2007

Spiders in Paint Creek, a Local Wetland: Initial Findings in Family Composition and Distribution

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Abstract

The presence of spiders in terrestrial ecosystems has been studied extensively. Little is known, however, about the role of spiders in aquatic ecosystems, especially wetlands. The purpose of this study was to obtain a preliminary understanding of the spider community found in a local wetland, Paint Creek. Aerial and ground samples were collected along a 50-meter transect in a dense stand of native *Typha angustifolia*. Samples were taken monthly from May to September, and were analyzed for both species composition and plant biomass. Initial findings indicate that spider communities in wetlands are highly variable. Ground samples yielded the largest number of individuals, high plant biomass yielded high species composition, and all variables changed with season. Overall, the family Lycosidae exhibited the highest abundance, followed by Clubionidae. Unexpectedly, the family Tetragnathidae exhibited the least number of individuals collected over the five month period. Continued sampling is needed to further understand the complex dynamics of spider communities in wetland habitats.

Degree Type

Open Access Senior Honors Thesis

Department

Biology

First Advisor

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Keywords

Spiders Michigan, Wetland ecology Michigan

SPIDERS IN PAINT CREEK, A LOCAL WETLAND:

INITIAL FINDINGS IN FAMILY COMPOSITION AND DISTRIBUTION

by

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A Senior Thesis Submitted to the

Eastern Michigan University

Honors Program

In Partial Fulfillment of the Requirements for Graduation

With Honors in Biology

Approved at Ypsilanti, Michigan on this date:

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Senior Honors Thesis

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Title: Spiders in Paint Creek, a local wetland: initial findings in family composition and distribution
Length: 16 pages
Completion Date: June 15, 2007

ABSTRACT

The presence of spiders in terrestrial ecosystems has been studied extensively. Little is known, however, about the role of spiders in aquatic ecosystems, especially wetlands. The purpose of this study was to obtain a preliminary understanding of the spider community found in a local wetland, Paint Creek. Aerial and ground samples were collected along a 50-meter transect in a dense stand of native *Typha angustifolia*. Samples were taken monthly from May to September, and were analyzed for both species composition and plant biomass. Initial findings indicate that spider communities in wetlands are highly variable. Ground samples yielded the largest number of individuals, high plant biomass yielded high species composition, and all variables changed with season. Overall, the family Lycosidae exhibited the highest abundance, followed by Clubionidae. Unexpectedly, the family Tetragnathidae exhibited the least number of individuals collected over the five month period. Continued sampling is needed to further understand the complex dynamics of spider communities in wetland habitats.

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INTRODUCTION

Spiders (members of the family Araneae) are some of the most diverse but least understood arthropods on Earth. At present, it is estimated that there are at least 34,000 known species of Spiders (Foelix, 1996) with many more yet to be discovered. Spiders are present in all habitats, and are important invertebrate predators within numerous ecosystems, making them an essential part of the grazing food chain.

Despite ample research on spiders in terrestrial habitats, little is known about their role in aquatic ecosystems. Previous studies conducted in tropical ecosystems (Coddington *et. al.*, 1991) and desert riparian ecosystems (Sanzone *et. al.*, 2003) have provided some evidence as to the impact of Spider species in both terrestrial and aquatic habitats, but this information is relatively broad. What has been noted, however, is that Spider species are essential in the transfer of energy in these systems, and hold key roles as both predator and prey (Coddington *et. al.*, 1991, Sanzone *et. al.*, 2003). Nevertheless, in regards to the potential impact of predatory spiders in transitional ecosystems such as wetlands, little information is available.

The term "wetland" describes a large array of habitats, but generally applies to any area which has hydric soils and the presence of adapted hydrophytic vegetation. Wetland ecosystems represent a transition zone between the terrestrial and the aquatic, and as a result large species diversity is coupled with exceedingly high rates of biomass production. Consequently, these are some of the most complex ecosystems on earth, boasting a wide variety of animal and plant species.

Regardless of their ecological (and recreational) importance, wetlands are being destroyed at an alarming rate (averaging 1% per year). As a result, many wetland plant and animal species remain quite threatened due to this habitat destruction. Therefore, it is important to obtain as much data on wetland plant and animal species, especially those affecting both the aquatic and the terrestrial (such as spiders), as possible. Currently, though, only a small amount of published literature exists on spiders in wetland habitats or their potential impact on wetland grazing food webs.

Therefore, the purpose of this study was to identify and quantify the types of predatory spider families inhabiting a small freshwater emergent wetland ecosystem. In addition, it also investigated the potential influence of plant biomass on predatory spiders. This study was conducted in a small inland emergent marsh wetland, Paint Creek (**Figure 1**), located in southeast Michigan (N42°12.971 W083°181). The study site is a created retention basin wetland formed more than 20 years ago, which receives waters draining from the surrounding Paint Creek watershed.

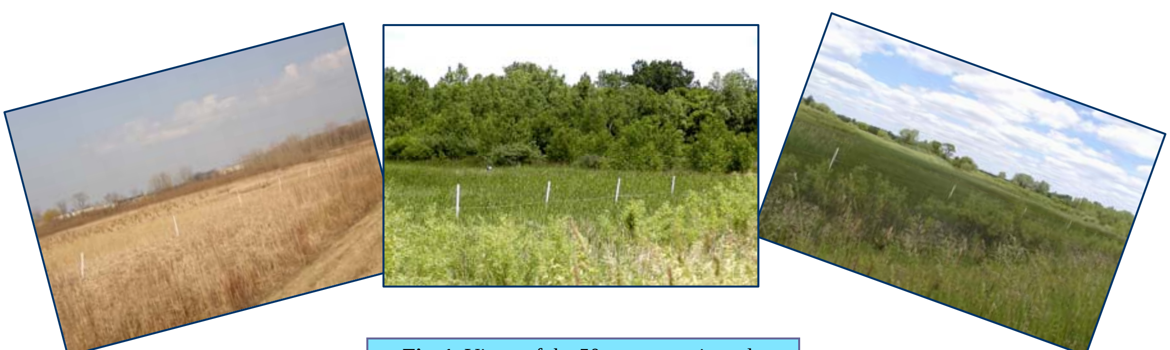

Fig. 1: Views of the 50 m transect in early spring and late summer. Note the change in native vegetation over the sampling period.

Given the efficient predatory behavior of spiders, and their importance to both aquatic and terrestrial habitats alike, it was hypothesized that there would be a large number of spiders found in the wetland, and that these spiders would exhibit a high family diversity. A positive correlation between spider abundance and high plant biomass was also expected.

MATERIALS AND METHODS

Because spiders exhibit both diurnal and nocturnal behavior, and exhibit a spatially horizontal distribution (Coddington, 1996), great care was taken to collect specimens from all structural levels within the wetland (i.e., plant canopy and benthic zones). Thus, field samples were collected at both the ground level and among plant stalks to incorporate vegetation layers within the wetland and day and night time distributions.

A 50-meter transect was constructed in a southeastern corner of the wetland dominated by the native emergent macrophyte *Typha angustifolia*. Every month, from May 2006-September 2006, ten sampling areas total were selected at random along the 50-meter transect. The transect was marked in one-meter increments, from one to 50, and each month ten numbers from one to 50 were randomly selected. Then, the samples were taken at the coordinating meter mark based on the number drawn. The samples were taken approximately three feet to the left or right of the indicated spot on the transect line (also determined at random). This was to ensure that the vegetation within the sampling area had not been walked through or stepped on. Five samples were collected from ground vegetation and five were collected from live *Typha* stalks. The bags and ground crates were placed in the wetland during the second week of every month, and collected during the third week of every month to ensure consistency.

To sample at the ground level, crates made of wire fencing (Al Cady, pers. comm. 2006) were filled on site with local vegetation and placed at the water-vegetation boundary (**Figure 2**). Because of highly fluctuating water levels, these crates were monitored throughout the week to ensure that they remained as close to the ground as possible. To sample along the *Typha* stalks directly, large collecting bags were made from water-resistant and rip-proof material. These bags were placed around one-square-meter stands of *Typha angustifolia* and secured to the stalks using cable ties (**Figure 3**).

Fig. 2: Ground crate sample awaiting collection in the wetland.

Fig. 3: Bagged *Typha angustifolia* awaiting collection in the wetland.

Both the ground crates and the collecting bags were allowed to sit in the wetland for one week before collecting. This helped to create an unbiased sample by ensuring that human activity did not interrupt regular dispersal patterns of spiders and other organisms. After one week, the ground crates were removed and placed into separately marked bags for transfer to the laboratory. At the same time, the collecting bags around the *Typha* stands were quickly unrolled upwards, encasing all of the stalks, and secured tightly at the top using labeled flagging. The stalks were then cut near the root and the entire plant, wrapped tightly in the collecting bag, was transferred to the laboratory.

Once in the laboratory, each sample, one at a time, was placed into a large plastic bin and uncased. Plant material was examined closely for spiders and all other organisms. Spiders were collected as they escaped from the plant material or as they were found, using a modified version of beating. They were immediately preserved in 70% ethanol for later examination.

All plant material was dried and then identified and weighed to obtain total plant biomass for each collection site. Spiders were identified to the level of family. When possible, sex and maturity were also determined, although these data were not used in this publication. As an added precaution, traditional sweep netting was done three times over the course of five months to check for any differences in sample size or composition of web building spiders in the tall vegetation.

RESULTS

Upon completion of the five month sampling period, preliminary results indicating the importance of spiders in wetlands were obtained. The overall trend in number of spiders collected from May through September showed the highest abundance during the mid to late summer months (**Figure 4**). In terms of individual spiders collected, numbers were quite low over the entire sampling period (**Table 1)**. In total, 73 spiders were collected over five months. Regarding monthly totals, the largest number of spiders was collected in August (22 out of 73), making up about 30% of all the spiders collected over the sampling period. September exhibited the lowest number of spiders collected, only eight out of a total 73.

Month 2006	Number of Spiders Collected
May	14
June	11
July	18
August	20
September	8

Table 1: Monthly Spider Totals for the Paint Creek Wetland. Samples from May to September indicate that the largest number of spiders was collected in August, and the least amount collected in September.

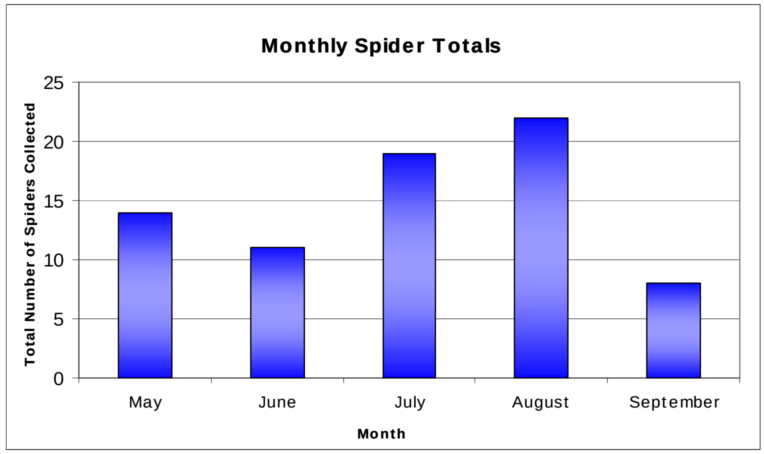

Fig. 4: Monthly Spider Totals for the Paint Creek Wetland. August exhibited the highest number of individuals collected, 20 in total. However, the overall number of Spiders collected per month was low for all five months of the sampling period, with only 73 spiders collected.

Trends in the total number of spiders collected per family were also examined to determine which types of spiders were common in the wetland (**Figure 5)**. The most prevalent family in the wetland was Lycosidae, with a total of 34 individuals found from May to September. Members of the family Clubionidae were also common (20 out of 73) throughout all of the samples. The family Tetragnathidae was least represented, with only three individuals found over the five month period.

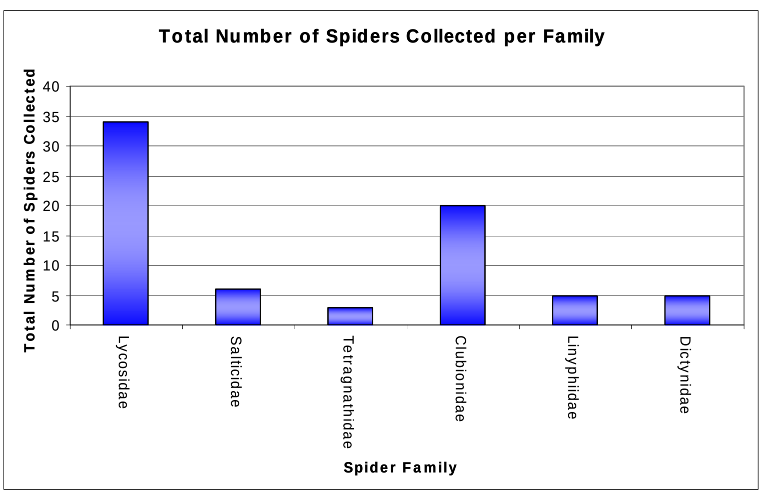

Fig. 5: Total Number of Spiders Collected per Family. The most abundant families collected in total were Lycosidae (34) and Clubionidae (20). The least abundant, with only three caught during the entire sampling period, was Tetragnathidae.

Each month brought with it a different overall spider composition such that certain families of spiders were present throughout the entire sampling period, while others were only found in abundance during the mid-summer months (**Figure 6)**. In May, the most common family found was Lycosidae with nine individuals collected (out of a total 14). However, samples in June exhibited an equal number of Lycosidae and Clubionidae. The widest range in family composition (but not the highest number of individuals collected) occurred in July, with members from six different families found in total. While August had the largest number of individuals collected, it did not display the largest amount of diversity. In fact, 50% of the total number of spiders collected belonged to the family Clubionidae (11 out of 22), the remaining families found were Lycosidae (six), Linyphiidae (four), and Salticidae (one). By September, the dominant family was once again Lycosidae.

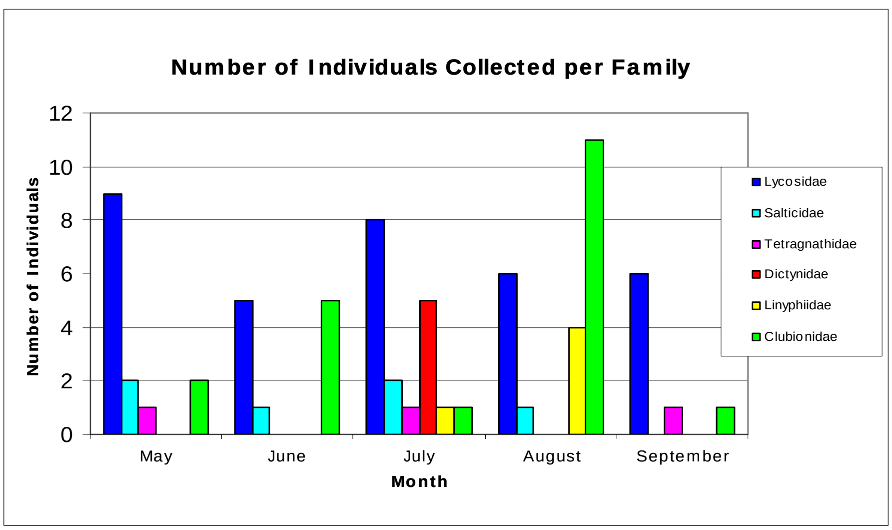

Fig. 6: Number of Individuals Collected per Family per Month. Different families were more abundant at different times throughout the sampling period. While Lycosids were collected in abundance during the month of May, Clubionids became extremely prevalent in August collections. July exhibited the greatest amount of diversity in Spider families, with representatives of six different families collected during that month.

The effect of biomass on spider composition was also investigated. Initial findings in indicate that no correlation exists between plant biomass and number of spiders collected (**Figure 7**). For example, site B-19 L in July which only contained three spiders also had the largest plant biomass out of all the sites throughout the sampling period. To compare two sites of more equal biomass, six spiders were found at site GC-14 R in August, which had a total plant biomass of 144.60 grams. Only two spiders were found, however, at site GC-2 R which had a total plant biomass of 156.9 grams. In some instances, even larger variations existed throughout the data set. In general, the only possible trend, which should be investigated further, was that the largest amount of plant biomass was collected in July, which was also when family diversity was greatest, suggesting a possible connection between plant biomass and spider richness. One other correlation to note was that, overall, a larger number of spiders were found in the ground samples (sites labeled GC) than in the samples of plant stalks (sites labeled B), regardless of the sampling month.

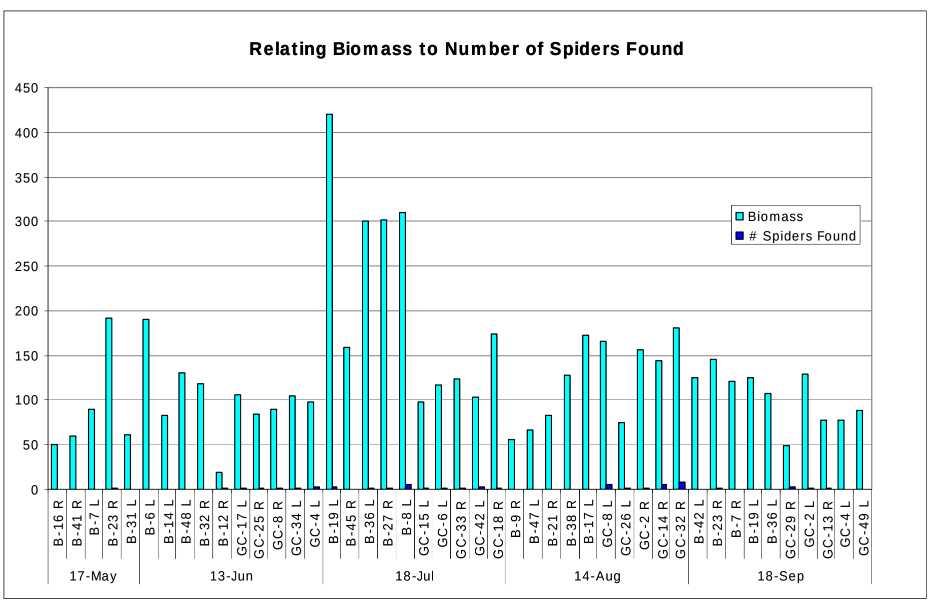

Fig. 7: Comparing Biomass to the Number of Spiders Found. Based on the above figure, little can be deduced from the biomass data obtained in this experiment. The largest amount of plant biomass was obtained in July, while the largest number of individuals was obtained in August. Thus, there seems to be no correlation between plant biomass and spider abundance.

Finally, on all three occasions, sweep-netting failed to collect any spiders within the transect boundaries. Since sweep-netting has been an acceptable and widely-used method of spider collection for decades, the absence of spiders in the sweep net implies that low abundance was due to variables other than sampling method.

DISCUSSION

Overall, spider presence in wetlands seems highly variable and somewhat unpredictable. Casual observations within the Paint Creek wetland prior to this investigation suggested that there was an abundance of both web-building and ground dwelling spiders in the area. However, the results from this study did not support these observations since the total number of spiders collected was much lower than anticipated.

While the total number of spiders collected was low, the distribution in numbers was logical considering the sampling period. In May and June when conditions are transitioning from spring to summer, most families of spiders are still emerging from their dormant winter state. In September, as the weather once again turns cold, most spiders seek refuge beneath the soil or in dense stands of vegetation. Therefore, this makes sense that the lowest number of spiders collected were in the late spring and early fall, when conditions were more variable. Likewise, peak collections in July and August suggest that spider activity was at its highest during the mid-summer months when vegetation, ground cover, food availability, and ecosystem stability were at their prime.

One factor that may be attributable to the low numbers of spiders collected is weather patterns. Because the Paint Creek wetland is a fast draining retention basin, water levels changed rapidly both weekly and monthly depending on the amount of precipitation received. An ecological instability such as this could easily influence the number of spiders found. Studies of spiders in desert riparian systems (Wenninger and Fagan, 2000) suggest that in terms of abundance, moist soils and moderate temperatures may be more important than prey availability alone in some members of the family Lycosidae. This has been shown for some species of Lycosidae near freshwater pond habitats as well (Graham, *et. al.* 2003). However, Graham and others (2003) have found that other spider families (and even some members of the family Lycosidae) exhibit the opposite effect: a negative correlation between soil moisture and abundance (Graham, *et. al.* 2003). Based on these trends, it is likely that precipitation events in the Paint Creek wetland could alter spider habitat, dispersal and abundance. Although the soils of the Paint Creek wetland always exhibit some level of saturation, large variations in soil moisture, temperature and water level could ultimately have a profound affect on spider abundance within this ecosystem.

It should be noted that other factors may have also contributed to low spider numbers. While communication with other scientists and photographs of the site from previous years showed large numbers of web-building spiders, visual observations during the sampling period did not affirm past accounts. Little web-building activity was observed, and there were very few intact webs found throughout the transect (or the rest of the wetland). Even ground observations proved minimal, with only a few Lycosidae or Salticidae observed throughout the season. In addition, since sweep-netting failed to collect any spiders, it is possible that the number of spiders present was just low during the sampling year. Reasons for these low numbers can only be suggested, and therefore, further samplings should be conducted to investigate changes in collection size over time.

Although it was hoped that biodiversity would be higher, insight into the abundance and presence of spiders in wetlands was still obtained. The greatest number of spiders found belonged to the family Lycosidae. Lycosids are ground-dwelling, sit-and-wait predators that are often associated with water. Because some species of Lycosids can walk on the surface of the water, where they often hunt insects or catch small fish (Foelix, 1996), it is logical for them to be found in a wetland habitat. Furthermore, because they are very active and usually seek refuge in patches of ground vegetation, it makes sense that they would be caught easily and thus contribute the largest number of individuals overall.

The family Salticidae is a very active group of spiders, but they are also more sensitive. They prefer sunshine and will often retreat to silken nests under cloudy or rainy conditions (Foelix, 1996). This can make them more difficult to catch, which might be a reason for the low number of Salticids found within the wetland samples.

Members of the family Tetragnathidae are often found near lakes or ponds and can effortlessly walk across aquatic surfaces (Foelix, 1996). They should be found easily within wetland habitats. However, only three out of a total 73 spiders collected belonged to this family. This was unexpected, since Tetragnathids are so closely associated with aquatic habitats. Reasons for the lack of Tetragnathids in the samples are unknown.

Small numbers of Dictynids and Linyphiids (each making up 6.8% of the total spiders collected) were expected. A large contribution to the total number from the family Clubionidae (20 out of 73 spiders) was not necessarily expected, however. Clubionids are most active during night time hours and spend much of the day in a dense web of silk usually camouflaged between stones, loose bark or under leaves. Because of their size and nocturnal behavior, it was thought that they would be more difficult to find. Instead, although they were less conspicuous, they were often still found hiding in their silk tubes, tucked between leaves of *Typha* stalks.

Among the published literature that does exist on spiders in wetlands (LaSalle and de la Cruz, 1985; Bardwell and Averill, 1997; Aiken and Coyle, 2000) the above six spider families were always dominant. This suggests that although the numbers of spiders collected per family were low, the family composition of Paint Creek is typical for a northern marsh wetland.

When comparing the number of spiders per family per month, greater variation occurred. These variations were likely caused by weather conditions, mating behavior, and life history patterns.

While Lycosidae was present in high abundance throughout all of the sampling months, other spider families peaked in abundance at specific times. Salticids were present until September, but never in high abundance. Clubionids were collected in the highest amount during the month of August. This could be because *Typha* stalks reached their maximum heights by August, giving the Clubionidae the most amount of area for building retreats. Tetragnathidae was present in May, July and September. Because their reproduction cycle is usually from May to June (Aiken and Coyle, 2000), it would make sense that they would be most active, and thus prone to collection during this time. Tetragnathids collected in September were likely May-June offspring searching for burrows in which to spend the winter.

July exhibited the greatest diversity in family composition, with representatives of all six of the families present collected. This was the only month in which Dictynidae was present, and the first time Linyphiidae was collected. These two families tend to exhibit broader reproduction periods (from March to August), but most northern species within these two families mate during mid to late summer (LaSalle and de la Cruz, 1985). Therefore, the later appearances of these two families in July and August coincide with increased activity due to reproductive cycles. The overall increase in diversity in July was likely caused by an overlap of reproductive cycles (most spider families are searching for mates or giving birth to offspring during this time), abundance in food availability, favorable weather conditions, and ample vegetation. With all of these basic needs satisfied, a diversity of spider families were able to flourish in July.

The last trend examined was the relationship between plant biomass and spider abundance. Unfortunately, on a site specific basis, there was no correlation between the number of spiders collected and the amount of vegetation present. This does not support research by other authors (LaSalle and de la Cruz, 1985; Bultman and Uetz, 1982) who have found that the depth of ground litter and amount of vegetation directly correlate with spider abundance and diversity. Consequently, the relationship between number of spiders and plant biomass within Paint Creek wetland should be investigated further.

On a wider scale, however, two trends did develop. One of these is that the ground samples consistently contained more spiders than did samples of bagged *Typha* stalks. Two explanations for this phenomenon exist: either the spiders in the wetland prefer habitats closer to the water-vegetation boundary or the ground crates were superior to the bags in sampling for spiders. Based on visual observations, which detected very few webs and very little web-building activity in the plant canopy, it is possible that most of the spiders prefer ground dwellings. However, the presence of three web-building spider families suggests that the plant canopy is being used by these spiders at some point. Therefore, it is also quite possible that sampling protocols should be modified and a better alternative to the bags explored. Only further investigations will be able to determine which, if any, of these issues might affect differences in ground and bag samples.

The second trend discovered in terms of plant biomass and spiders was that although biomass did not seem to correlate to numbers of spiders collected at each site, it may have played a role in the diversity of spiders collected. Measured plant biomass was highest during the month of July, which may coincide with the high family diversity also observed during that month. Even though the greatest number of spiders was not collected in July, diversity was still the highest – at a time when plant biomass was also at its peak. It would make sense that a large plant biomass would increases available niches within the ecosystem, thus resulting in more opportunities for a wider range of spider families. With an increase in useable habitat space and new ecological roles, a more diverse spider community could quickly develop.

In summary, while the results obtained were not the same as those expected, the complexity of wetland ecosystems should not be dismissed. Spiders are still present and active within the Paint Creek wetland and investigations into the role they play as both predator and prey should continue to be pursued.

The proposed hypothesis: that there would be a large number of spiders found in the wetland, that these spiders would exhibit a high family diversity, and that a positive correlation between spider abundance and high plant biomass would exist was only partially supported. While a relatively wide range in spider families was obtained, the overall number of spiders collected was very low. In addition, there was no obvious correlation between plant biomass and spider abundance displayed within this preliminary data.

Follow-up research is currently underway to investigate some of the potential problems encountered in this first experiment. Modifications include sampling for emergent aquatic insects near the collection sites and extensive documentation of weather patterns and water levels within the wetland. It is hoped that with this additional information a clearer picture of the importance of spiders in wetlands will continue to develop.

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