh	Jefferson	25 March, 2008	5	0	1
Edward's Run WMA	Hampshire	12 May, 2007	5	0	0
Edward's Run WMA	Hampshire	7 March, 2008	4	0	0
Blue-Gray Marsh	Jefferson	10 May, 2007	4	96	0
Ridge State Hatchery	Morgan	13 March, 2008	4	0	0
Morgan Site 1	Morgan	March, 2008	8	0	0
Morgan Site 2	Morgan	March, 2008	8	0	0
Morgan Site 3	Morgan	March, 2008	8	0	0
Morgan Site 4	Morgan	March, 2008	8	336	0
Bullskin Run	Jefferson	24, 25 March, 2008	10	576	0
Sleepy Creek WMA	Berkeley	12 May, 2007	6	0	0
Michaels Farm/Stauffer's Marsh	Berkeley	3 March, 2008	2	0	0

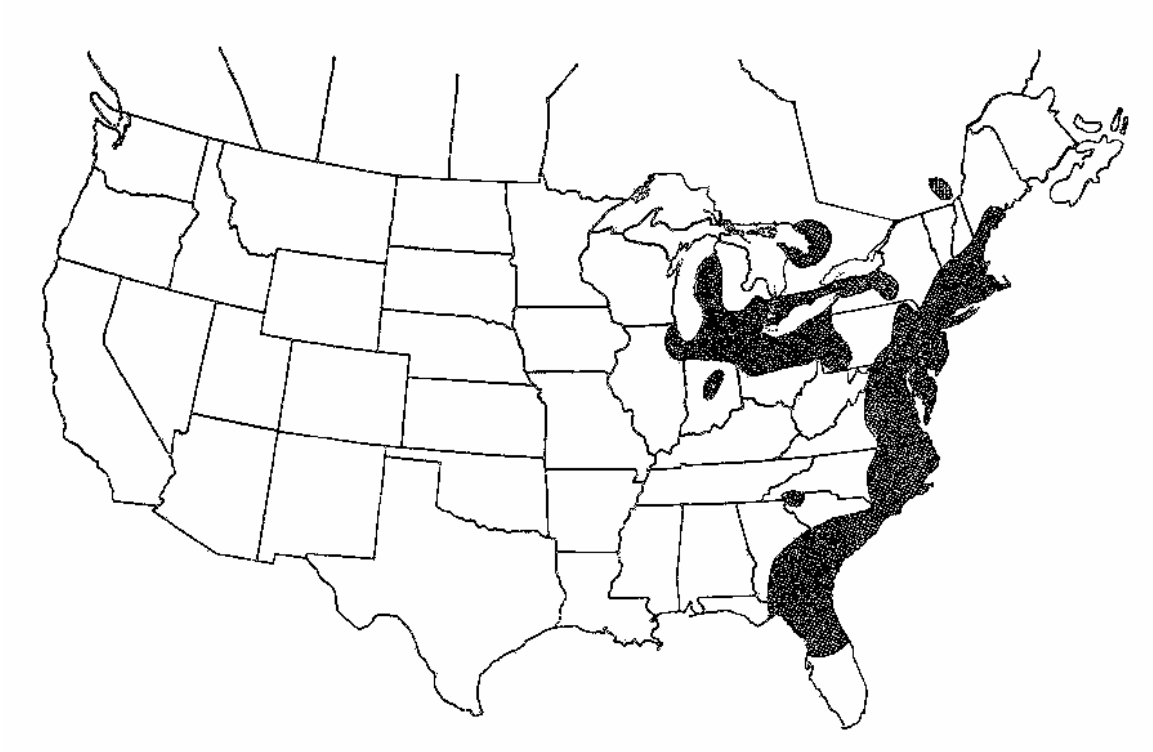

Figure 1: Overall distribution of *C. guttata*.
Adapted from Ernst et al. 1994.

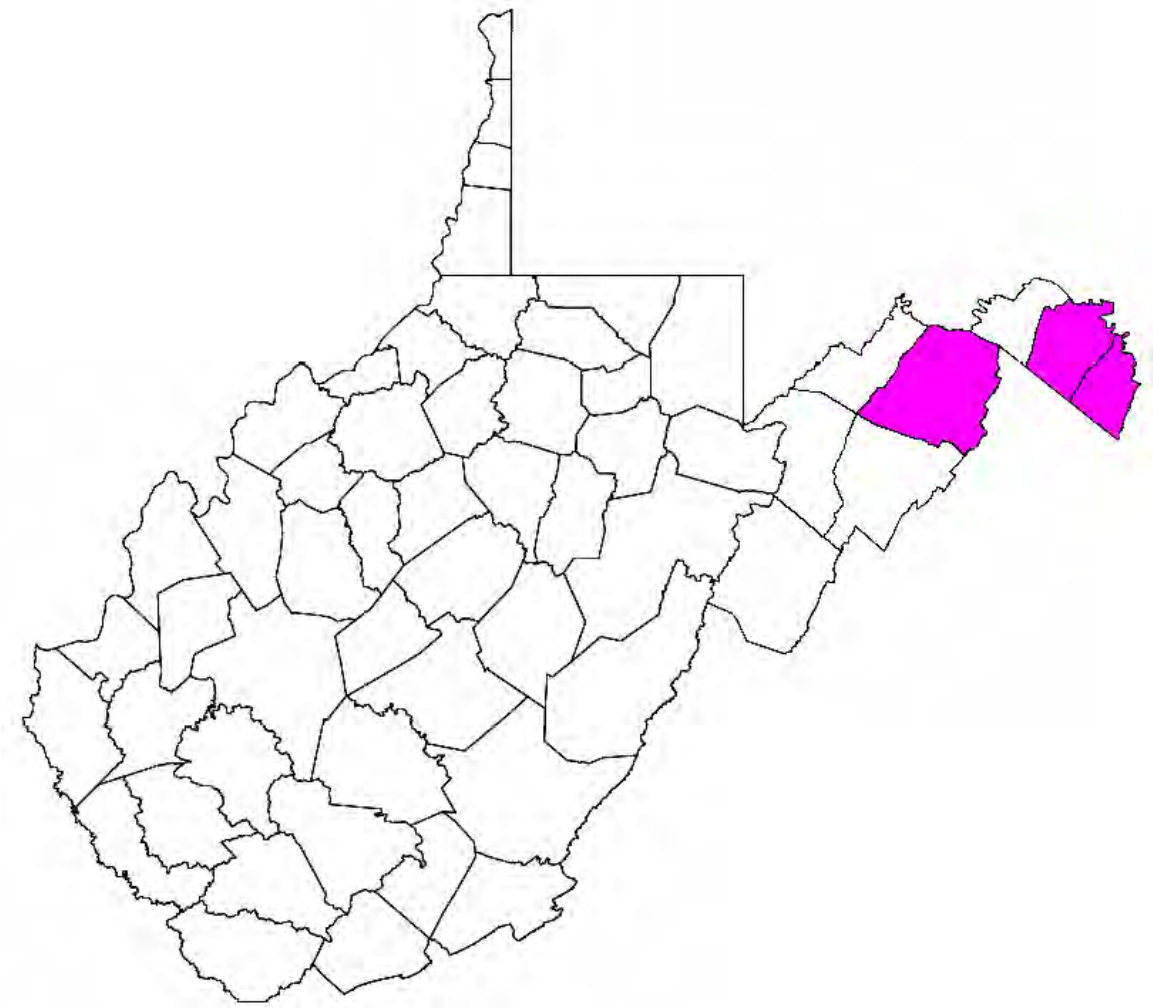

FIGURE 2: Distribution of *C. guttata* in West Virginia
Adapted from Breisch, 2006.

Figure 3: *Clemmys guttata* hand captured at Altona Marsh, May 2007.

Figure 4: *Clemmys guttata* hand captured at Altona Marsh, May 2007.

Figure 5: Dried up Blue Gray Marsh 10 May, 2007

Figure 6: Very little standing water at the Blue Gray Marsh 10 May, 2007

Figure 7: Morgan County site near Berkeley Springs March of 2008

Figure 8: Bullskin Run 24, 25 March, 2008

Figure 9: Bullskin Run 24, 25 March, 2008

Figure 10: Marl marsh at Bullskin Run 24, 25 March, 2008

Figure 11: Marl marsh at Bullskin Run 24, 25 March, 2008

Figure 12: Marl marsh at Bullskin Run 24, 25 March, 2008

Figure 13: Bullskin Run trap site between stream and marsh 24, 25 March, 2008

Figure 14: Bullskin Run trap site between stream and marsh 24, 25 March, 2008

Figure 15: Bullskin Run trap site between stream and marsh 24, 25 March, 2008

Figure 16: Bullskin Run trap site near marsh 24, 25 March, 2008

Part Two: Habitat Comparison of *Pseudacris f. feriarum* and *Pseudacris c. crucifer* in West Virginia with Emphasis on Associated Plant Communities and Distribution

Chapter 1: Habitat Comparison and Study Site Descriptions

Scott Albaugh

Abstract:

Four sites in Morgan County were chosen as study sites for this project. The sites were chosen based on the amount of calling activity and ease of access. Upland Chorus Frogs (*Pseudacris feriarum*) and Northern Spring Peepers (*Pseudacris crucifer*) were measured and released at each of the sites. Vegetation and abiotic data were collected at each site. Similarities and differences among the sites were found. In one instance, *Pseudacris feriarum* were found calling from a shallow pond. Six were found calling away from aquatic vegetation altogether. *Pseudacris feriarum* were also found breeding in areas without overhanging plants, while *Pseudacris crucifer* were found frequently in areas with overhanging plants. The abiotic factors that were measured were nearly the same for each aquatic habitat. Species segregation was observed at all but one site.

Introduction

The range of the *Pseudacris f. feriarum* extends from northern New Jersey southwest to the panhandle of Florida and west to eastern Texas (Conant and Collins, 1998.) In West Virginia it has historically been found in the Ridge and Valley Province. This area included the eastern panhandle and south along the Virginia border to Monroe County (Green and Pauley, 1987.)

The habitat for this species has been described by Conant and Collins as, "Grassy swales, moist woodlands, river-bottom swamps, and environs of ponds, bogs, and marshes…" Hulse, et al. (2001) describe the habitat in Pennsylvania as "…dense vegetation in wooded areas or in marshes and meadows." Finally, Green and Pauley

(1987) describe it's habitat in West Virginia as, "…swampy areas of broad valleys, grassy swales, moist areas of woodlands, and borders of heavily vegetated ponds."

The term "species segregation" is used to describe the occurrence of different species in different parts of a wetland. It does not imply that competition has created the segregation.

Methods

Pseudacris feriarum was studied at four sites in Morgan County, WV. All sites were in the Sleepy Creek drainage and were on private property. The Sleepy Creek drainage was chosen because of the previous work done in that area by Jamie Sias and from personal correspondence with Zachary Loughman who assisted Sias with her research.

Sites were located within by traveling the roads at night in early March and listening for high call activity. The location of these areas were marked on a map and revisited the following day during daylight hours to assess the habitat visually. If frogs were heard during the day and the habitat looked accessible, houses were visited to determine the land owner. Once land owner permission was granted, the sites were visited at the next appropriate time.

The sites were named Private Wetland 1 through Private Wetland 3 with the fourth called Dawson Wetland (the name "Dawson" was chosen because it is the name of the property owner).

Frogs of two species; *Pseudacris f. feriarum* and *Pseudacris crucifer* were collected at each site. The following series of variables were collected at the sites; air and water temperatures, pH, DO, depth of the water where the frog was found, the frog's weight, and size, and vegetation of the aquatic habitat. Dissolved oxygen was not collected at the Dawson Wetland due to a malfunction in the DO meter. Plant surveys were also conducted at each site (chapter 3).

A basic illustrated map of each site was constructed using Microsoft Paint that shows the locations of the frogs at the sites. The maps also show that species segregation was clearly seen in all sites except one.

Nocturnal haphazard searches required the use of headlamps. My colleagues and I located the frogs by sound and then crawled on our hands and knees through the water in search of them.

The minnow traps were placed in the water with the top above the water's surface.

Private Wetland 1

Private Wetland 1 was located at the intersection of Morgan County Road 28/1 and 38/6 (Table 1.2). Nocturnal haphazard searches were conducted on 14 and 15 of March, 2008 totaling approximately 7 man hours. Four minnow traps were placed in the pond and pools for 24 hours.

Private Wetland 2

This area was located on Morgan County road 13/3 (Table 1.2). I conducted nocturnal haphazard searches at Private Wetland 2 on 13 and 25 of March, 2008 totaling nearly 9 man hours. Trapping was also conducted on two occasions for 954 trap hours.

Ten traps were placed in the area for 24 hours on March 8th and 17 traps were placed in the area for 42 hours on March 23rd.

Private Wetland 3

This wetland was located on Morgan County road 38/8. Nocturnal haphazard searches were conducted at this location on March 14th for 4 man hours. Eight traps were set at this site for 44 hours, totaling 352 trap hours.

Dawson Wetland

The nocturnal haphazard searches at this site were conducted on March 15th and March 23rd, 2008. Approximately 5 man hours were invested in the searches. I did not trap at this site.

Results

The variables at each site were similar. Air temperatures averaged between 4.44 and 8.44 degrees Celsius. The pH at each site averaged between 6.65 and 7.25. Water temperatures averaged between 9 and 12 degrees Celsius. Water depths averaged 7.93 to 12.57 centimeters. Dissolved oxygen at each site averaged 9.79 to 12.48 mg/L (Table 1.1).

Private Wetland 1

Six *Pseudacris. feriarum* and 5 *P. crucifer* were captured at this site. *Pseudacris feriarum* eggs were observed in a trap at this site on 15 March (Figure 1.8) and hatched eggs were found at this location on 25 March (Figure 1.9).

Private Wetland 2

Seven *P. feriarum* and 5 *P. crucifer* were captured during haphazard searches. No frogs were caught in the traps on March 8. The March 23rd trapping resulted in the capture of 4 *P. feriarum* and 2 *P. crucifer*.

Private Wetland 3

5 *P. crucifer* and 6 *P. feriarum* were caught. Although trap time was 352 hours, no frogs were caught from trapping.

Dawson Wetland

Only 4 *P. feriarum* were caught while 10 *P. crucifer* were manually ensnared. No traps were set at this site.

Discussion

There were some differences and similarities among habitats in the sites used in this study. Private Wetland 3 and the Dawson Wetland were the most similar in that they were both agricultural fields. The other two sites were more overgrown and were in turn more botanically diverse and more diverse in structure (arrangement and diversity of water bodies.)

There were a few similarities among all the sites. Every site was either fully open with no trees or woody underbrush, or had areas where there were no trees or woody underbrush. Every site contained both *P. crucifer* and *P. feriarum.* All sites had very similar water temperature, pH, and dissolved oxygen. Every site contained standing water that was centralized linearly in ditches except Private Wetland 1.

Private Wetland 1

This area was privately owned and was the location of the first *Pseudacris feriarum* heard during this study on 6 March, 2008. The frogs called consistently at this location throughout the day and into the night. *Pseudacris feriarum* was heard at this site every time that it was visited during the study. This is one of two locations where *P. feriarum* seemed to out number *P. crucifer*. This statement is based on observation and cannot be backed up quantitatively (Figure 1.1).

This site consisted of several small pools and one larger shallow pond (Figures 1.1-1.7). This shallow pond was the only pond where *P. feriarum* was found to inhabit during the entire study (Figure 1.4). About three-fourths of the perimeter of the large shallow pond was lined with *Juncus effusus*, sedges, and grasses. During daylight hours frogs were heard calling from these clumps of vegetation. At night *P. feriarum* was hand captured floating freely in the water up to one meter from vegetation.

Many of the smaller pools had no aquatic macrophytes, *Juncus effusus*, grasses, or sedges growing in or around them, but still had chorus frogs calling from them (Figures 1.6-1.7). Therefore *P. feriarum* was found in pools with no aquatic vegetation. This observation contradicts Hulse et al.'s statement that calling males are "usually associated with emergent vegetation." Based on this observation, it could be stated that *P. feriarum* could reproduce independently of living aquatic vegetation so long as submerged vegetative material is present to attach the egg masses to (Hulse et al., 2001).

Hatched eggs were found at this location on 25 March (Figure 1.9). The hatched eggs were determined to be *P. feriarum* eggs because the mass was stuck on vegetation in a small (1 inch) gelatinous mass of 25-50 eggs. Egg masses of *P. feriarum* are laid in clusters less than 2.5cm (1 inch) in diameter and contain 12 to 245 eggs (Hulse

et al., 2001). I knew the eggs were hatched because I could see that the tadpoles within the protective gelatinous mass (Figure 1.9).

There was no clear sign of species segregation here most likely because of the limited amount of habitat. Frogs were restricted to edges of pools. Only the large pond was big enough to show segregation. *Pseudacris feriarum* lined the edge of the pond and could be heard calling from every clump of vegetation. Field observations show that there were more *P. feriarum* in the pond than *P. crucifer*, but there are no numerical values to prove that.

Searches at this site were abandoned upon the discovery of fresh tire tracks made by four wheeled vehicles in the pools. I did not think it was wise to leave flags, or traps at the site overnight lest they be destroyed (Figure 1.3).

Private Wetland 1 was the only area in all of the searches where *P. ferarium* was found calling and breeding in a pond (Figure 1.4). This pond was devoid of fish and had a vegetated edge from which most frogs were calling.

Other amphibians at this site included *Bufo americanus* and *Notopthalamus v. viridescens.*

Private Wetland 2

The land owner at this location was from Virginia and used the land for hunting. It was the most biologically diverse site in the study with more plants and animals found here than in all other sites. It was also the most over-grown area with tall grasses and forbs found throughout (Figures 1.9-1.15).

Private Wetland 2 consisted of a series of long ditches with a slow moving stream dissecting the area. The central part of the wetland was an over-grown field and was

bordered by wet woods all around. The woods consisted mainly of Red Maple, *Acer rubrum*, and Birch, *Betula* sp., with Tulip Poplar, *Liriodendron tulipifera*, and alders, *Alnus* sp. also in the area. Poison Ivy, *Rhus radicans*, was the most common understory plant both in the woods and in the over-grown field. Thorny brambles were also found in the over-grown field.

Species segregation was clearly seen at this site. *Pseudacris feriarum* was found calling from all ditches in the over-grown field during the day and night. This was the only area were *P. feriarum* was found calling from moving water. They seemed to avoid ditches in the woods. *Pseudacris crucifer* was found mainly at the deeper part of the stream where large grasses dominated bank. They were also found in the ditches, but not as commonly as *P. feriarum.* Wood Frogs (*Rana sylvatica*) were heard calling from the area where there were ditches in the woods. This was also the only site were *P. feriarum* was found inhabiting moving water.

Five amphibian species were found at this site. In addition to the above mentioned species; *Notophthalmus v. viridescens and Ambystoma maculatum* were also found at this site.

Private Wetland 2 stood out from the other sites in that it was the most overgrown area. As can be seen from the photos this area is in a successional stage where the herbaceous layer is overgrown and woody plants have begun to grow among the herbaceous vegetation in the field.

Pseudacris feriarum was very common at this site, and could be heard calling on every occasion that researchers visited. Based on field observations, chorus frogs were most common and abundant at this site.

An interesting note is that *P. feriarum* was rarely heard calling from woods with standing water. During the vehicular surveys for *P. feriarum* only on one occasion were they heard calling from a wooded area. From these observations it seems that *P. feriarum* can be found in areas that are well overgrown in the herbaceous layer, and may tend to shy away from areas with too much woody vegetation. A working small scale example of this hypothesis was seen a few hundred meters to the north of Private Wetland 2 along CR 13/3 (Figures 1.16-1.19). *Pseudacris feriarum* were heard calling from what seemed to be a heavily wooded area. My colleague and I stopped to explore and found that *P. feriarum* were not calling from within the woods, but in an open spot beneath a power line (Figure 1.19). All around the open area adjacent to the power line in the smaller growth of trees were *P. crucifer* (Figure 1.18). Outside of the range of the saplings where larger trees were growing, *R. sylvatica* was calling (Figure 1.17). From this observation, one could speculate that *P. feriarum* may find optimal habitat in late successional fields just before woody plants take over or in areas where no woody plants overhang the water where the frogs are breeding. If this were true, *P. feriarum* would have a very narrow window during habitat succession in which to optimize reproduction. This could also explain the apparent decline of this species in some areas of West Virginia. As old farms and pastures return to forest they will support different species throughout each successional period. With the decline in agriculture has come an increase in forest and that has impacted wildlife throughout the state.

An avian example of this phenomenon is the Bachman's Sparrow (*Aimophila aestivalis*). Bachman's Sparrow was historically a bird of the southeast US that was found in open pine woods, edges and brushy fields. It expanded its range in the 1800's

and early 1900's to the north as forests were removed and replaced by small farms. The bird survived in this area north of its historical range due to the presence of scrubby fields and edges created by the deforestation and farming. As small farms began to dry up and even more fields turned to scrub the bird persisted. In West Virginia this species was most widespread between 1915 and 1922. It then declined briefly and seemed to increase in the 1930's through the 1950's. Post 1950's the decline was rapid and the bird had nearly disappeared by the 1970's (Hall, 1983.) This reflects the growth and decline of farms which may have created suitable habitat for this species. As the amount of forest increased in West Virginia and other states at the northern end of the sparrow's range it retreated to its historical range in the south. It may be possible that an amphibian such at the Upland Chorus Frog would expand and retract its range in a similar way.

It was also at Private Wetland 2 where *P. feriarum* called the most consistently during both night and day throughout the entire study. It was also observed that *P. feriarum* seemed to outnumber *P. crucifer* at this site. This statistic of outnumbering is a result of field observations and also of the number of frogs caught; where 4 more *P. feriarum* were caught than *P. crucifer.*

In all instances when *P. feriarum* was manually ensnared there was little or no woody vegetation above the water.

Private Wetland 3

This area was large farm field (possibly a hay field) flooded with a series of ditches (Figures 1.20-1.23). I estimate the size at 3-4 acres. This wetland consisted mostly of one or two species of grasses or sedges making it one of the least botanically diverse sites.

Pseudacris crucifer clearly dominated at this location and species segregation was present. *Pseudacris crucifer* was heard throughout the flooded ditches at the site while *P. feriarum* called primarily from the southeast corner of the flooded part of the field (Figure 1.21). Both species could be heard calling during day and night. It was at this site where *P. feriarum* was also found calling from a ditch along the road (Figure 1.25). This ditch was nearly 100 meters from the main population of *P. feriarum* at the site. The ditch was less than one meter wide and two meters long. Water depth in the ditch was not measured, but was estimated to be less than 50 centimeters.

An adjacent flooded woods contained *Rana sylvatica*. A pond was also located near this site from which *P. feriarum* was never heard calling (Figure 1.24.)
This wetland was similar to Private Wetland 3 in that it was also a flooded farm field and had less botanical diversity than the first two sites (Figure 1.26-1.27).

Dawson Wetland

This site was also a large farm field. The area that was flooded was several acres (Figure 1.28). Species segregation could also be clearly seen at this location. *Pseudacris crucifer* was found throughout the wetland in good numbers while *P. feriarum* was found mostly at a corner edge of the site (Figure 1.27).

This site was most similar to Private Wetland 2. Both sites were dominated by grasses and sedges, *Pseudacris crucifer* occupied a greater area, and *P. feriarum* was found occupying a small section of the wetland near the edge of the water.

Table 1.1 Average variables for each site during study March, 2008

	Private Wetland 1	Private Wetland 2	Private Wetland 3	Dawson Wetland
Water Temp Degrees C	12	7.27	9	11.67
Air Temp Degrees C	6.72	6.43	4.44	8.44
Water Depth cm	?	12.57	10.82	7.93
pH	7.25	6.65	7.05	7.23
Dissolved Oxygen mg/L	12.48	9.79	10.57	?

Table 1.2 *Pseudacris feriarum* study sites March, 2008

Location	UTM	Nearest Road or Intersection	County	Hours of Hand Capture
Private Wetland Number 2	17S 737776 4377362	13/3 Luther Michael Rd.	Morgan	6
Private Wetland Number 1	17S 734843 4378010	Corner of Creek Rd. 28/1 and 38/6	Morgan	4
Private Wetland Number 3	17S 736668 4377610	Cr 38/8	Morgan	4
Dawson Wetland		Cr 28/1	Morgan	5

Table 1.3. Site variables for Private Wetland Number 1 March, 2008

		Water Temp C	Ambient Temp F	pH	DO (mg/l)
3/14/2008	P. feriarum 1	12	45	7.2	11.3
3/14/2008	P. feriarum 2	12	45	7.3	13.9
3/14/2008	P. feriarum 3	12	45	7.3	13.9
3/14/2008	P. feriarum 4	12	45	7.3	13.9
3/14/2008	P. feriarum 5	12	45	7.3	13.9
3/15/2008	P. feriarum 6	12	47	7.2	11.3
3/14/2008	P. crucifer 1	12	47	7.3	13.9
3/15/2008	P. crucifer 2	12	47	7.2	11.3
3/15/2008	P. crucifer 3	12	47	7.2	11.3
3/15/2008	P. crucifer 4	12	47	7.2	11.3
3/15/2008	P. crucifer 5	12	47	7.2	11.3

Table 1.4. Site variables for Private Wetland Number 2 March, 2008

		Water Temp C	Water Depth (cm)	Ambient Temp F	pH	DO (mg/L)
3/13/2008	P. crucifer 2	7	8.5	40	6.1	8.37
3/13/2008	P. crucifer 3	7	15	40	6.1	8.37
3/13/2008	P. crucifer 4	7	5	40	6.1	8.37
3/13/2008	P. crucifer 5	7	14	40	6.1	8.37
3/13/2008	P. feriarum 6	7	9.5	40	6.1	8.37
3/14/2008 (Caught during daylight)	P. feriarum 7	7	3	40	6.1	8.37
3/25/2008	P. feriarum 8	8	22.5	45	7.3	11.5
3/25/2008	P. feriarum 9	8	17	45	7.3	11.5
3/25/2008	P. feriarum 10	8	14	45	7.3	11.5
3/25/2008	P. feriarum 11	8	17.8	45	7.3	11.5
3/25/2008	P. crucifer 6	6	12	45	7.3	11.5
3/25/2008	P. crucifer 7	?	?	58	?	?

Table 1.5. Site variables for Private Wetland Number 3 March, 2008

		Water Temp C	Water Depth (cm)	Ambient Temp F	pH	DO (mg/l)
3/14/2008	P. crucifer 1	9	14	45	7	10.5
3/14/2008	P. crucifer 2	9	9	45	7	10.5
3/14/2008	P. crucifer 3	9	8	45	7	10.5
3/14/2008	P. crucifer 4	9	6.5	45	7	10.5
3/14/2008	P. crucifer 5	9	11.5	45	7	10.5
3/14/2008	P. feriarum 1	9	13.5	45	7.1	11.14
3/14/2008	P. feriarum 2	9	11.5	45	7.1	11.14
3/14/2008	P. feriarum 3	9	12.5	45	7.1	11.14
3/14/2008	P. feriarum 4	9	13	45	7.1	11.14
3/14/2008	P. feriarum 5	9	13	45	7.1	11.14
3/14/2008	P. feriarum 6	9	6.5	45	?	8.1

Table 1.6. Site variables for Dawson Wetland March, 2008

		Water Temp C	Water Depth (cm)	Ambient Temp F	pH	DO (mg/L)
3/15/2008	P. crucifer 1	13	10	47	7.4	?
3/15/2008	P. crucifer 2	13	10	47	7.4	?
3/15/2008	P. crucifer 3	13	10.5	47	7.4	?
3/15/2008	P. crucifer 4	13	7	47	7.4	?
3/15/2008	P. crucifer 5	13	13	47	7.4	?
3/23/2008	P. crucifer 6	?	8.5	44	?	?
3/23/2008	P. crucifer 7	?	17	44	?	?
3/23/2008	P. crucifer 8	?	1	44	?	?
3/23/2008	P. crucifer 9	?	2.5	44	?	?
3/23/2008	P. crucifer 10	?	3.5	44	?	?
3/15/2008	P. feriarum 1	10	10	47	7.4	?
3/15/2008	P. feriarum 2	10	6.5	47	7	?
3/15/2008	P. feriarum 3	10	6	47	7	?
3/15/2008	P. feriarum 4	10	5.5	47	7	?

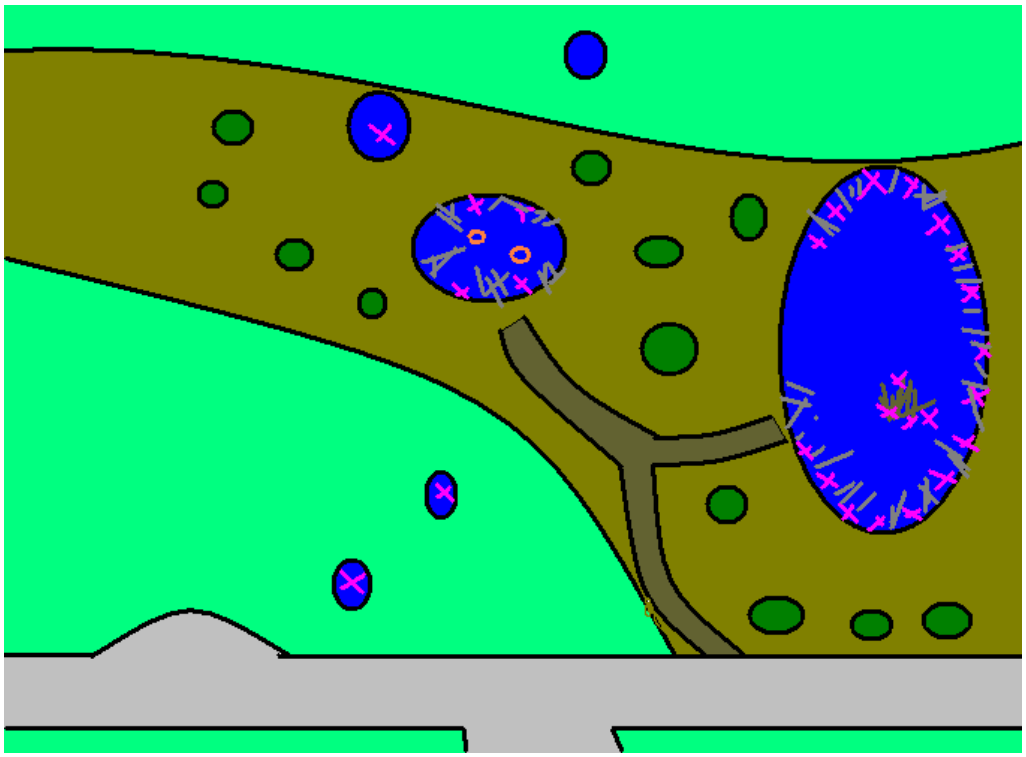

Figure 1.1 Illustrated map of Private Wetland 1. Pink X's represent the location of *P. ferarium* and orange O's represent the location of *P. crucifer.*

Figure 1.2 One of the small pools at Private Wetland 1, March, 2008

Figure 1.3 Minnow trap and flag in the small pool at Private Wetland 1, March, 2008

Figure 1.4 The large pond at Private Wetland 1, March, 2008

Figure 1.5 A small pool at Private Wetland 1, March, 2008

Figure 1.6 Puddle at Private Wetland 1 from which *P. feriarum* was calling, March, 2008

Figure 1.7 Puddle at Private Wetland 1 from which *P. feriarum* was calling, March, 2008

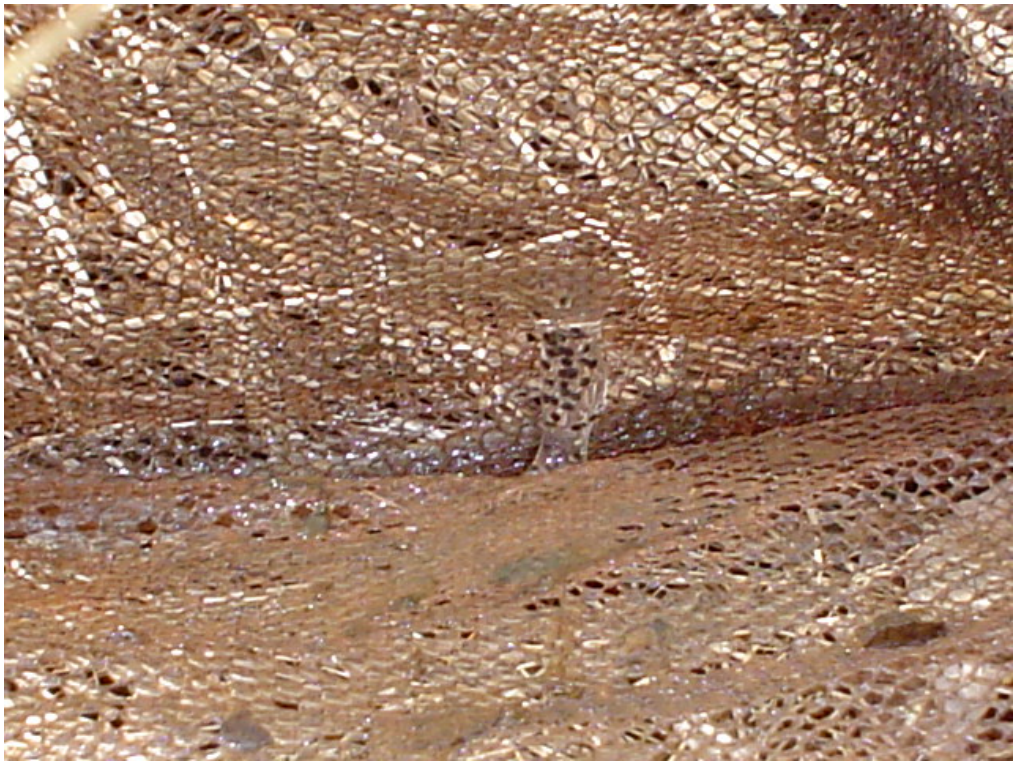

Figure 1.8 *P. feriarum* eggs in minnow trap on March 15, 2008

Figure 1.9 Hatched *P. feriarum* eggs on March 25, 2008

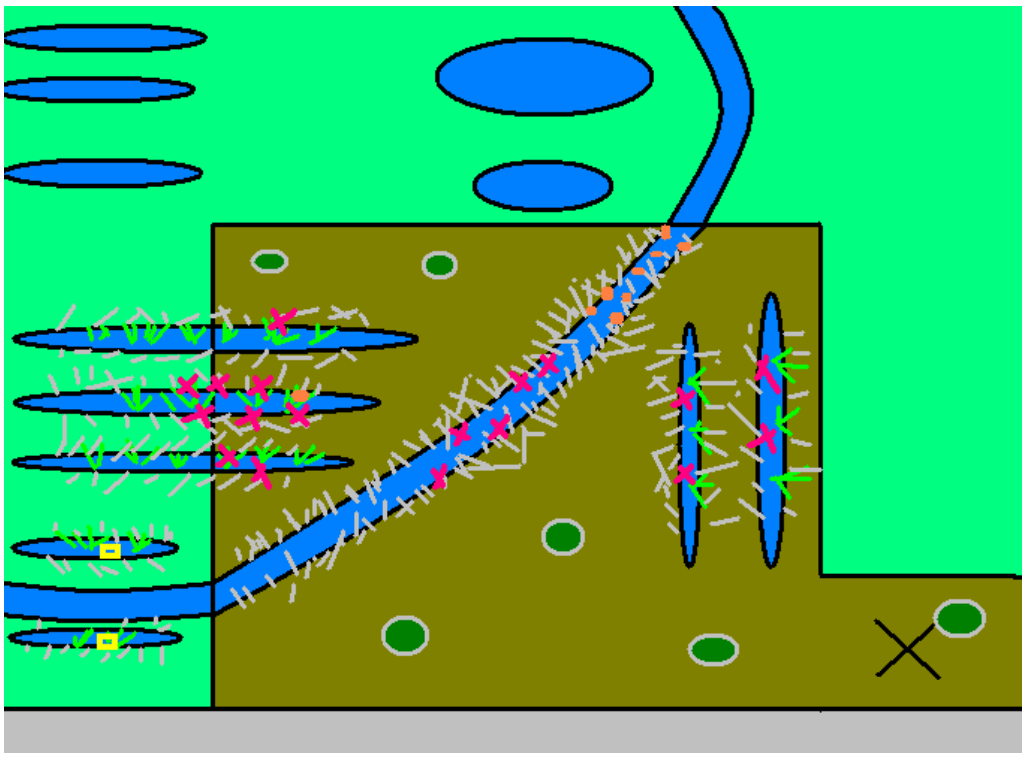

Figure 1.10 Illustrated map of Private Wetland 2. Pink X's represent the location of *P. ferarium*, orange O's represent the location of *P. crucifer* and yellow squares represent *R sylvatica.*

Figure 1.11 Overgrown field at Private Wetland 2, March, 2008

Figure 1.12 Overgrown field at Private Wetland 2, March, 2008

Figure 1.13 Overgrown field at Private Wetland 2, March, 2008

Figure 1.14 Overgrown field at Private Wetland 2, March, 2008

Figure 1.15 Flags marking frog locations at Private Wetland 2, March, 2008

Figure 1.16 One of the ditches from where *P. feriarum* frequently called at Private Wetland 2, March, 2008

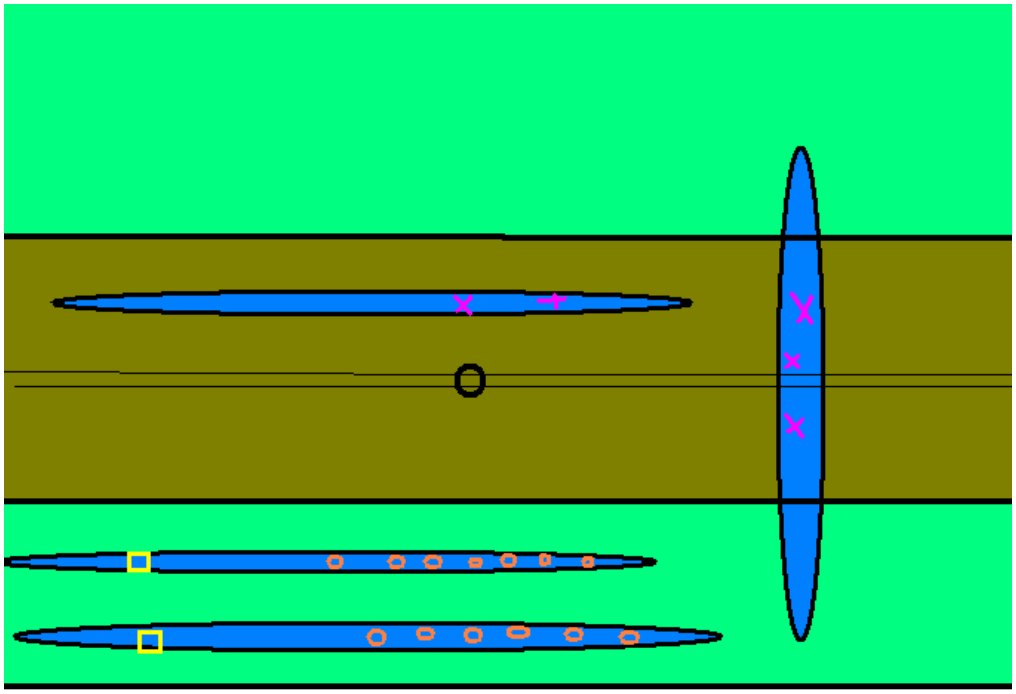

Figure 1.17 Illustrated map of wet area adjacent to Private Wetland 2. Pink X's represent the location of *P. ferarium*, orange O's represent the location of *P. crucifer* and yellow squares represent *R sylvatica.*

Figure 1.18 Wet area adjacent to Private Wetland 2 from where *R. sylvatica* was calling, March, 2008

Figure 1.19 Wet area adjacent to Private Wetland 2 from where *P. crucifer* was calling, March, 2008

Figure 1.20 Wet area adjacent to Private Wetland 2 from where *P. feriarum* was calling, March, 2008

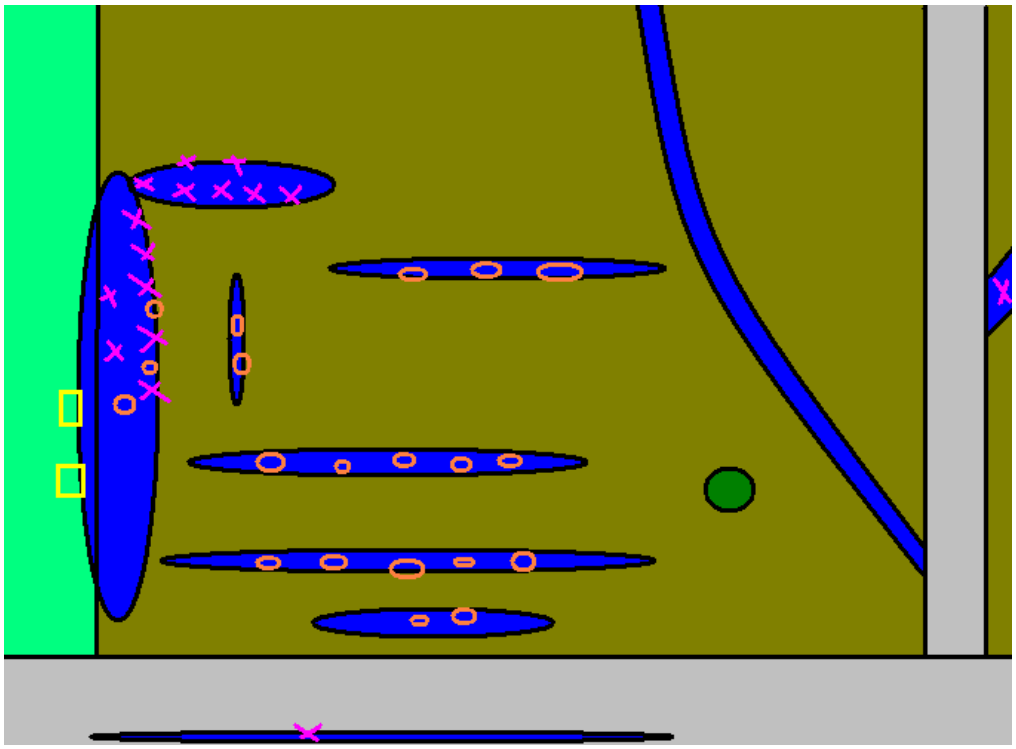

Figure 1.21 Illustrated map of Private Wetland 3. Pink X's represent the location of *P. ferarium*, orange O's represent the location of *P. crucifer* and yellow squares represent *R sylvatica.*

Figure 1.22 Private Wetland 3, March, 2008

Figure 1.23 View of Private Wetland 3 from the road, March, 2008

Figure 1.24 View of Private Wetland 3 from the road, March, 2008

Figure 1.25 Pond near Private Wetland 3 where *P. feriarum* did not occur, March, 2008

Figure 1.26 Roadside ditch near Private Wetland 3 from where *P. feriarum* was calling, March, 2008

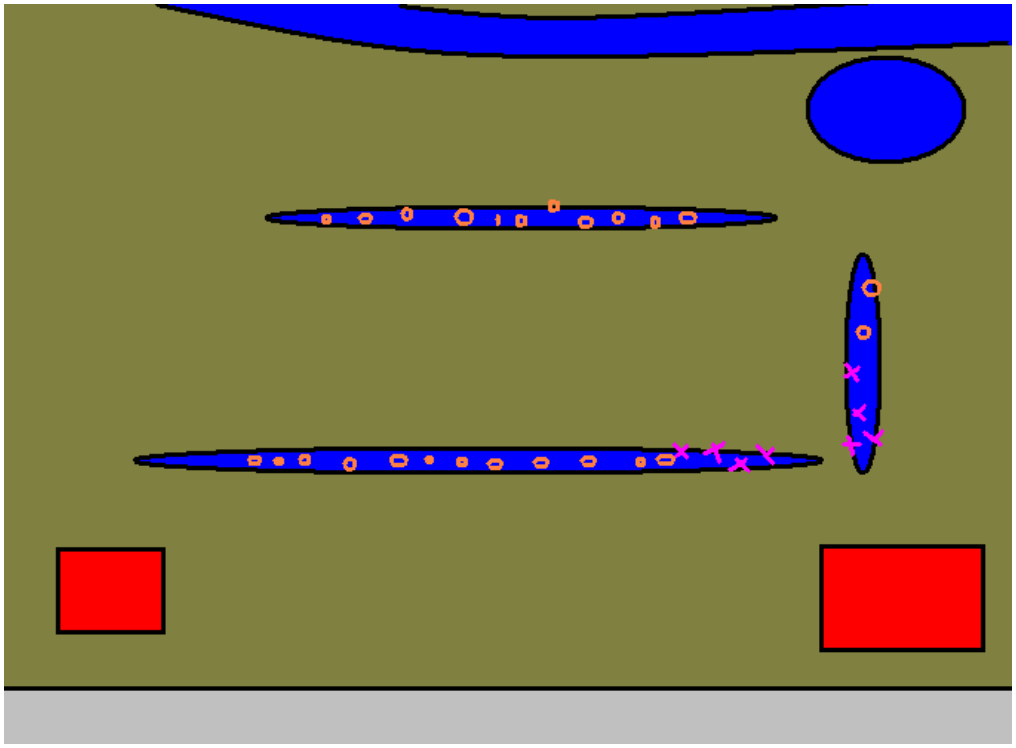

Figure 1.27 Illustrated map of Dawson Wetland. Pink X's represent the location of *P. ferarium* and orange O's represent the location of *P. crucifer*.

Figure 1.28 Main ditch at Dawson Wetland. Photo courtesy of Zac Loughman.

Chapter 2: Species Accounts: Collection and Comparison of Upland Chorus Frog (*Pseudacris feriarum*) and Northern Spring Peeper (*Pseudacris crucifer*)

Scott Albaugh

Abstract

The greatest area of occurrence for Upland Chorus Frogs (*Pseudacris feriarum*) in West Virginia is Morgan County. This species and Northern Spring Peepers (*Pseudacris crucifer*) were studied in March of 2008. *Pseudacris crucifer* was studied so that morphometric and behavioral could be compared with *P. feriarum.* The most effective method of collection was hand collecting during the early hours of the night. Trapping was much less effective. Morphometric data that was obtained showed that both species in this area are physiologically similar to what has been reported from other studies. Behavioral observations show that the two frogs occupy a different niche in the breeding pools. *Pseudacris feriarum* were observed calling while floating in the water while *P. crucifer* were observed calling while sitting on vegetation.

Introduction

Upland Chorus Frog (*Pseudacris f. feriarum*) is listed by the West Virginia Natural Heritage Program as an S2 species (WVDNR 2001). It is the rarest frog known to occur in West Virginia (Pauley, pers comm.) In West Virginia it has historically been found in the Ridge and Valley Province (Figure 2.1), which includes the eastern panhandle and south along the counties that border Virginia to Monroe County (Green and Pauley, 1987.) Preferred habitat of *P. feriarum* includes a variety of wetland habitats such as grassy swales, moist woodlands, river-bottom swamps, in and around ponds, bogs, and marshes (Conant & Collins 1998). Males typically call from concealed grassy areas near water (Crenshaw and Blair, 1959; Landreth and Ferguson, 1966; Lord and Davis, 1956).

Pseudacris feriarum are a diminutive species at 1.9 - 3.5cm that is identified by a light line that runs along the upper lip and by a dark line that runs from the snout through

the eye and ends at the groin (Conant & Collins 1998) (Figure 2.2). There are 3 longitudinal lines which may be complete or broken into spots on the dorsal surface and a triangular spot on the head usually connects with the middle stripe (Green and Pauley, 1987) but some individuals may lack dorsal markings altogether (Johnson, 2000) (Figure 2.3). Females are often larger than males.

The voice of the *Pseudacris feriarum* is a regularly repeated *crreek* or *prreep* (Conant & Collins 1998). Its pitch is lower and four times slower than the related Mountain Chorus Frogs (*Pseudacris brachyphona*) (Green and Pauley, 1987). By visiting potential breeding sites during the breeding season using the NAAMP protocol this study determined the most important monitoring sites for *Pseudacris feriarum* in West Virginia.

A study of *Pseudacris feriarum* was conducted from spring of 2004 through spring of 2005 by Jamie Sais, a Marshall University Graduate Student. In that study historic data on the distribution of Upland Chorus Frogs was compared to current data that was collected from auditory surveys.

Pseudacris crucifer are the most common treefrog in West Virginia (Pauley, pers comm.) It can be found throughout the state in nearly every county (Green and Pauley, 1987). Habitat frequented by Northern Spring Peepers includes woodlands especially those with scrubby secondary growth and adjacent wet areas such as swamps, marshes, or wet meadows (Conant & Collins 1998, Hulse et al. 2001).

Pseudacris crucifer are small frogs that measure 1.9 -3.2cm in length (Conant & Collins 1998). They have a dark X on the back that distinguishes them from other species of *Pseudacris.* This species can also be differentiated from *P. feriarum* by the

amount of toe webbing. The webbing on the rear feet of *P. crucifer* extends half the distance to the ends of the toes, while the webbing on the rear feet of *P. feriarum* extends one quarter of the distance to the ends of the toes. The dorsal coloration in general is a shade of dark brown or tan (Hulse et al. 2001). Females are larger than males (Hulse et al. 2001).

The voice of *P. crucifer* is distinctive. Green and Pauley describe the sound as a, "shrill, high pitched trill or monosyllable described as a 'peep'." (1987).

In appropriate breeding habitat it occurs sympatrically with *P. feriarum*.

Both *P. feriarum* and *P. crucifer* were captured during this study at the four study sites. The goal of capturing both was to make comparisons between the vegetation and abiotic factors where they were found. Every individual that was caught was measured.

Methods

Frogs searches were started once the four private study sites were located and permission was granted from the landowners. Each study was conducted at night in March. Equipment used was headlamp, waders, note book, plastic bags, calipers, and scale. Headlamps were used to illuminate the area from where the frogs were calling. Chest waders were needed so that we could crawl on our hands and knees to the frogs. A "Write it the Rain" notebook was used. Plastic bags were used to hold frogs for measuring. Calipers and scale were used to measure and weigh frogs.

Frogs were located by their calls. Upon locating the general location of a frog, we crawled on hands and knees searching with headlamps. Specimens were captured by hand and placed into a plastic bag (Figure 2.4). The snout to urostyle length (SUL) and

tibia length (Tib) were measured. Frogs were weighted to the nearest gram. Finally, notes were taken on the physical position and behavior of each frog while calling (Figure 2.5). The location of the capture was marked with a flag that was labeled to identify the individual frog (Figure2.6).

At three of the four sites, frogs were trapped using minnow traps. The traps were placed into the water for no less than 24 hours.

Results

The snout to urostyle length (SUL) of *P. crucifer* males average 25.2 mm and females average 31.8mm (Hulse et al. 2001). The average SUL of *P. feriarum* is 24.9mm for males and 28.7mm for females (Hulse et al. 2001). The average SUL of *P. crucifer* caught in this study was 27.5mm. The average tibia length for *P. crucifer* was 14.1mm. Average SUL and tibia lengths for *P. feriarum* were 27.4mm and 14.1mm respectively (Tables 2.1 and 2.2). These numbers agree with measurements found in literature regarding these species (Conant and Collins, 1998; Green and Pauley, 1987; Pollio and Kilpatrick, 2002).

Trapping was ineffective. Ten frogs were caught (7 *P. feriarum*, 3 *P. crucifer*) in 1402 trapping hours. The capture rate was 0.7%. Trapping hours were determined by multiplying the number of hours that a trap was in the water by the total number of traps set

Most of *P. feriarum* that were capture by hand were in the water either free floating, or sitting on submerged vegetation with the tops of their heads out of the water. Conversely, most *P. crucifer* captured by hand were completely above the surface of the water sitting on vegetation (Tables 2.1 and 2.2).

Discussion

Nothing unexpected was found in the sizes of any of the frogs. SUL's, tibia lengths, and weights were close to average for both species (Conant and Collins, 1998; Green and Pauley, 1987; Pollio and Kilpatrick, 2002).

The most effective method of capturing frogs was by stalking them at night and catching them by hand. Trapping was highly ineffective with a capture rate of only 0.7%. Although more effective than trapping, hand capturing had shortcomings. The most serious shortcoming was fatigue of the researchers. With both air temperatures and water temperatures at or less than 10 degrees C, we got cold and tired after about two hours of capturing frogs.

Pseudacris feriarum prefers open water for calling because they were found either free floating or sitting on submerged vegetation. *Pseudacris crucifer* almost always called from floating mats of vegetation, or from within a clump of grasses or sedges. This observation supports the observation that *P. feriarum* prefers water with no overhanging plants. It is unclear at this time as to why *P. feriarum* prefers to call from open water seemingly without cover.

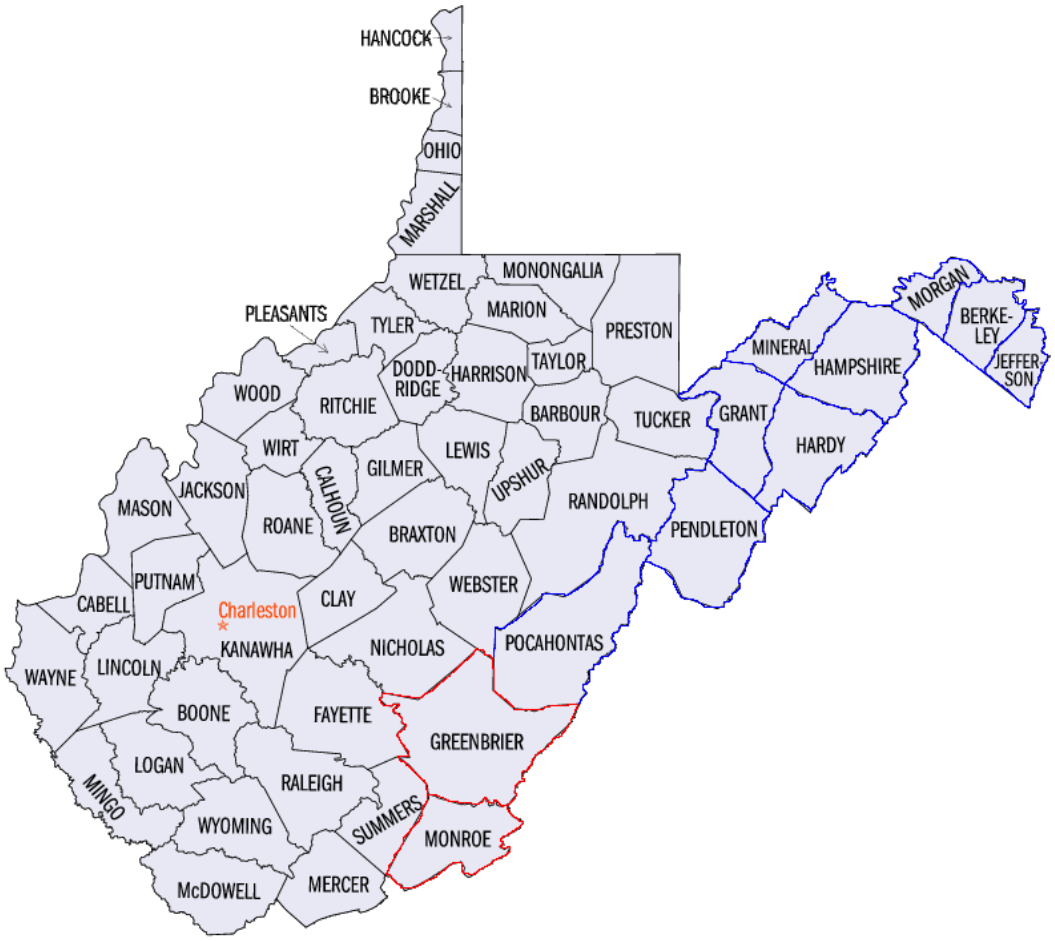

Figure 2.1: Range of *P. feriarum* in West Virginia prior to this project. The counties in red represented areas of possible extirpation. Blue counties were counties where the frog was known to occur. Adapted from Marshall University web site, http://www.marshall.edu/herp/Toads_Frogs/Upland_Chorus_Frog.htm

Table 2.1: Size and position data for all *P. feriarum*.

Species	SUL (mm)	Tib (mm)	Weight(g)	Position
P. feriarum 1	24.5	13.5	2.4	In water grasping or in close proximity to vegetation w/ head out
P. feriarum 2	26.6	13.8	1.8	In water grasping or in close proximity to vegetation w/ head out
P. feriarum 3	27	13.9	1.8	In water grasping or in close proximity to vegetation w/ head out
P. feriarum 4	23.2	14	2.2	In water grasping or in close proximity to vegetation w/ head out
P. feriarum 5	27.4	14	2.2	In water grasping or in close proximity to vegetation w/ head out
P. feriarum 6	25.9	13.1	1.6	Sitting on submerged vegetation with only head above the surface in flowing water
P. feriarum 7	33.5	15.9	2	In water grasping vegetation with head out in daylight hours
P. feriarum 8	32.4	16.3	2.6	In trap
P. feriarum 9	25.9	14.2	2.2	In trap
P. feriarum 10	27	15.2	1.5	In trap in amplexus with P. feriarum number 11
P. feriarum 11	27.2	14.4	2.5	In trap in amplexus with P. feriarum number 10
P. feriarum 12	26.5	13.2	1.9	Sitting on submerged vegetation with only head above

				the surface
P. feriarum 13	28.5	15	2.8	In water with head sticking above surface
P. feriarum 14	28	14	2.4	In water with head sticking above surface
P. feriarum 15	28	14.4	1.4	In water with head sticking above surface
P. feriarum 16	27.8	13.8	2.2	In water with head sticking above surface
P. feriarum 17	29.8	14	2.4	Swimming through water
P. feriarum 18	26.8	13.5	2	In water with head sticking above surface
P. feriarum 19	26.8	14.2	1.8	In water with head sticking above surface
P. feriarum 20	21.6	13.5	1.2	In trap
P. feriarum 21	30.3	15	2	In trap
P. feriarum 22	24.4	12	1.6	In trap
P. feriarum 23	29.1	14.7	2.3	Free floating in water
P. feriarum 24	28.2	14.5	1.6	In water with head sticking above surface
P. feriarum 25	28.4	14.2	2.1	In water with head sticking above surface hidden in clump of grass
P. feriarum 26	26.7	12.7	1.3	In water with head sticking above surface hidden in clump of grass and juncus
P. feriarum 27	27	13	2.1	In water with head sticking above surface hidden in clump of juncus
Average	27.35185	14.07407	1.996296	

Table 2.2: Size and position data for all *P. crucifer*.

Species	SUL (mm)	Tib (mm)	Weight(g)	Position
P. crucifer 1	25.6	14.6	2.9	Out of water on a clump of vegetation
P. crucifer 2	26	14.3	2.4	Out of water on a clump of vegetation
P. crucifer 3	escaped	escaped	escaped	Out of water on a clump of vegetation
P. crucifer 4	27.5	14.4	2	Out of water on a clump of vegetation
P. crucifer 5	28	14.2	1.6	Out of water on a clump of vegetation
P. crucifer 6	19	13.4	2.5	In trap in amplexus with P. crucifer number 7
P. crucifer 7	31.8	14.2	2.5	In trap in amplexus with P. crucifer number 6
P. crucifer 8	27	14.2	2	Out of water on a clump of vegetation
P. crucifer 9	27	14.5	2.5	Out of water on a clump of vegetation
P. crucifer 10	30.5	13.9	2.8	Swimming through water
P. crucifer 11	27.6	14.9	2.8	Swimming through water
P. crucifer 12	30.2	14	2.8	Out of water on a clump of vegetation
P. crucifer 13	28.7	14.6	2.8	On a log above the surface of the water
P. crucifer 14	28.4	14	2	Out of water on a clump of vegetation
P. crucifer 15	26.5	14.2	2.4	Out of water on a clump of vegetation
P. crucifer 16	26.5	13.7	2.2	In trap
P. crucifer 17	26.2	13.2	2.8	Out of water on a clump of vegetation
P. crucifer 18	27.5	12.8	2	Out of water on a clump of vegetation
P. crucifer 19	28	14.3	2	Out of water on a

				clump of vegetation
P. crucifer 20	29.5	14.2	2.3	Out of water on a clump of vegetation
P. crucifer 21	25.9	14.3	24	Out of water on a clump of vegetation
P. crucifer 22	27	14	2.2	Out of water on a clump of vegetation
P. crucifer 23	29	14.9	2.5	Out of water on a clump of vegetation
P. crucifer 24	19.2	14.8	2.4	Out of water on a clump of vegetation
P. crucifer 25	37.8	14.7	2.7	Out of water on a clump of vegetation
P. crucifer 26	25.5	13.2	2	Out of water on a clump of vegetation
P. crucifer 27	28.1	13.6	2.3	Out of water on a clump of vegetation
Average	27.46154	14.11923	3.207692	

Table 2.3: Trap data for Private Wetland 1

Date	Number of Traps	Number of Trap Hours	# of feriarum	# of cricifer	Other captures
3/14/2008	4	96	3	1	0

Table 2.4: Trap data for Private Wetland 2

Date	Number of Traps	Number of Trap Hours	# of feriarum	# of cricifer	Other captures
3/8/2008	10	240	0	0	2 A. maculatum
3/23/2008	17	714	4	2	0

Table 2.5: Trap data for Private Wetland 3

Date	Number of Traps	Number of Trap Hours	# of feriarum	# of crucifer	Other captures
3/23/2008	8	352	0	0	2 adult newts with ten larva

Figure 2.2: Upland Chorus Frog (*Pseudacris feriarum*).

Figure 2.3: Dorsal striping of Upland Chorus Frog.

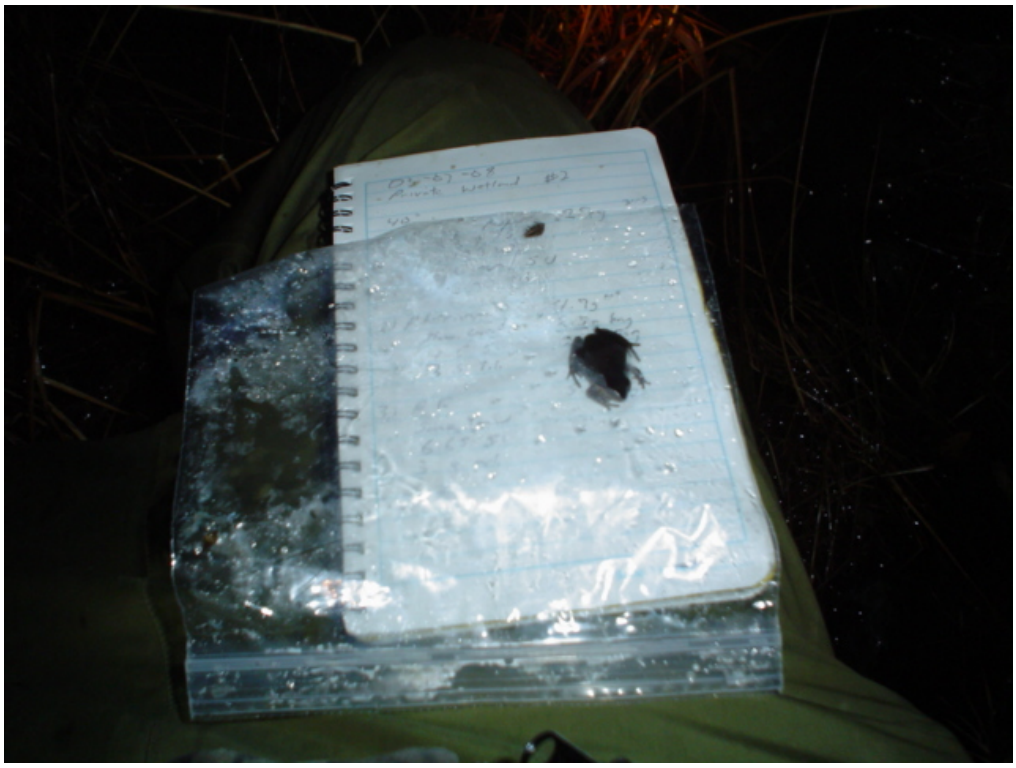

Figure 2.4: *P. feriarum* in a bag prior to measuring.

Figure 2.5: Researcher measuring *P. feriarum*.

Figure 2.6: Flags marking the locations of frogs caught the night before.

Chapter 3: Vegetation Study to Determine Presence of Indicator Plants

Scott Albaugh

Abstract

Plants play a vital role in nearly every ecosystem. Many species have direct associations with specific plants which enable them to exist in an area. This project sought to discover if such a relationship existed between Upland Chorus Frogs (*Pseudacris feriarum*) and a specific plant or group of plants in their aquatic breeding habitats in West Virginia. Plant surveys were conducted on two scales at each of the 4 study sites during this project. Small scale 30cm² surveys were conducted around capture locations of *P. feriarum* and Northern Spring Peepers (*Pseudacris crucifer*). Larger 1m² random plant surveys were also conducted at each study site. Upland Chorus Frogs were found in water that on average had a higher percentage of plant groups present when compared to Northern Spring Peeper. Chorus frogs were also found more frequently in water that contained no aquatic plants. Data shows that chorus frogs are not linked to any specific plant. Data also shows that peepers are able to utilize water that does not possess a large diversity of plant species.

Introduction

Amphibians breed in aquatic ecosystems and therefore are linked to water as an obligatory part of their survival. Plants supply animals with food and shelter and play an integral role in all ecosystems. In nearly all ecosystems plants are also a link between the abiotic environment and the biotic environment. In aquatic environments, plants not only form the base of the food chain, but they also influence water chemistry by absorbing and releasing nutrients, stabilizing the sediments in a wetland, and providing habitat structure for all taxonomic groups (Cronk and Fennessy, 2001).

A study of vegetation located in breeding pools of *P. feriarum* and *P. crucifer* was conducted. Two goals of this study were to determine any specific vegetational component that could be used as an indicator for the presence of *P. feriarum,* and look at

vegetation as a possible explanation for the observed partitioning between the two species in breeding pools.

This study was conducted in March when many wetland plants are in the early stages of development and difficult to identify. Two common species were identifiable, however; Common Rush (*Juncus effusus)* and Marsh Purslane (*Ludwigia palustris)*. Grasses (*Poaceae*) and sedges (*Cyperaceae*) were difficult to identify to species and therefore were lumped into a single category. Pondweeds (*Zosteraceae*) were also lumped. Because of the difficulty in identifying some plants to genus and species, four categories were created; Grasses and Sedges, Rushes, Purslanes, and Pondweeds.

Methods

A vegetation survey was conducted at every location where a frog was found. Every time a frog was captured a flag was placed in the ground to mark the location for the vegetation survey that was conducted on the following day. One 30cm² vegetation survey was conducted in the capture site (Figure 3.1). Since the frogs are diminutive, a small survey diameter was chosen to appropriately represent the microhabitat in the area where frogs were calling.

Random 1m² surveys were also conducted at each of the four wetlands until 10 surveys had been conducted which created a total of 40 random surveys. I chose sites for the random surveys by standing at the location of one of the 30cm² surveys and tossing a meter stick over my shoulder and conducting the survey where ever the stick landed.

Results

Twenty-three 30cm² plant surveys were conducted where *P. feriarum* was captured. Four plant groups were present within 30cm² of where *P. feriarum* were calling. There were 6 locations where *P. feriarum* was calling in areas where no plants were within 30cm². The Grass/Sedge group was present at 61% of the survey sites. The Rush group was present at 30% of the survey sites. The Purslane group was present at 48% of the sites. The Pondweed group was present at 44% of the sites. At 26% of the survey sites, no plants were found within 30cm².

Twenty-five 30cm² surveys were conducted where *P. crucifer* was captured. All four plant groups were present within 30cm² of where *P. crucifer* was calling; however the Grass/Sedge group was present more frequently than it was in the *P. feriarum* surveys. The Grass/Sedge group was present at 92% of the survey sites. The Rush group was present at 8% of the sites. The Purslane group was present at 20% of the sites. The Pondweed group was present at 16% of the sites. At 8% of the survey sites, no plants were found within 30cm².

Ten random vegetation surveys were conducted at each site for a total of 40 surveys (Table 3.3-3.7). Grasses and Sedges were present at 93% of the random sites. Rushes were present at 48% of the sites. Purslanes were found at 40% of the random sites. Pondweeds were found at 18% of the sites. At one of the random sites, there was no vegetation.

Discussion

There was a higher diversity of plants in the micro-habitats where *P. feriarum* was captured compared to *P. crucifer*. *P. feriarum* was also found in the highest percentage of places with no aquatic vegetation (Table 3.1). This makes the importance of aquatic vegetation to *P. feriarum* in its breeding pools somewhat ambiguous. On one hand *P. feriarum* was found in a relatively botanically diverse setting, but on the other hand it was also found in roadside puddles and other small pools with no aquatic macrophytes at all.

P. feriarum also seemed to prefer areas without overhanging trees or shrubs. This observation lends to the idea that because breeding pools for *P. feriarum* receive more sunlight, those sites may have a higher botanical diversity.

The most consistent factor is the presence of water. Green and Pauley (1987) state that in West Virginia eggs of *P. feriarum* hatch 3 to 4 days after deposition and transform within about 60 days. The time in which the presence of water is needed for *P. feriarum* egg and larval development may be too short for aquatic macrophytes to grow. Therefore, *P. feriarum* breeding pools may dry up before aquatic plants can grow. This suggests that *P. feriarum* may be able to exist with no direct connection to wetland plants.

Vegetative data shows that *P. feriarum* does not require aquatic vegetation for breeding. Presence of water is the only consistent factor in the local distribution of *P. feriarum*. It is possible that the most important resource for sustaining populations of *P. feriarum* is the preservation of the ditches in which the species breeds. *P. feriarum* was found most consistently in the Sleepy Creek Valley in Morgan County. This valley had

numerous fields with ditches of water. Agricultural fields with wet ditches may turn out to be a more important habitat than any type of wetland.

There was not enough data or observations obtained in this study to speculate on why *P. feriarum* occurred in ditches that did not have overhanging vegetation. Therefore the question still remains as to why *P. feriarum* was observed much less often in wooded areas with ditches.

Vegetative survey data for *P. crucifer* shows the frog in areas less botanically diverse than where *P. feriarum* was found (Table 3.2). What the data does not show is that *P. crucifer* was also found with *P. feriarum* in more botanically diverse zones. Although species segregation was observed in three of the study sites, there were always a few *P. crucifer* outliers mixed in with *P. feriarum.*

The most significant difference between the two species and the vegetation data and field observations was that *P. crucifer* occurred less frequently in water without aquatic plants. *Pseudacris crucifer* also occurred in water with larger overhanging vegetation. This suggests that *P. crucifer* may be more connected with vegetation than *P. feriarum*. This data shows that *P. crucifer* was found in conjunction with grasses and sedges, but I have heard them at other times calling from wet areas with cattails (*Typha* sp.). It is not the species of plant that *P. crucifer* is attracted to, but the habitat that the plant creates. This study show that *P. crucifer* prefers to sit on vegetation above the water's surface and call. We know from other studies that *P. crucifer* also lays eggs singly on submerged vegetation (Hulse et al., 2001). That data suggests that *P. crucifer* may require more surface area under the water to lay its eggs on. Large overhanging

vegetation therefore provides cover for *P. crucifer* when calling and may supply it with more places to attach eggs.

Table 3.1. Vegetative groups present in areas where *P. feriarum* was caught. Gr/Sg = grass/sedge group, R = Common Rush, P = Marsh Purslane, Pw = pondweeds.

P. feriarum	Gr/Sg	R	P	Pw	no plants
1	x	x	x	x	
2		x	x	x	
3	x	x	x	x	
4	x	x	x		
5		x	x	x	
6	x				
7	x				
8	x		x	x	
9	x		x	x	
10	x		x		
11	x		x		
12	x		x		
13	x		x	x	
14					x
15					x
16					x
17					x
18					x
19					x
20	x			x	
21	x			x	
22	x	x		x	
23		x			
Totals	14	7	11	10	6
Percent	61	30	48	44	26

Table 3.2. Vegetative groups present in areas where *P. crucifer* was caught.

P. crucifer	Gr/Sg	R	P	Pw	None
1	x	x	x	x	
2	x				
3	x				
4	x				
5	x				
6	x			x	
7	x		x		
8	x		x		
9	x		x	x	
10	x		x		
11					x
12	x				
13	x				
14					x
15	x				
16	x				
17	x	x			
18	x				
19	x				
20	x				
21	x				
22	x				
23	x				
24	x			x	
25	x				
Totals	23	2	5	4	2
Percent	92	8	20	16	8

Table 3.3. Vegetative groups present at wetland 1 random surveys.

Wetland 1	Gr/Sg	R	P	Pw	None
1	x	x			
2	x	x			
3	x	x			
4	x	x			
5		x			
6	x				
7					x
8	x	x		x	
9	x				
10	x				
Totals	8	6	0	1	1

Table 3.4. Vegetative groups present at Private Wetland 2 random surveys.

Wetland 2	Gr/Sg	R	P	Pw	No Plants
1	x	x	x		
2		x	x	x	
3	x	x	x	x	
4	x	x	x		
5	x	x	x		
6	x		x		
7	x				
8	x				
9	x				
10	x				
Totals	9	5	6	2	0

Table 3.5. Vegetative groups present at Private Wetland 3 random surveys.

Wetland 3	Gr/Sg	R	P	Pw	No Plants
1	x		x		
2	x		x		
3	x		x		
4	x	x	x		
5	x		x		
6	x		x		
7	x		x		
8	x		x		
9	x		x		
10	x	x	x		
Totals	10	2	10	0	0

Table 3.6. Vegetative groups present at Dawson Wetland random surveys.

Sias Wetland	Gr/Sg	R	P	Pw	No Plants
1	x				
2	x	x		x	
3	x	x		x	
4	x			x	
5	x				
6	x	x			
7	x	x			
8	x	x		x	
9	x				
10	x	x			
Totals	10	6	0	4	0

Table 3.7. Percent totals for each vegetative group in all 4 wetlands combined.

Vegetative Group	Gr/Sg	R	P	Pw	None
Total out of 40	37	19	16	7	1
Percent Totals	93	48	40	18	3

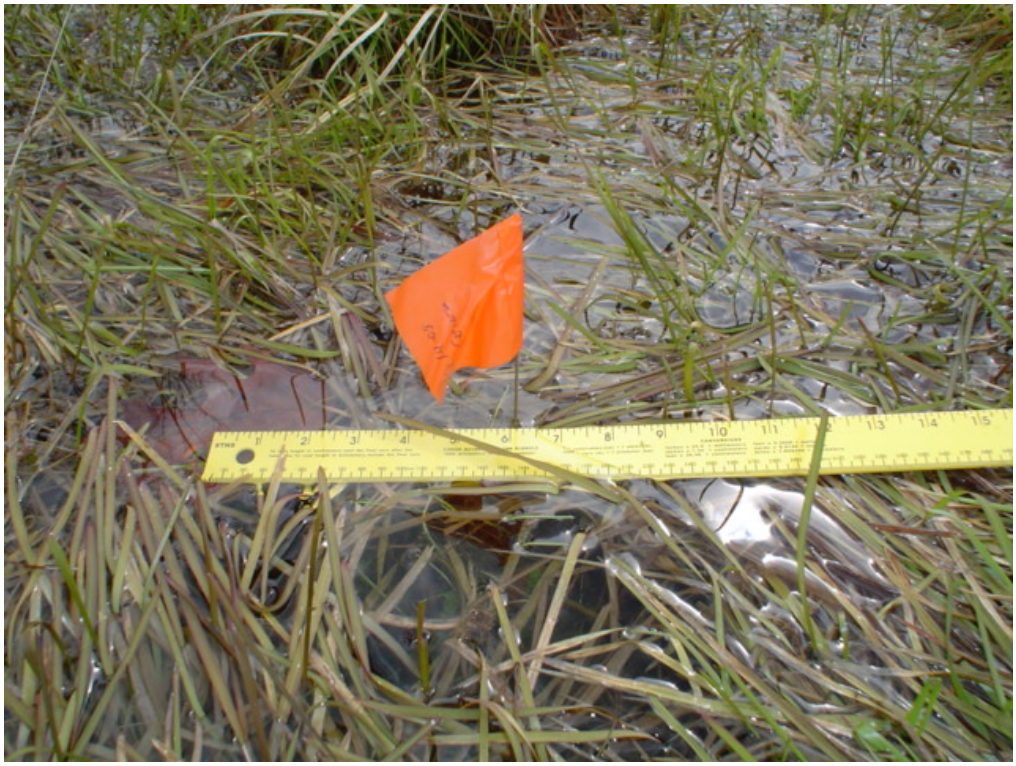

Figure 3.1. Example of vegetation study site.

Chapter 4: Distribution of *Pseudacris feriarum* in West Virginia

Scott Albaugh

Abstract

The distribution of *Pseudacris feriarum* in West Virginia has been in question in recent years. It has historically occurred in the eastern panhandle and the counties that border Virginia. There has been some speculation that possibly the species has disappeared from the southern portion of its range in WV in Monroe, Summers, and Greenbrier Counties. The goal of this study was to determine the distribution of the frog throughout its range in the state. Auditory surveys were conducted in the counties of Jefferson, Berkeley, Morgan, Hampshire, Mineral, Hardy, Pendleton, Greenbrier, Summers, and Monroe Counties. Frogs were found Morgan, Berkeley, Mineral, and Greenbrier counties. The area of greatest occurrence in the state was found to be Morgan County in the drainage of Sleepy Creek. Based on call survey data, a gap exists along the Virginia border between the Morgan County and the Greenbrier County populations.

Introduction

In West Virginia *Pseudacris feriarum* has historically been found in the Ridge and Valley Province (Figure 2.1). This area included the eastern panhandle and south to Monroe County (Green and Pauley, 1987). The range of *P. feriarum* in West Virginia has been thought to be shrinking from the south to the north (TKP pers comm). In her 2006 thesis, Jamie Sias reported that this species no longer occurred in the counties of Monroe, Summers, and Greenbrier. Sias conducted call surveys in 12 counties and a total 153 sites. She located *P. feriarum* in the counties of; Berkeley, Grant, Hampshire, Hardy, Mineral, Morgan, Pendleton, and Pocahontas. She searched but did not located the frog in; Greenbrier, Jefferson, Monroe and Summers.

Call surveys were conducted during this 2008 study in the counties of: Morgan, Jefferson, Berkeley, Hampshire, Mineral, Hardy, Pendleton, Summers, Monroe, and

Greenbrier. Fifty four sites were surveyed. Only a few sites surveyed were TKP historic sites. Survey routes were chosen by driving roads in valleys. A numeric value was given to quantify the calls when heard from a site.

Methods

Roads in broad valleys were prime choice for the surveys because there were more likely to have standing water. I surveyed all agricultural fields that I drove past especially those with ditches.

A survey consisted of listening for frogs along the roadside for five minutes. Most of the surveys were conducted during the peak breeding period in daylight hours. Landreth and Ferguson (1966) reported that males chorus frogs call day and night during this time. The call surveys were similar to the protocol established by the North American Amphibian Monitoring Program (NAAMP). All anurans heard were identified to species based on the sound of the call. A value of 1-3 was placed on the calls heard based on frequency and intensity. A value of 1 was given if during the 5 minute survey only 1-3 individuals were heard. A value of 2 was given if more than 3 individuals were heard or if gaps of 1-2 seconds could be heard between calls. A value of 3 was given when a full chorus was heard (Loughman, 2005). A brief description of habitat was recorded as well as GPS data.

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Results

Pseudacris feriarum was found at 7 of the 54 sites surveyed (Tables 4.1-4.10). It was found in Morgan, Mineral, Berkeley, and Greenbrier Counties. It could not be

located in Hardy, Hampshire, Monroe, Summers, Jefferson, or Pendleton Counties. Three known TKP historic sites were surveyed. *Pseudacris feriarum* was found in one of the three historic locations (Morgan County).

A Marshall Herpetology student heard *P. feriarum* calling in Hampshire County on Short Mountain while working on an unrelated project. The site is located at Short Mountain WMA behind one of the campsites.

Discussion

Hundreds of miles of West Virginia roads were driven in search of *P. feriarum*. The most by far were found in Morgan County in the Sleepy Creek drainage south of Berkeley Springs and east of Omps. This area should be considered as the most important area in the entire state for the survival of this species. The presence of ditches in the agricultural fields in this area of Morgan County is the key reason that this frog is surviving well here. Outside of the Sleepy Creek drainage near Omps, the species is only found sporadically and normally in ditches.

The Sleepy Creek drainage near the sites used in this study should be considered as a monitoring site in an area where the species commonly occurs. I recommend the Mineral County location on county road 11 be monitored as the western-most occurrence of the species. County road 27 near Meadow River WMA in Greenbrier County should be monitored as the southern-most occurrence of this species. County road 7 in Berkeley County along Back Creek should also be a monitoring site because it is likely the eastern-most occurrence of *P. feriarum* in West Virginia.

Table 4.1: Morgan County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 7, 2008	CR 8	738783 4376222	Farm field with ditches	***P. feriarum***	2
March 7, 2008	?	736541 4374704	?	None	
March 7, 2008	CR 28	739238 4376741	Farm field with ditches near woods/TKP historic site	***P. feriarum***	1
March 7, 2008	CR 24	740195 4385493	Series of small ponds	*P. crucifer*	2
March 7, 2008	CR 8/1	743040 4386719	Marginal habitat-water in low spot in field	None	
March 7, 2008	CR 15	741260 4387321	Wet ditch - good habitat	None	
March 7, 2008	CR 8	735500 4369449	Wet fields, no juncus -H2O may not be permanent enough	None	
March 7, 2008	SR 522	?	State Fish Hatchery	None	

Table 4.2: Hampshire County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 16, 2008	CR 3	17S 7009338 4365943	Ditch in field with Juncus	None	
March 16, 2008	CR 50/9	17S 708019 4364594	Wet woods adjacent to wet overgrown fields	*P. crucifer* *R. sylvatica*	3 (*P. crucifer*) 2 (*R. sylvatica*)
March 16, 2008	CR 50/9	17S 706489 4362662	Wet pasture, large flooded ditch	*P. crucifer* *R. sylvatica*	3 (*P. crucifer*) 1 (*R. sylvatica*)
March 23, 2008	St.Rt. 127	720969 4364297	Farm Fields - Good Habitat	*P. crucifer*	2
March 27, 2008	SR 50	722779 4353520	Wet spot in field with Juncus	None	
March 27, 2008	CR 14	720047 4350480	Wetland near river and ditch with Juncus	None	

Table 4.3: Mineral County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 16, 2008	CR 46	17S 687981 4368824	Flooded farm fields	None	
March 16, 2008	CR 11	17S 686201 4367513	Wet ditch in farm fields	*P. crucifer* *R. sylvatica*	3 (*P. crucifer*) 2 (*R. sylvatica*)
March 16, 2008	CR 11	17S 684668 4366744	Farm pond with Juncus	None	
March 16, 2008	CR 11	17S 683070 4360873	Wet ditches around corn field	*P. crucifer* *R. sylvatica*	2 (*P. crucifer*) 1 (*R sylvatica*)
March 16, 2008	CR 11	17S 682942 4360633	Swampy field surrounded by cedars	*P. crucifer* *R. sylvatica*	2 (*P. crucifer*) 1 (*R. sylvatica*)
March 16, 2008	CR 11	17S 682270 4359504	Wet ditch in pasture	*P. crucifer*	1
March 16, 2008	CR 11	17S 681696 4359127	Pond and wet meadow	*P. crucifer*	3
March 16, 2008	CR 11	17S oops	Wet ditches in pasture abundant Juncus	*P. crucifer* *R. sylvatica*	2 (*P. crucifer*) 1 (*R. sylvatica*)
March 16, 2008	CR 11	17S 678304 4354451	Wet ditches with Juncus	*P. crucifer*	2
March 16, 2008	CR 11	17S 673131 4347891	Wet short grass pasture	*P. crucifer* ***P. feriarum***	1 (*P. crucifer*) 2 (*P. feriarum*)
March 16, 2008	CR 46	17S 687981 4368824	Flooded farm fields	None	

Table 4.4: Monroe County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 18, 2008	SR 12	0518823 4141729	Too Dark	*P. crucifer*	2
March 18, 2008	SR 12	0519339 4146043	Too Dark	*P. crucifer*	2
March 18, 2008	SR 12	520829 4150690	Too Dark	*P. crucifer*	2
March 18, 2008	SR 12	520446 4152064	Best habitat for P. feriarum	None	

Table 4.5: Summers County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 18, 2008	SR 12	518659 4154664	Cattail Marsh	*P. crucifer*	3
March 18, 2008	SR 12	518204 4157312	Too Dark	*P. crucifer*	2
March 18, 2008	SR 12	517009 4162127	Too Dark	*P. crucifer*	1
March 18, 2008	SR 12	518234 4164055	Good habitat for P. feriarum	*P. crucifer*	2
March 18, 2008	SR 12	525322 4170609	Too Dark	*P. crucifer*	2

Table 4.6: Greenbrier County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 19, 2008	SR 12	527167 4191160	Too Dark	*P. crucifer*	2
March 19, 2008	SR 12	525330 4189036	Too Dark	*P. crucifer*	2
March 19, 2008	CR 27	525347 4188860	Farm Fields with Ditches	***P. feriarum*** *R.sylvatica*	2 (*P. feriarum*) 1 (*R. sylvatica*)
March 19, 2008	CR 27	525544 4188120	Too Dark	*P. crucifer* *R. sylvatica*	2 (*P. crucifer*) 1 (*R. sylvatica*)

Table 4.7: Berkeley County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 25, 2008	CR 7	746461 4368823	Stoufer's Marsh - large wetland	***P. feriarum***	2
March 25, 2008	CR 7	0744716 4364621	Michael's Farm Airport - Great habitat	***P. feriarum***	1
March 25, 2008	CR23 & CR 9/4	Precisely at the intersection	Wet Ditches - marginal habitat	*P. crucifer*	2
March 25, 2008	CR 7	746953 4369968	Wet Ditch on roadside	***P. feriarum***	1

Table 4.8: Jefferson County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 25, 2008	CR 1	18S 245534 4357691	Small shallow pond with Juncus	None	
March 25, 2008	CR 13	18S 245835 4348752	Small pool with adjacent small wetland	None	
March 25, 2008	CR 13/2	Bullskin Run at Cool Spring Farm	Marl Marsh	*P. crucifer*	3

Table 4.9: Hardy County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 27, 2008	SR 55	709335 4329571	Farm with wet field and Juncus/TKP historic site	None	
March 27, 2008	CR 7	678145 4321197	Wet area with Juncus/marginal habitat	None	
March 27, 2008	CR 7	676360 4317769	Wet swampy area adjacent to road	None	
March 27, 2008	CR 7	676135 4317198	Wet ditch with Juncus leading to small pond	*P. crucifer*	1
March 27, 2008	CR 7	668603 4303208	Vernal Pool in woods	*P. crucifer*	2
March 27, 2008	CR 7	666771 4300271	Wet roadside ditch with Juncus	*P. crucifer*	2

Table 4.10: Pendleton County Call Survey Locations and Results

Date	Road	UTM	Habitat	Species	NAAMP
March 27, 2008	CR 3	661236 4287238	Farm pond with a ditch and Juncus	P. crucifer	1
March 27, 2008	CR 21	652244 4274029	Pool beside road with Juncus - good habitat	None	
March 27, 2008	CR 25	641257 4265466	Farm field that was dry with dead Juncus/TKP historic site	None	

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