# The Specificity of Dragonfly Species Distribution within Different Subhabitat Regions of Varying Habitats

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**Meghan R. Marcus**

**306 Pangborn Hall**

**Dr. Ronald A. Hellenthal**

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**ABSTRACT**

Structural diversity of different species of Odonata larvae constitutes a major reason for high species diversity within varying subhabitats. Other factors affecting distribution patterns include predation, water chemistry factors like pH level, conductivity, and temperature, egg placement by adults, and interspecific competition. The specific distribution of dragonfly species within different subhabitat regions of seven varying habitats on the University of Notre Dame Environmental Research Center property was investigated by sampling these subhabitats three times, three collections performed each time, during a one month period in the summer of 1998. A total of fifteen species were found in the nine defined subhabitats. A definite trend was discovered regarding the distribution of different species of Odonata. The individual species participate in this segregation at different levels. Some of the discovered species were classified as generalists. They do not have a distinguishable trend in inhabiting subhabitat regions. Most of the discovered dragonfly species, however, were classified as specialists; these species have a definite arrangement preference around the parameter of a particular habitat.

## INTRODUCTION

Dragonflies, of the order Odonata, constitute a small, widely distributed, and primitive group of insects characterized by aquatic larvae, strong jaws and compound eyes (Corbet 1980). The 5000 species of Odonata are divided into three suborders. The Anisoptera have dissimilar fore and hind wings and are large and fast flying. The Zygoptera, also known as damselflies, have similar fore and hind wings, and they are small and slender. The third suborder, the Anisozygoptera, is represented by only two living species (Miller 1987).

This experiment focuses only on the Anisoptera suborder, more commonly referred to as the Dragonfly suborder. Dragonflies lay their eggs in water; and, after at least two weeks of incubation, the eggs hatch into tiny nymphs (Needham and Westfall 1954). With no exceptions, all dragonfly larvae are aquatic, with two-thirds being lentic (still-water inhabitants) and one-third being lotic. Lentic larvae inhabit permanent and temporary ponds, marshes, swamps, littoral zones, and shoreline areas of lakes. Lotic larvae, on the other hand, occur in all types of permanent stream habitats, including gravel and rock riffles, debris along banks, bank vegetation, soft sediments, and sand (Pierce and Johnson 1985). When the nymphs have completed their lifestage, they creep out of the water onto a solid support, fix their claws to it firmly and shed their loosened nymphal skins (Needham and Westfall 1954). Dragonflies go directly from the nymphal stage to the adult stage with no intermediate pupal stage (Needham and Westfall 1954). Dragonflies are an excellent group for study purposes because they can be easily observed, distinguished, and caught; because of this, there is lots of acquired information regarding their reproduction methods, distinctive life stages, and physical development. On the other hand, few studies have focused on the habitat selection of different species of dragonflies; very little information is known about the stimuli of males and females to settle in specific habitats and subhabitats (Corbet et al. 1960). Dragonflies experience three distinct life stages in their life histories—egg, nymph, and adult. The nymphal stage is the longest, making it the easiest target for experimental study (Needham and Westfall 1954).

While few specifics have been proven regarding the subhabitat preferences of different species of Anisoptera, many assumptions can be drawn from the information that is known. Structural diversity of different species of Odonata larvae is a major reason for high species diversity within varying subhabitats (Schridde and Suhling 1994). Odonata nymphs are distinguishable by two main characteristics--a huge labium, or lower lip, that can be thrust forward to grasp living prey and a distinctly formed tracheal gill that serves for respiration (Needham and Westfall 1954). The two lateral lobes of the labium cover the face up to the eyes, and its middle hinge extends backward between the bases of the fore and middle legs. The tracheal gills that line the inner walls of a rectal gill chamber aid in breathing, and the dragonflies swim by jet propulsion of water from this gill chamber (Needham and Westfall 1954). The abdomen of Odonata larvae is also worth noting; it is relatively broad and terminates in three triangular shaped, pointed appendages—the upper one being the "epiproct" and the lower the "paraprocts"; between them are triangular-shaped cerci (Hilsenhoff 1995). The slight variations among the different species of each of these distinguishable parts could cause the varying species to inhabit different subhabitats that best match their needs. For example, dragonfly larvae with dorso-ventrally flattened abdomens typically inhabit finer sediments since the shape of the abdomen helps prevent passive sinking. More specifically, Gomphids found living in course sediments have elongate abdomens and short legs (Huggins and DeBois 1982).

Odonata nymphs fall into three main groups: climbers, sprawlers, and burrowers. The more active ones climb about in green vegetation in beds of waterweeds or cling to stems of reeds. The more sluggish dragonfly larvae lie flat upon the bottom and sprawl amid the silt with outspread legs (Needham and Westfall 1954). The active *Progomphus obscurus* and *Gomphus externius* larvae are found to burrow completely beneath bottom substrates by using their front and middle legs never deeper than two centimeters (Huggins and DuBois 1982). Site selection of such species is related functionally to both the mechanisms of digging and the need to avoid obstructing the anal respiratory orifice (Corbet 1980). The hyperdevelopment of the tenth abdominal segment in Gomphids prevents them from being able to settle in subhabitats that obstruct the area. Odonata larvae may select the type of sediment to which they are best adapted according to substrate particle size using their tarsal sensoreceptors (Corbet 1980).

Other than structural diversity, community structure in larval dragonflies is affected by predation, interspecific competition, and seasonal segregation (Schridde and Suhling 1994). Females lay eggs in two different ways. Some lay their eggs "endophytically", meaning within or among plant tissue or similar material. When choosing which plants to place their eggs in or on, species tend to be selective. Others release their eggs above or upon a surface, or "exophytically" (Corbet 1980). The varying methods of egg-laying may result in specific species distribution within different subhabitats. The exact placement of the eggs within a habitat could be affected by the surrounding conditions. Site selection within aquatic habitats has implications for resource partitioning and for concealment from both predators and prey (Corbet 1980). Eggs can be eaten by fish and are subject to parasitism (Corbet et al. 1960). Also, when approaching water for reproduction, adult dragonflies may be attacked by aquatic predators like fish, water bugs, and water spiders which inevitably affects final distribution (Miller 1987).

Examining habitats and subhabitats at different times of the day and in different months of the year provide useful information about specific factors that affect distribution of larvae within subhabitats. Such factors include the pH of water, amount and type of aquatic vegetation, and the mobility of the water (Miller 1987). For example, the ponds that have no Odonata tend to be temporary, shaded heavily by trees, or have little to no aquatic vegetation (Corbet 1980). Studies done in Britain show a trend of specific species found in different areas. For example, acid bogs and peaty areas with *Sphagnum* moss are likely to contain larvae of *Libellula quadrimaculata, Pyrrhosoma nymphula, Aeshna juncea,* and *Sympetrum danae. Cordulegaster boltonii, Orthetrum coerulescens,* and *Calopteryx virgo* prefer small streams. Small ponds contain *Libellula depressa, Aeshna cyanea,* and *Sympetrum striolatum* (Miller 1987). Within these individual habitats, different species tend to colonize different subhabitat areas. The larvae of *Cordulegaster* and *Orthetrum* are mud-dwellers; these bottom-dwelling larvae appear to have low metabolic rates and move slowly which supports the fact that they live in the microhabitat with the lowest temperature, lowest concentration of oxygen, and the lowest light intensity. The weed-dwellers include the *Anax, Lestes*, and *Erythromma* (Corbet et al. 1960).

Because there is little knowledge concerning the environmental preferences of dragonfly species distribution and whether this distribution is specific or random, the objective of this study is to intensely examine various habitats and subhabitats and find the connection, if there is one, regarding the distribution of dragonfly species. Specifically, this study will closely examine the varying larvae of Odonata within different environmental surroundings of lake parameters and compare the discovered species and the amount found to those of similar surroundings within different types of aquatic areas.

## MATERIALS AND METHODS

The collection of dragonfly larvae was carried out on the University of Notre Dame Environmental Research Center property in Land O' Lakes, Wisconsin from June 1, 1998 through July 1, 1998 (Figure 1). A total of 373 specimens were collected within this time in 216 samples. The samples were taken from 24 different subhabitats in seven different aquatic areas. The different aquatic areas were chosen based on water chemistry and subhabitat variation. Crampton Lake, the most easterly lake on the property, has a surface area of 63.77 acres, and its shoreline in 8410 feet in length. It is heavily stocked with fish including large-mouthed bass, northern pike, and yellow perch (Figure 2). Eight total subhabitats were investigated from this lake, including Mud and Leaves, Sand and Rocks, Grass Emergent Vegetation, Leatherleaf on Tree, Leatherleaf Emergent Vegetation, Lily Pad Emergent Vegetation, Gravel, and Branches. Morris Lake, with a surface area of 14.64 acres, has a shoreline of 3367 feet (Figure 3). It is filled with large-mouthed bass and northern pike. Collections were taken from seven subhabitats, including Mud and Leaves, Grass Emergent Vegetation, Leatherleaf on Tree, Leatherleaf Emergent Vegetation, Lily Pad Emergent Vegetation, Gravel, and Branches. The third lake used for sampling in this experiment was Tenderfoot Lake. Its massive surface area equals 480 acres, and its shoreline extends 5.87 miles (Figure 4). Fish in Tenderfoot Lake include muskellunge, northern pike, walleye, sunfish, and large- and small-mouthed base. Only one subhabitat was needed for comparison from this lake. The Sand and Rocks area surrounding the dock was used for sampling. Another sampling site was Trout Pond, which is located on the northwestern end of the property. Because of Trout Pond's swampy and inaccessible nature, there is no recorded information on its surface area and shoreline length. Four subhabitats were used for collection: these included Grass Emergent Vegetation, Leatherleaf Emergent Vegetation, Branches, and Gravel. A swamp located on the south roadside 1.4 miles west on Cranberry Lake Road was chosen as a comparison to Trout Pond. Because of its ever-changing parameters, shoreline and surface area are not recorded. Roadside Swamp had two accessible subhabitats—Branches and Grass Emergent Vegetation. The final two aquatic areas chosen for this study were two similar bogs located on opposite ends of the property. Tender Bog has a shoreline of 386.5 feet and a surface area of .15 acres (Figure 5). It is fishless and its homogeneous parameter provided one subhabitat for study—Leatherleaf with *Sphagnum*. Ed's Bog, very similar to Tender Bog, has a shoreline of 405.7 feet, a surface area of .21 acres, and no fish (Figure 6). It, too, has one subhabitat, which is Leatherleaf with *Sphagnum*.

The different types of subhabitat were classified according to vegetation present, sediment types, or type of detritus. Mud and Leaves subhabitat is

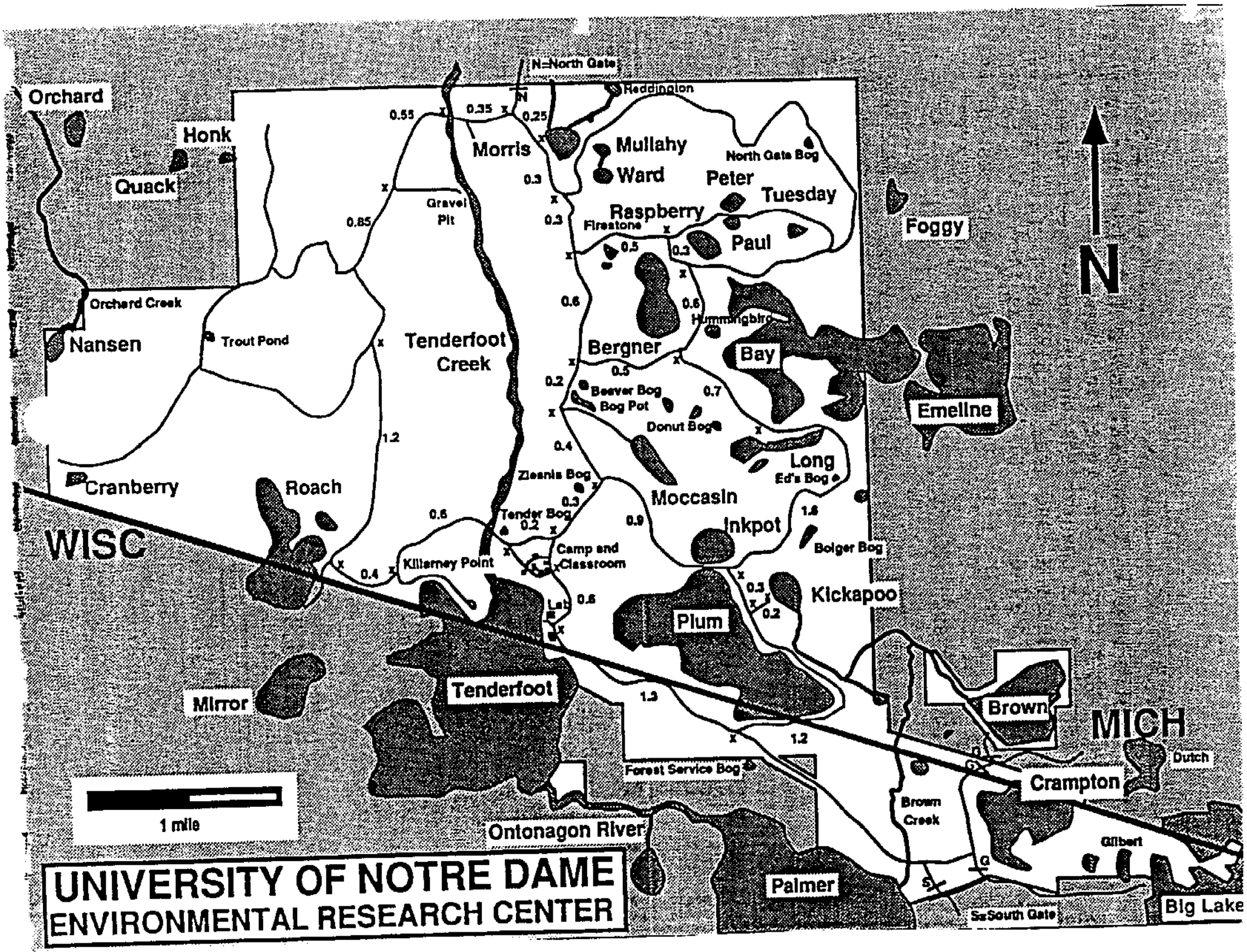


**Figure 1:** Map of the University of Notre Dame Environmental Research Center Property

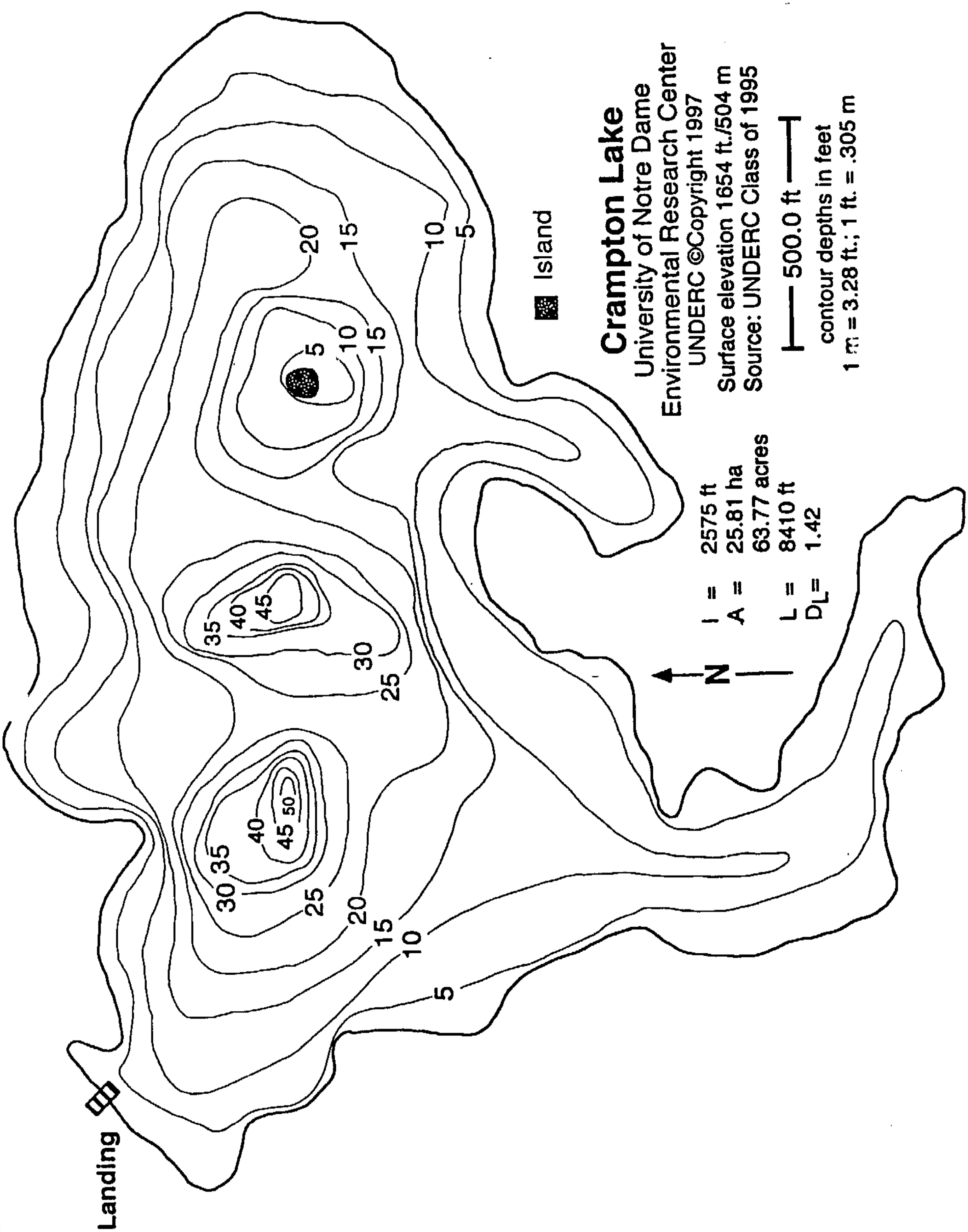


**Figure 2:** Topographical Map of Crampton Lake.

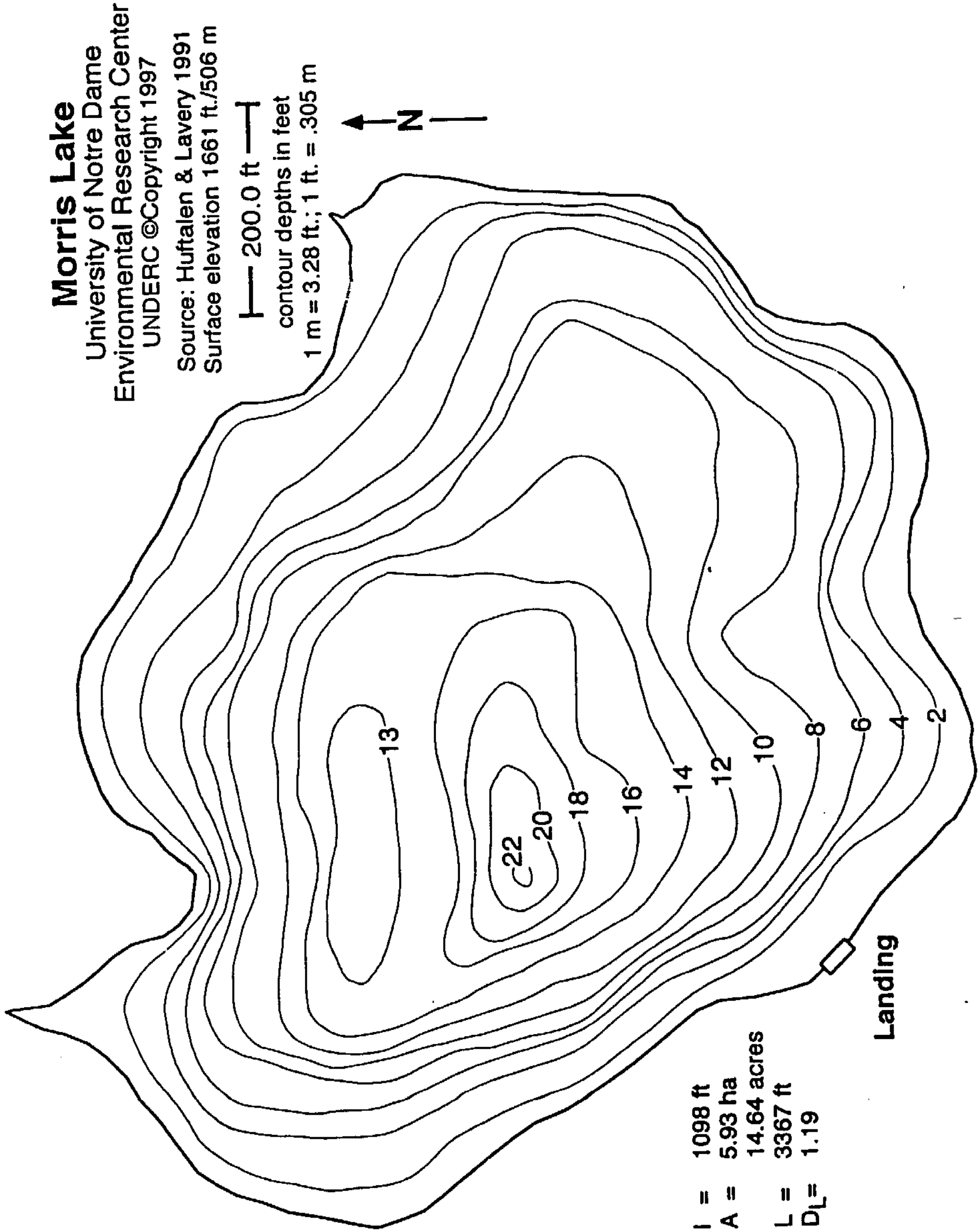


Figure 3: Topographical Map of Morris Lake.

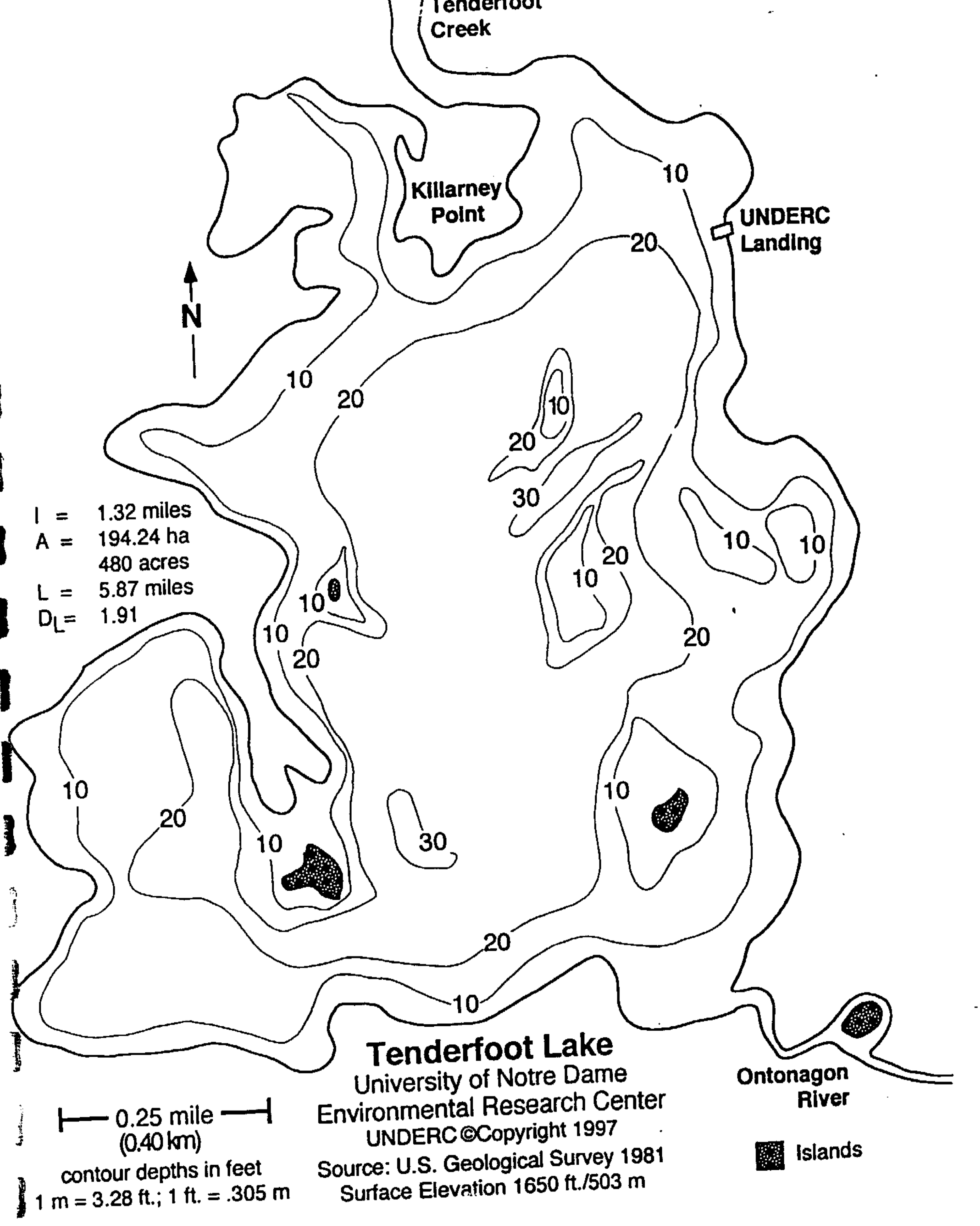


**Figure 4**: Topographical Map of Tenderfoot Lake.

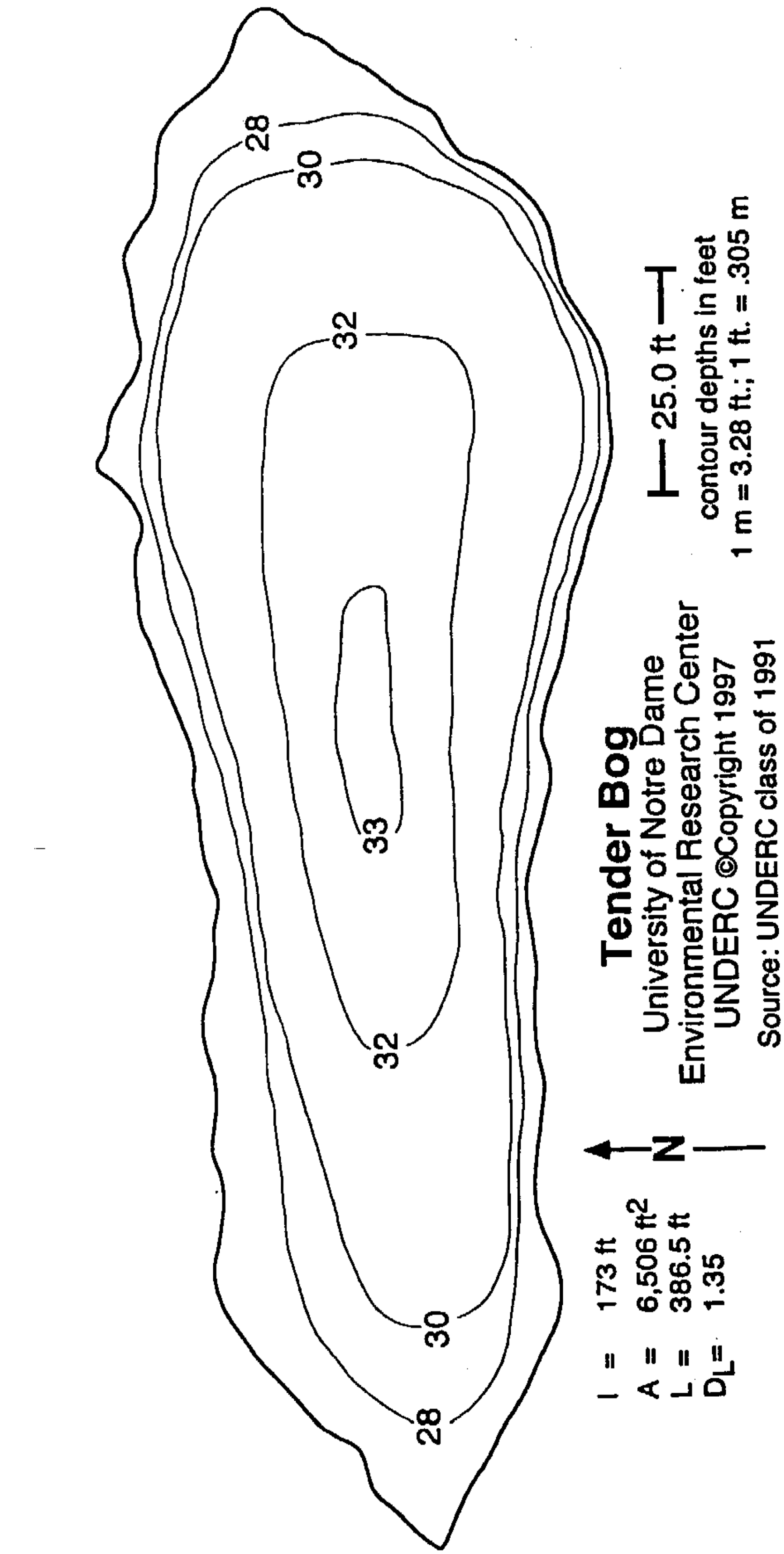


**Figure 5**: Topographical Map of Tender Bog.

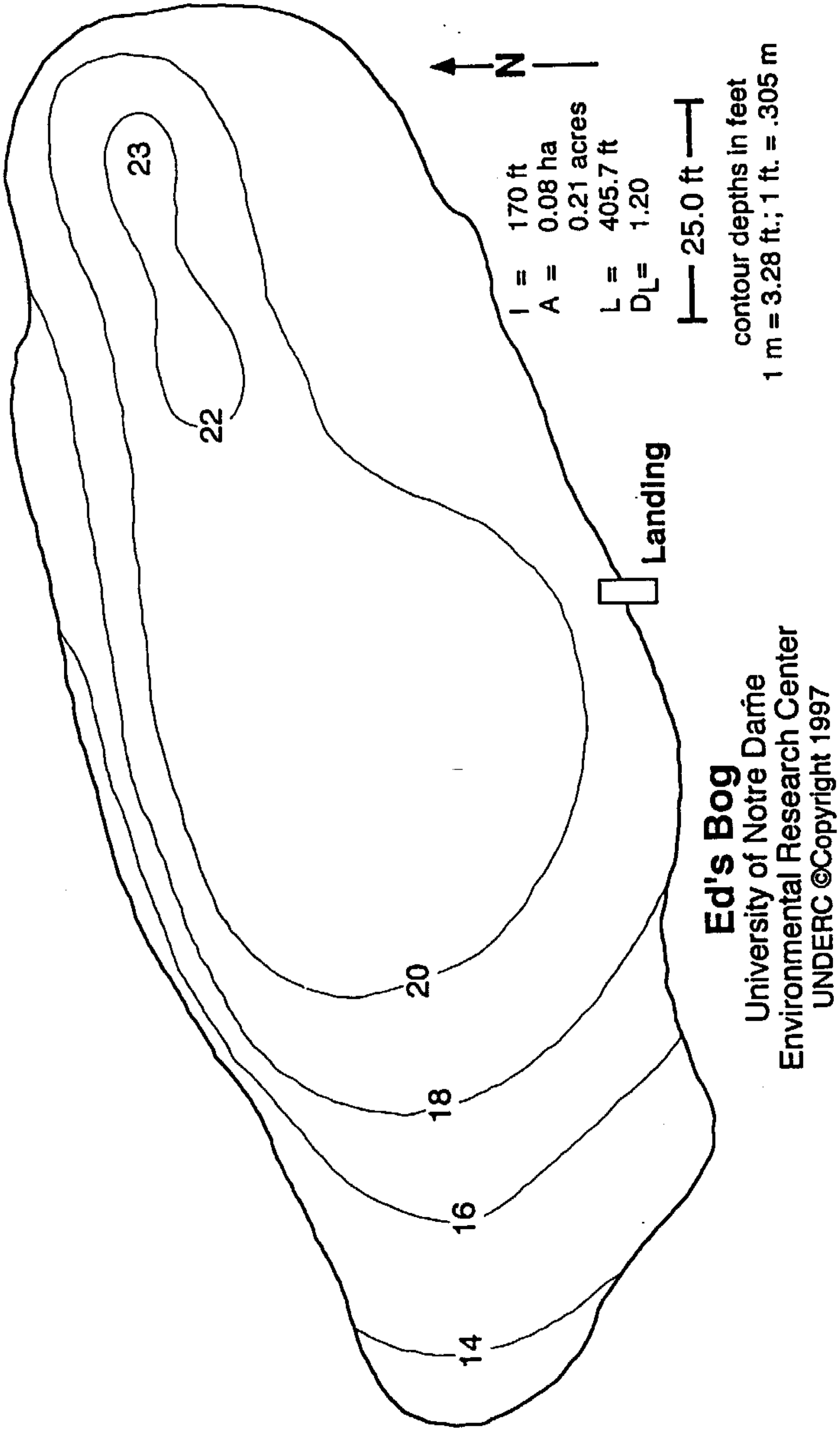


**Figure 6**: Topographical Map of Ed's Bog.

distinguishable by the absence of vegetation, woody debris, and rocky bottom. It contains only muddy bottom that is covered by fallen, dead leaves. Sand and Rocks subhabitat is distinguishable by the absence of vegetation, woody debris, and mud. It is different from gravel because the main sediment is sand with a minor amount of rocks. Grass Emergent Vegetation Subhabitat includes areas that are dominated by emerging grass. There are no rocks or woody debris, and the bottom sediment is a silty mud. This was counted as a separate subhabitat only when no other vegetation was present. Leatherleaf on Tree Subhabitat was only found in two of the aquatic areas because of its specific conditions. It includes a fallen dead tree with leatherleaf plants growing out the sides of its trunk. The leatherleaf is not emerging out of the water; instead, a minor part of the plant touches the surface of the water. Samples from this subhabitat were taken from up underneath the surface-touching portion of the leatherleaf. Leatherleaf Emergent Vegetation is a similar subhabitat to Grass Emergent Vegetation except the only present vegetation is leatherleaf. The bottom sediment in this subhabitat is mud. Lily Pad Emergent Vegetation Subhabitat is much less dense than the other two emergent vegetation subhabitats and is located in deeper waters because of the stem length of the lily pads. The bottom sediment consisted solely of mud and dead, fallen lily pad debris. The Gravel Subhabitats were all located at the loading docks and consisted purely of rocks of medium size. The Branches Subhabitats were made up of woody debris that fully covered the bottom. They lacked vegetation and rocks. The final studied subhabitat was Leatherleaf with *Sphagnum* Moss. It was found only along the parameters of bogs. The samples were taken from up underneath the bog mat.

The procedure used to collect the Odonata was the same in each subhabitat and throughout each week of sampling. The samples were taken using a dipnet and a square meter metal frame attached to a ten foot rope. Once the varying subhabitats were established in each habitat, the square meter sampler was dropped in three random sites without overlapping within each subhabitat in order to verify that the samples correctly display the contents of the entire area of the subhabitat. Within each placement of the sampler, the dipnet took three consecutive scoops in order to cover the entire area of the sampler. All of the collected debris and sediment from the three scoops within the sampler were then placed within a common plastic bag and labeled with microhabitat type and sample number.

The samples were then taken to lab where they were prepared for Odonata larvae separation. The method used was a modified flotation technique developed for sorting bottom fauna samples. First, the contents of one plastic bag were poured into a glass bowl. Then, all of the large debris was manually removed from the sample, and all excess water was drained out of the bowl using a sieve. The remaining contents were then placed in a white enamel dissecting pan. The sample was then covered with 95% ethanol and proper time was allotted in order for all organisms to die. The ethanol was then drained out of the pan. A sugar solution with a specific gravity of 1.12 was prepared (approximately 2.5 pounds of granulated sugar per gallon of solution), and three quarts of the solution was then added per 0.5 quarts of solid. The debris is then stirred and distributed evenly over the bottom of the dissecting pan. The Odonata larvae were then collected from the surface of the solution (Anderson 1959). After all larvae were removed from the samples, they were identified to species *using Aquatic Insects of Wisconsin* by W.L. Hilsenhoff, *Dragonflies of North America* by J.G. Needham and M.J. Westfall, and *The Odonata of Canada and Alaska* by E.M. Walker; then they were placed in 95% ethanol in separate vials with labels including habitat, subhabitat, species name, date, and sample number.

The procedure of this experiment was carefully followed to avoid as many variables and errors as possible. Areas of converging subhabitat regions were avoided to eliminate the possibility of error in determining the proper subhabitat type. There were three random samples taken from each area during each sampling period to provide repetition to make the data more supported. The samples had to cover completely different square meters within the subhabitats in order to assure a better representation of the population within the region. Three different collections were made throughout the one-month period at each subhabitat in order to eliminate the variable of changes over time.

Another important aspect of this experiment was the water conditions of each habitat chosen. Because all varying aspects of each habitat must be considered when making accurate comparisons between the habitats, water chemistry tests were done at each site. The performed tests included pH Reading, Temperature, and Conductivity. All three of these tests were taken on the same day at all of the habitats in order to minimize variables. The pH Reading measures the acidity level in the water, and it was taken using a device that displays the pH level to the tenth of a point. The Conductivity Meter provided the information required to record the measurements of conductivity and temperature. Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. The units used to measure conductivity were microSiemens per centimeter. The temperature was read in degrees Celsius and was taken from a foot deep just out from the parameter in each habitat.

There were five weeks allotted for individual research purposes during the ten weeks on the University of Notre Dame Environmental Research Center property. The first week was dedicated to surveying the varying habitats on the property to determine the proper ones to use for the specifics of this research topic. The next three available research weeks were dedicated to sampling, collecting, and identifying. All seven habitats were sampled a total of three times within these three weeks, once a week each.

**RESULTS**

A total of fifteen dragonfly species were collected at the University of Notre Dame Environmental Research Center within the time frame of June 1st through July 1st (Table 1).

Only one specimen of *Aeshna canadensis* was collected within the seven collecting sites. It was found at Morris Lake in the Grass Emergent Vegetation at the end of the first week of sampling.

There were four collections of *Aeshna clepsydra*. Three of them were collected in the Leatherleaf with *Sphagnum* subhabitiat, one in Ed's Bog and two in Tender Bog, and one was found in Morris Lake in the Branches subhabitat.

Three *Aeshna eremita* larvae were collected from Morris Lake. Two of these were found in the Grass Emergent Vegetation and one in the Branches.

*Anax junius* larvae were found only in Grass Emergent Vegetation subhabitat. Two were found in Morris Lake and one was found in the Roadside Swamp.

There were five total *Boyeria vinosa* larvae collected. The two found in Crampton Lake were both collected from Grass Emergent Vegetation. There were two found in the Branches subhabitat and one found in the leatherleaf Emergent Vegetation of Morris Lake.

*Cordulia shurtleffi* were widely distributed throughout the habitats and subhabitats. One specimen was collected from the Branches subhabitat in Morris Lake. Eight total were found in Grass Emergent Vegetation with four of these found in Trout Pond, two found in Crampton Lake, one found in the Roadside Swamp, and one found in Morris Lake. Three larvae were collected in Crampton Lake's Leatherleaf Emergent Vegetation, while twelve were collected in the same subhabitat in Trout Pond. There were many collections made of Cordulia shurtleffi within the Leatherleaf with *Sphagnum* subhabitat—twelve in Ed's Bog and twenty-three in Tender Bog. The final subhabitat in which this species was found is Lily Pad Emergent Vegetation; all six were collected from Morris Lake.

There were two *Epiaeschna heros* larvae collected from the Branches subhabitat of Crampton Lake.

*Epitheca canis* were collected from four different subhabitats in two different habitats. Within Morris Lake, one was found in Leatherleaf Emergent Vegetation and one was found in Branches. The rest of the *Epitheca canis* were taken from Trout Pond. Fourteen of these were collected from the Gravel subhabitat, seven from Leatherleaf Emergent Vegetation, and five from Grass Emergent Vegetation.

One *Epitheca cynosura* larva was collected from Morris Lake in the Branches subhabitat. The other two were both collected from Trout Pond, one from Gravel and one from Grass Emergent Vegetation.

**Table 1:** Complete listing of the collections made within the one month period at the seven different habitats on the UNDERC property including number collected, sampling date, and sample number.

| SUBHABITAT | SITE | FAMILY | SPECIES | NUMBER | DATE | SAMPLE |
|---|---|---|---|---|---|---|
| Mud and Leaves | Crampton Lake | | | 0 | 6/1/98 | 1 |
| Mud and Leaves | Crampton Lake | | | 0 | 6/1/98 | 2 |
| Mud and Leaves | Crampton Lake | | | 0 | 6/1/98 | 3 |
| Mud and Leaves | Crampton Lake | | | 0 | 6/18/98 | 1 |
| Mud and Leaves | Crampton Lake | | | 0 | 6/18/98 | 2 |
| Mud and Leaves | Crampton Lake | | | 0 | 6/18/98 | 3 |
| Mud and Leaves | Crampton Lake | | | 0 | 7/1/98 | 1 |
| Mud and Leaves | Crampton Lake | | | 0 | 7/1/98 | 2 |
| Mud and Leaves | Crampton Lake | | | 0 | 7/1/98 | 3 |
| Mud and Leaves | Morris Lake | | | 0 | 6/5/98 | 1 |
| Mud and Leaves | Morris Lake | | | 0 | 6/5/98 | 2 |
| Mud and Leaves | Morris Lake | | | 0 | 6/5/98 | 3 |
| Mud and Leaves | Morris Lake | | | 0 | 6/17/98 | 1 |
| Mud and Leaves | Morris Lake | | | 0 | 6/17/98 | 2 |
| Mud and Leaves | Morris Lake | | | 0 | 6/17/98 | 3 |
| Mud and Leaves | Morris Lake | | | 0 | 6/30/98 | 1 |
| Mud and Leaves | Morris Lake | | | 0 | 6/30/98 | 2 |
| Mud and Leaves | Morris Lake | | | 0 | 6/30/98 | 3 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 1 | 6/1/98 | 1 |
| Grass Emergent Vegetation | Crampton Lake | Corduliidae | *Cordulia shurtleffi* | 1 | 6/1/98 | 2 |
| Grass Emergent Vegetation | Crampton Lake | Corduliidae | *Cordulia shurtleffi* | 1 | 6/1/98 | 3 |
| Grass Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 1 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 1 | 6/18/98 | 2 |
| Grass Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 3 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 2 | 7/1/98 | 1 |
| Grass Emergent Vegetation | Crampton Lake | Aeshnidae | *Boyeria vinosa* | 1 | 7/1/98 | 1 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Leucorrhinia frigida* | 1 | 7/1/98 | 2 |
| Grass Emergent Vegetation | Crampton Lake | Aeshnidae | *Boyeria vinosa* | 1 | 7/1/98 | 2 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Leucorrhinia frigida* | 1 | 7/1/98 | 3 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 2 | 7/1/98 | 3 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 3 | 6/3/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/3/98 | 2 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/3/98 | 3 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 4 | 6/15/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/15/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 2 | 6/15/98 | 2 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 2 | 6/15/98 | 3 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia hudsonica* | 1 | 6/15/98 | 3 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 2 | 6/16/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/16/98 | 2 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia hudsonica* | 1 | 6/16/98 | 2 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/16/98 | 3 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 8 | 6/29/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 1 | 6/29/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 2 | 6/29/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca cynosura* | 1 | 6/29/98 | 1 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 6 | 6/29/98 | 2 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 1 | 6/29/98 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 1 6/29/98 | 2 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 10 6/29/98 | 3 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 1 6/29/98 | 3 |
| Grass Emergent Vegetation | Roadside Swamp | Aeshnidae | *Anax junius* | 1 6/4/98 | 1 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Leucorrhinia frigida* | 4 6/4/98 | 2 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Leucorrhinia frigida* | 3 6/4/98 | 3 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Libellula quadrimaculata* | 2 6/29/98 | 1 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Leucorrhinia frigida* | 3 6/29/98 | 1 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Libellula quadrimaculata* | 2 6/29/98 | 2 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Leucorrhinia frigida* | 2 6/29/98 | 2 |
| Grass Emergent Vegetation | Roadside Swamp | Corduliidae | *Cordulia shurtleffi* | 1 6/29/98 | 3 |
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Aeshna canadensis* | 1 6/5/98 | 1 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 2 6/5/98 | 2 |
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Aeshna eremita* | 1 6/5/98 | 3 |
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Anax junius* | 1 6/5/98 | 3 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 6/17/98 | 1 |
| Grass Emergent Vegetation | Morris Lake | Corduliidae | *Somatochlora williamsoni* | 1 6/17/98 | 2 |
| Grass Emergent Vegetation | Morris Lake | | | 0 6/17/98 | 3 |
| Grass Emergent Vegetation | Morris Lake | Corduliidae | *Somatochlora williamsoni* | 1 6/30/98 | 1 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 2 6/30/98 | 1 |
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Anax junius* | 1 6/30/98 | 1 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Leucorrhinia frigida* | 1 6/30/98 | 2 |
| Grass Emergent Vegetation | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 1 6/30/98 | 2 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 6/30/98 | 2 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 6/30/98 | 3 |
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Aeshna eremita* | 1 6/30/98 | 3 |
| Leatherleaf on Tree | Crampton Lake | | | 0 6/1/98 | 1 |
| Leatherleaf on Tree | Crampton Lake | | | 0 6/1/98 | 2 |
| Leatherleaf on Tree | Crampton Lake | | | 0 6/1/98 | 3 |
| Leatherleaf on Tree | Crampton Lake | | | 0 6/18/98 | 1 |
| Leatherleaf on Tree | Crampton Lake | | | 0 6/18/98 | 2 |
| Leatherleaf on Tree | Crampton Lake | | | 0 6/18/98 | 3 |
| Leatherleaf on Tree | Crampton Lake | | | 0 7/1/98 | 1 |
| Leatherleaf on Tree | Crampton Lake | | | 0 7/1/98 | 2 |
| Leatherleaf on Tree | Crampton Lake | | | 0 7/1/98 | 3 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/5/98 | 1 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/5/98 | 2 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/5/98 | 3 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/17/98 | 1 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/17/98 | 2 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/17/98 | 3 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/30/98 | 1 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/30/98 | 2 |
| Leatherleaf on Tree | Morris Lake | | | 0 6/30/98 | 3 |
| Sand and Rock | Crampton Lake | | | 0 6/1/98 | 1 |
| Sand and Rock | Crampton Lake | | | 0 6/1/98 | 2 |
| Sand and Rock | Crampton Lake | | | 0 6/1/98 | 3 |
| Sand and Rock | Crampton Lake | | | 0 6/18/98 | 1 |
| Sand and Rock | Crampton Lake | | | 0 6/18/98 | 2 |
| Sand and Rock | Crampton Lake | | | 0 6/18/98 | 3 |
| Sand and Rock | Crampton Lake | | | 0 7/1/98 | 1 |
| Sand and Rock | Crampton Lake | | | 0 7/1/98 | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sand and Rock | Crampton Lake | | | 0 | 7/1/98 | 3 |
| nd and Rock | Tenderfoot Lake | | | 0 | 6/4/98 | 1 |
| and and Rock | Tenderfoot Lake | | | 0 | 6/4/98 | 2 |
| Sand and Rock | Tenderfoot Lake | | | 0 | 6/4/98 | 3 |
| Sand and Rock | Tenderfoot Lake | | | 0 | 6/18/98 | 1 |
| Sand and Rock | Tenderfoot Lake | | | 0 | 6/18/98 | 2 |
| Sand and Rock | Tenderfoot Lake | | | 0 | 6/18/98 | 3 |
| Sand and Rock | Tenderfoot Lake | | | 0 | 7/1/98 | 1 |
| Sand and Rock | Tenderfoot Lake | | | 0 | 7/1/98 | 2 |
| Sand and Rock | Tenderfoot Lake | | | 0 | 7/1/98 | 3 |
| Leatherleaf Emergent Vegetation | Crampton Lake | Corduliidae | *Cordulia shurtleffi* | 1 | 6/1/98 | 1 |
| Leatherleaf Emergent Vegetation | Crampton Lake | | | 0 | 6/1/98 | 2 |
| Leatherleaf Emergent Vegetation | Crampton Lake | Corduliidae | *Cordulia shurtleffi* | 1 | 6/1/98 | 3 |
| Leatherleaf Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 1 |
| Leatherleaf Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 2 |
| Leatherleaf Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 3 |
| Leatherleaf Emergent Vegetation | Crampton Lake | | | 0 | 7/1/98 | 1 |
| Leatherleaf Emergent Vegetation | Crampton Lake | Corduliidae | *Cordulia shurtleffi* | 1 | 7/1/98 | 2 |
| Leatherleaf Emergent Vegetation | Crampton Lake | | | 0 | 7/1/98 | 3 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 4 | 6/3/98 | 1 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/3/98 | 2 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 1 | 6/3/98 | 3 |
| Leatherleaf Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/16/98 | 1 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 1 | 6/16/98 | 1 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/16/98 | 1 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 2 | 6/16/98 | 2 |
| Leatherleaf Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/16/98 | 3 |
| .eatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/16/98 | 3 |
| Leatherleaf Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 2 | 6/29/98 | 1 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 3 | 6/29/98 | 1 |
| Leatherleaf Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 3 | 6/29/98 | 2 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 1 | 6/29/98 | 2 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/29/98 | 2 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 3 | 6/29/98 | 3 |
| Leatherleaf Emergent Vegetation | Trout Pond | Libellulidae | *Libellula quadrimaculata* | 1 | 6/29/98 | 3 |
| Leatherleaf Emergent Vegetation | Trout Pond | | | 0 | 6/5/98 | 1 |
| Leatherleaf Emergent Vegetation | Morris Lake | | | 0 | 6/5/98 | 2 |
| Leatherleaf Emergent Vegetation | Morris Lake | | | 0 | 6/5/98 | 3 |
| Leatherleaf Emergent Vegetation | Morris Lake | | | 0 | 6/17/98 | 1 |
| Leatherleaf Emergent Vegetation | Morris Lake | | | 0 | 6/17/98 | 2 |
| Leatherleaf Emergent Vegetation | Morris Lake | | | 0 | 6/17/98 | 3 |
| Leatherleaf Emergent Vegetation | Morris Lake | Corduliidae | *Epitheca canis* | 1 | 6/30/98 | 1 |
| Leatherleaf Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/30/98 | 2 |
| Leatherleaf Emergent Vegetation | Morris Lake | Aeshnidae | *Boyeria vinosa* | 1 | 6/30/98 | 2 |
| Leatherleaf Emergent Vegetation | Morris Lake | | | 0 | 6/30/98 | 3 |
| Leatherleaf Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/1/98 | 1 |
| Lily Pad Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 1 | 6/1/98 | 2 |
| Lily Pad Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 1 | 6/1/98 | 3 |
| Lily Pad Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 1 |
| Lily Pad Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 2 |
| Lily Pad Emergent Vegetation | Crampton Lake | | | 0 | 6/18/98 | 3 |
| Lily Pad Emergent Vegetation | Crampton Lake | | | 1 | 7/1/98 | 1 |
| Lily Pad Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lily Pad Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 1 | 7/1/98 | 2 |
| 'y Pad Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 1 | 7/1/98 | 3 |
| .y Pad Emergent Vegetation | Morris Lake | | | 0 | 6/5/98 | 1 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/5/98 | 2 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/5/98 | 3 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/17/98 | 1 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/17/98 | 2 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/17/98 | 3 |
| Lily Pad Emergent Vegetation | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 3 | 6/30/98 | 1 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/30/98 | 1 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Leucorrhinia frigida* | 1 | 6/30/98 | 2 |
| Lily Pad Emergent Vegetation | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 1 | 6/30/98 | 2 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Leucorrhinia frigida* | 2 | 6/30/98 | 3 |
| Lily Pad Emergent Vegetation | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 2 | 6/30/98 | 3 |
| Gravel | Crampton Lake | | | 0 | 6/1/98 | 1 |
| Gravel | Crampton Lake | | | 0 | 6/1/98 | 2 |
| Gravel | Crampton Lake | | | 0 | 6/1/98 | 3 |
| Gravel | Crampton Lake | | | 0 | 6/18/98 | 1 |
| Gravel | Crampton Lake | | | 0 | 6/18/98 | 2 |
| Gravel | Crampton Lake | | | 0 | 6/18/98 | 3 |
| Gravel | Crampton Lake | | | 0 | 7/1/98 | 1 |
| Gravel | Crampton Lake | | | 0 | 7/1/98 | 2 |
| Gravel | Crampton Lake | | | 0 | 7/1/98 | 3 |
| Gravel | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/3/98 | 1 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/3/98 | 1 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/3/98 | 2 |
| Gravel | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 4 | 6/3/98 | 3 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/3/98 | 3 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/16/98 | 1 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 2 | 6/16/98 | 2 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/16/98 | 3 |
| Gravel | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 3 | 6/29/98 | 1 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 4 | 6/29/98 | 1 |
| Gravel | Trout Pond | Libellulidae | *Libellula quadrimaculata* | 1 | 6/29/98 | 1 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 1 | 6/29/98 | 2 |
| Gravel | Trout Pond | Corduliidae | *Epitheca cynosura* | 1 | 6/29/98 | 2 |
| Gravel | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 1 | 6/29/98 | 2 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 2 | 6/29/98 | 3 |
| Gravel | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 8 | 6/29/98 | 3 |
| Gravel | Morris Lake | | | 0 | 6/5/98 | 1 |
| Gravel | Morris Lake | | | 0 | 6/5/98 | 2 |
| Gravel | Morris Lake | | | 0 | 6/5/98 | 3 |
| Gravel | Morris Lake | | | 0 | 6/17/98 | 1 |
| Gravel | Morris Lake | | | 0 | 6/17/98 | 2 |
| Gravel | Morris Lake | | | 0 | 6/17/98 | 3 |
| Gravel | Morris Lake | | | 0 | 6/30/98 | 1 |
| Gravel | Morris Lake | | | 0 | 6/30/98 | 2 |
| Gravel | Morris Lake | | | 0 | 6/30/98 | 3 |
| Branches | Crampton Lake | Aeshnidae | *Epiaeschna heros* | 1 | 6/3/98 | 1 |
| Branches | Crampton Lake | | | 0 | 6/3/98 | 2 |
| Branches | Crampton Lake | Gomphidae | *Gomphus exilis* | 2 | 6/3/98 | 3 |
| Branches | Crampton Lake | | | 0 | 6/18/98 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Branches | Crampton Lake | | | 0 | 6/18/98 | 2 |
| Branches | Crampton Lake | | | 0 | 6/18/98 | 3 |
| Branches | Crampton Lake | Gomphidae | *Gomphus exilis* | 4 | 7/1/98 | 1 |
| Branches | Crampton Lake | Aeshnidae | *Epiaeschna heros* | 1 | 7/1/98 | 2 |
| Branches | Crampton Lake | Gomphidae | *Gomphus exilis* | 2 | 7/1/98 | 2 |
| Branches | Crampton Lake | Gomphidae | *Gomphus exilis* | 2 | 7/1/98 | 3 |
| Branches | Trout Pond | | | 0 | 6/3/98 | 1 |
| Branches | Trout Pond | | | 0 | 6/3/98 | 2 |
| Branches | Trout Pond | | | 0 | 6/3/98 | 3 |
| Branches | Trout Pond | | | 0 | 6/16/98 | 1 |
| Branches | Trout Pond | | | 0 | 6/16/98 | 2 |
| Branches | Trout Pond | | | 0 | 6/16/98 | 3 |
| Branches | Trout Pond | | | 0 | 6/29/98 | 1 |
| Branches | Trout Pond | | | 0 | 6/29/98 | 2 |
| Branches | Trout Pond | | | 0 | 6/29/98 | 3 |
| Branches | Roadside Swamp | | | 0 | 6/4/98 | 1 |
| Branches | Roadside Swamp | | | 0 | 6/4/98 | 2 |
| Branches | Roadside Swamp | | | 0 | 6/4/98 | 3 |
| Branches | Roadside Swamp | | | 0 | 6/16/98 | 1 |
| Branches | Roadside Swamp | | | 0 | 6/16/98 | 2 |
| Branches | Roadside Swamp | | | 0 | 6/16/98 | 3 |
| Branches | Roadside Swamp | | | 0 | 6/29/98 | 1 |
| Branches | Roadside Swamp | | | 0 | 6/29/98 | 2 |
| Branches | Roadside Swamp | | | 0 | 6/29/98 | 3 |
| Branches | Morris Lake | Aeshnidae | *Aeshna eremita* | 1 | 6/5/98 | 1 |
| Branches | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 1 | 6/5/98 | 1 |
| Branches | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/5/98 | 2 |
| Branches | Morris Lake | Corduliidae | *Epitheca cynosura* | 1 | 6/5/98 | 2 |
| Branches | Morris Lake | | | 0 | 6/5/98 | 3 |
| Branches | Morris Lake | | | 0 | 6/17/98 | 1 |
| Branches | Morris Lake | | | 0 | 6/17/98 | 2 |
| Branches | Morris Lake | | | 0 | 6/17/98 | 3 |
| Branches | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/30/98 | 1 |
| Branches | Morris Lake | Corduliidae | *Epitheca canis* | 1 | 6/30/98 | 1 |
| Branches | Morris Lake | Aeshnidae | *Boyeria vinosa* | 1 | 6/30/98 | 1 |
| Branches | Morris Lake | Libellulidae | *Ladona julia* | 2 | 6/30/98 | 2 |
| Branches | Morris Lake | Aeshnidae | *Aeshna clepsydra* | 1 | 6/30/98 | 2 |
| Branches | Morris Lake | Libellulidae | *Ladona julia* | 1 | 6/30/98 | 3 |
| Branches | Morris Lake | Aeshnidae | *Boyeria vinosa* | 1 | 6/30/98 | 3 |
| Branches | Morris Lake | Gomphidae | *Gomphus exilis* | 1 | 6/30/98 | 3 |
| Leatherleaf with Sphagnum | Tender Bog | Corduliidae | *Cordulia shurtleffi* | 2 | 6/3/98 | 1 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 6 | 6/3/98 | 1 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 7 | 6/3/98 | 2 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 3 | 6/3/98 | 3 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 4 | 6/15/98 | 1 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 7 | 6/15/98 | 2 |
| Leatherleaf with Sphagnum | Tender Bog | Corduliidae | *Cordulia shurtleffi* | 1 | 6/15/98 | 2 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 6 | 6/15/98 | 3 |
| Leatherleaf with Sphagnum | Tender Bog | Corduliidae | *Cordulia shurtleffi* | 2 | 6/15/98 | 3 |
| Leatherleaf with Sphagnum | Tender Bog | Corduliidae | *Cordulia shurtleffi* | 5 | 6/29/98 | 1 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 5 | 6/29/98 | 1 |
| Leatherleaf with Sphagnum | Tender Bog | Corduliidae | *Cordulia shurtleffi* | 8 | 6/29/98 | 2 |

*Gomphus exilis* larvae were consistently found only in the Branches subhabitat. Out of the total eleven that were collected, ten were taken from Crampton Lake and one was taken from Morris Lake.

*Ladona julia* were found only in Crampton Lake and Morris Lake. Out of the twelve total that were found in Crampton, six were taken from Lily Pad Emergent Vegetation and six were taken from Grass Emergent Vegetation. Seven were collected from Grass Emergent Vegetation in Morris Lake and six from Lily Pad Emergent Vegetation. There were also five larvae found in the Branches subhabitat of Morris Lake.

Trout Pond contained the majority of the *Leucorrhinia frigida* larvae that were collected. A total of sixty-three were taken from there; thirty-nine of these were found in Grass Emergent Vegetation, seventeen in Gravel, and seven in Leatherleaf Emergent Vegetation. There were also twelve larvae found solely in the Grass Emergent Vegetation of the Roadside Swamp. Three were collected from Morris Lake's Lily Pad Emergent Vegetation and one from its Grass Emergent Vegetation. There were also two *Leucorrhinia frigida* collected from Crampton Lake's Grass Emergent Vegetation.

126 out of the 128 total *Leucorrhinia hudsonica* larvae were found in the Leatherleaf with *Sphagnum* subhabitat; Ed's Bog gave up sixty-two of these, and Tender Bog gave up sixty-four. The remaining two larvae were taken from Tout Pond's Grass Emergent Vegetation.

There were four *Libellula quadrimaculata* larvae taken from Roadside Swamp, and they all were found in Grass Emergent Vegetation. Trout Pond provided two specimens; one of these was found in Leatherleaf Emergent Vegetation and one in Gravel.

*Somatochlora williamsoni* were found only Morris Lake. The two collections were both taken from the Grass Emergent Vegetation subhabitat.

The Mud and Leaves subhabitat did not provide any collections of larvae for any sample at any of the sites. Leatherleaf on Tree and Sand and Rock are the other studies subhabitat variations that didn't provide any dragonflies. Grass Emergent Vegetation was definitely the subhabitat with the most diversity in dragonfly species. Samples of twelve of the fifteen collected species were taken from this subhabitat type; *Leucorrhinia frigida* was found in most abundance. Branches was next for most number of species with nine total. Its main occupant was *Gomphus exilis*. Leatherleaf Emergent Vegetation also contained some diversification; six different species were found here with the most abundant being *Cordulia shurtleffi*. Four different species were found in the Gravel subhabitat with *Leucorrhinia frigida* and *Epitheca canis* coming out with the most numbers of collections. *Leucorrhinia hudsonica* dominated out of the three species found in leatherleaf with *Sphagnum*.

## DISCUSSION

There were four total dragonfly families collected from a sampling of habitats on the property (Table 3). Out of the four different families of dragonfly larvae found in the one-month period of research on the University of Notre Dame Environmental Research property, the Gomphidae family was found in the least abundance. Only one species of Gomphidae was collected, *Gomphus exilis*, and it was found solely in the Branches subhabitat in both Crampton Lake and Morris Lake (Figure 7-8). By looking at habitat selection alone, *Gomphus exilis* seems to prefer locations of larger lakes. Crampton Lake and Morris Lake are two of the larger wetlands on the UNDERC property, and they have close to neutral pH levels. The temperature of the two lakes is comparably identical (Table 2). These two habitats also have nearly identical subhabitat choices. With the exception of Gravel subhabitat that is not found in Morris Lake, the larvae of Morris and Crampton have identical choices regarding subhabitat selection. Within the habitats, the *Gomphus exilis* were only found in Branches subhabitat. There are a variety of reasons that this species could prefer this specific subhabitat. According to Corbet (1980), larvae of the genus *Gomphus* are active nymphs. This means they are burrowers and hide within the substrate bottom. Gomphidae larvae lie partially buried in substrate in order to ambush their prey (Hilsenhoff 1995). Hiding in the wooden debris may not only aid in prey mechanisms, but it could also have an advantage in terms of predation. The two habitats in which this species is found are both heavily populated with predators like fish. The *Gomphus exilis* may find the Branches subhabitat to be their best defense because it restricts the accessibility of the larvae to fish predators. From the collected data, it seems that *Gomphus exilis* has a specific distribution pattern within habitats.

The species found within the Aeshnidae family were not collected in large numbers, but a variety of species were collected in the various habitats. There was only one sample collected of *Aeshna canadensis*, and it was found in the Grass Emergent Vegetation of Morris Lake (Figure 9-10). Because of the lack of comparable data, it is not possible to come to any conclusions determining the distribution preferences, if any, of this species.

*Aeshna clepsydra* larvae were collected from three different habitats. Analysis of the *Aeshna clepsydra* collection shows a dependence of this particular species to habitat type. Three of the samples were collected from the bogs (two from Tender Bog and one from Ed's Bog). The other sample was taken from Morris Lake (Figure 11-12). Because the majority of the collections were taken from Leatherleaf with *Sphagnum* subhabitat, this seems to be the area preferred by this species. With Leatherleaf with *Sphagnum* being the subhabitat of choice, it is easily explained why other subhabitats also include this species. The larvae in Morris Lake do not have the option of Leatherleaf with *Sphagnum* as a place of

Table 3: A consolidated listing of the collections, focusing on abundance of certain species within specific subhabitats. Includes subhabitat type, site, scientific name, and number collected.

| SUBHABITAT | SITE | FAMILY | SPECIES | NUMBER |
|---|---|---|---|---|
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Aeshna canadensis* | 1 |
| Branches | Morris Lake | Aeshnidae | *Aeshna clepsydra* | 1 |
| Leatherleaf with Sphagnum | Tender Bog | Aeshnidae | *Aeshna clepsydra* | 2 |
| Leatherleaf with Sphagnum | Ed's Bog | Aeshnidae | *Aeshna clepsydra* | 1 |
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Aeshna eremita* | 2 |
| Branches | Morris Lake | Aeshnidae | *Aeshna eremita* | 1 |
| Grass Emergent Vegetation | Roadside Swamp | Aeshnidae | *Anax junius* | 1 |
| Grass Emergent Vegetation | Morris Lake | Aeshnidae | *Anax junius* | 2 |
| Grass Emergent Vegetation | Crampton Lake | Aeshnidae | *Boyeria vinosa* | 2 |
| Leatherleaf Emergent Vegetation | Morris Lake | Aeshnidae | *Boyeria vinosa* | 1 |
| Branches | Morris Lake | Aeshnidae | *Boyeria vinosa* | 2 |
| Grass Emergent Vegetation | Crampton Lake | Corduliidae | *Cordulia shurtleffi* | 2 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 4 |
| Grass Emergent Vegetation | Roadside Swamp | Corduliidae | *Cordulia shurtleffi* | 1 |
| Grass Emergent Vegetation | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 1 |
| Leatherleaf Emergent Vegetation | Crampton Lake | Corduliidae | *Cordulia shurtleffi* | 3 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Cordulia shurtleffi* | 12 |
| Lily Pad Emergent Vegetation | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 6 |
| Branches | Morris Lake | Corduliidae | *Cordulia shurtleffi* | 1 |
| Leatherleaf with Sphagnum | Tender Bog | Corduliidae | *Cordulia shurtleffi* | 23 |
| Leatherleaf with Sphagnum | Ed's Bog | Corduliidae | *Cordulia shurtleffi* | 12 |
| Branches | Crampton Lake | Aeshnidae | *Epiaeschna heros* | 2 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 5 |
| Leatherleaf Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca canis* | 7 |
| Leatherleaf Emergent Vegetation | Morris Lake | Corduliidae | *Epitheca canis* | 1 |
| Gravel | Trout Pond | Corduliidae | *Epitheca canis* | 14 |
| Branches | Morris Lake | Corduliidae | *Epitheca canis* | 1 |
| Grass Emergent Vegetation | Trout Pond | Corduliidae | *Epitheca cynosura* | 1 |
| Gravel | Trout Pond | Corduliidae | *Epitheca cynosura* | 1 |
| Branches | Morris Lake | Corduliidae | *Epitheca cynosura* | 1 |
| Branches | Crampton Lake | Gomphidae | *Gomphus exilis* | 10 |
| Branches | Morris Lake | Gomphidae | *Gomphus exilis* | 1 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 6 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 7 |
| Leatherleaf Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 1 |
| Lily Pad Emergent Vegetation | Crampton Lake | Libellulidae | *Ladona julia* | 6 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Ladona julia* | 6 |
| Branches | Morris Lake | Libellulidae | *Ladona julia* | 5 |
| Grass Emergent Vegetation | Crampton Lake | Libellulidae | *Leucorrhinia frigida* | 2 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 39 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Leucorrhinia frigida* | 12 |
| Grass Emergent Vegetation | Morris Lake | Libellulidae | *Leucorrhinia frigida* | 1 |
| Leatherleaf Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 7 |
| Lily Pad Emergent Vegetation | Morris Lake | Libellulidae | *Leucorrhinia frigida* | 3 |
| Gravel | Trout Pond | Libellulidae | *Leucorrhinia frigida* | 17 |
| Grass Emergent Vegetation | Trout Pond | Libellulidae | *Leucorrhinia hudsonica* | 2 |
| Leatherleaf with Sphagnum | Tender Bog | Libellulidae | *Leucorrhinia hudsonica* | 64 |
| Leatherleaf with Sphagnum | Ed's Bog | Libellulidae | *Leucorrhinia hudsonica* | 62 |
| Grass Emergent Vegetation | Roadside Swamp | Libellulidae | *Libellula quadrimaculata* | 4 |
| Leatherleaf Emergent Vegetation | Trout Pond | Libellulidae | *Libellula quadrimaculata* | 1 |
| Gravel | Trout Pond | Libellulidae | *Libellula quadrimaculata* | 1 |
| Grass Emergent Vegetation | Morris Lake | Corduliidae | *Somatochlora williamsoni* | 2 |
| Mud and Leaves | Crampton Lake | | | 0 |
| Mud and Leaves | Morris Lake | | | 0 |
| Leatherleaf on Tree | Crampton Lake | | | 0 |
| Leatherleaf on Tree | Morris Lake | | | 0 |
| Sand and Rock | Crampton Lake | | | 0 |
| Sand and Rock | Tenderfoot Lake | | | 0 |
| Gravel | Crampton Lake | | | 0 |
| Gravel | Morris Lake | | | 0 |
| Branches | Trout Pond | | | 0 |
| Branches | Roadside Swamp | | | 0 |

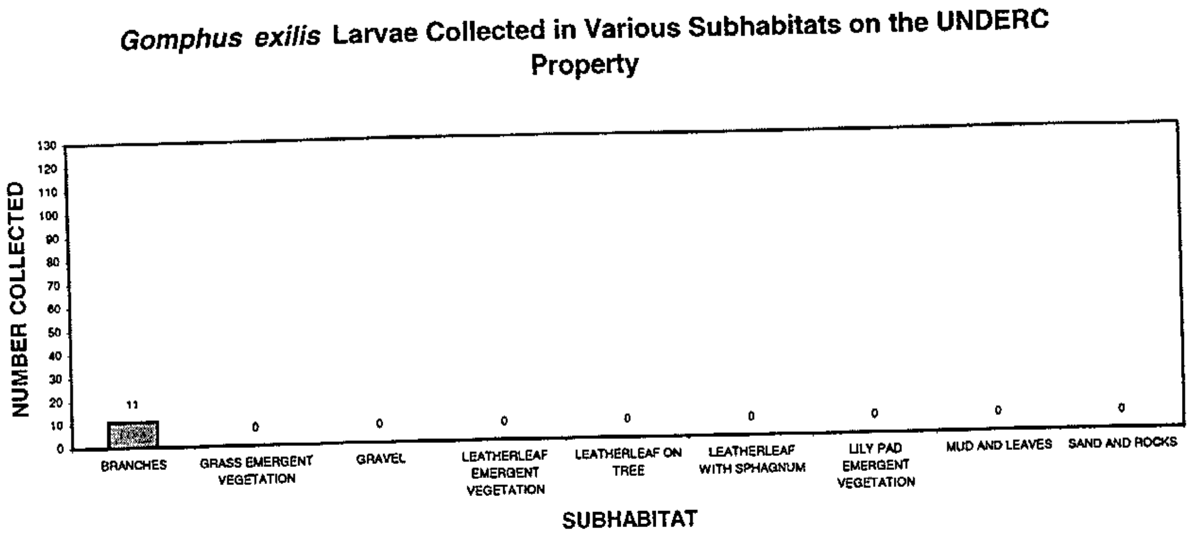


**Figure 7:** Number of *Gomphus exilis* collected in each subhabitat.

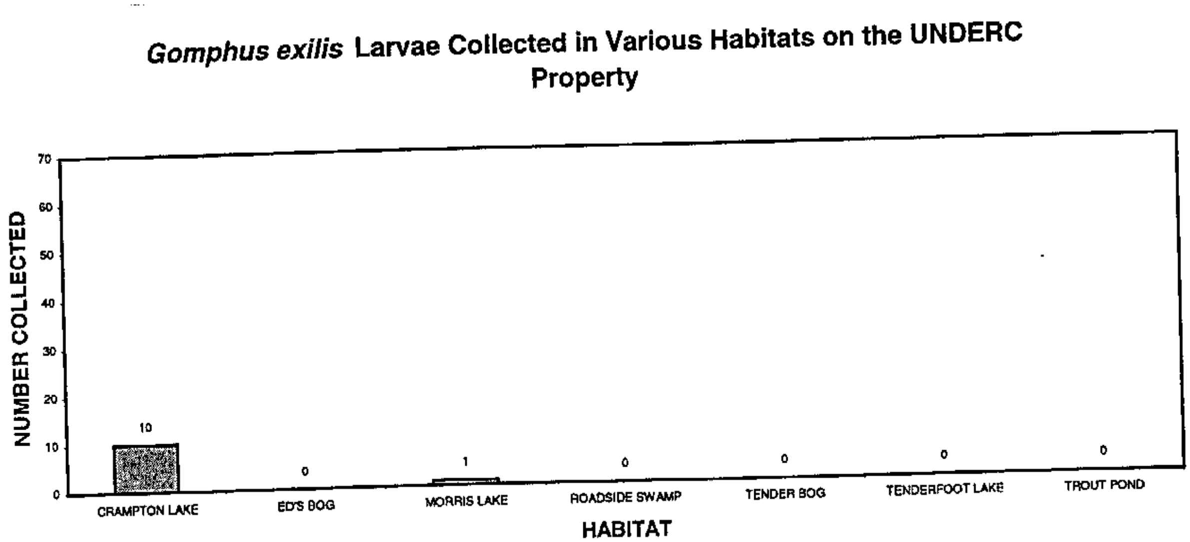


**Figure 8:** Number of *Gomphus exilis* collected in each habitat.

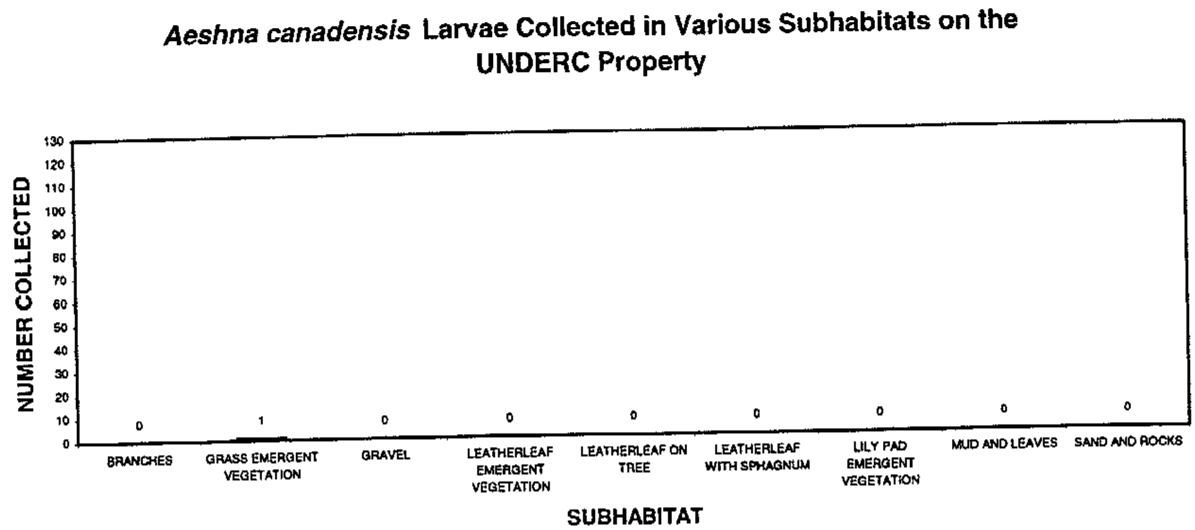


**Figure 9:** Number of *Aeshna canadensis* collected in each subhabitat.

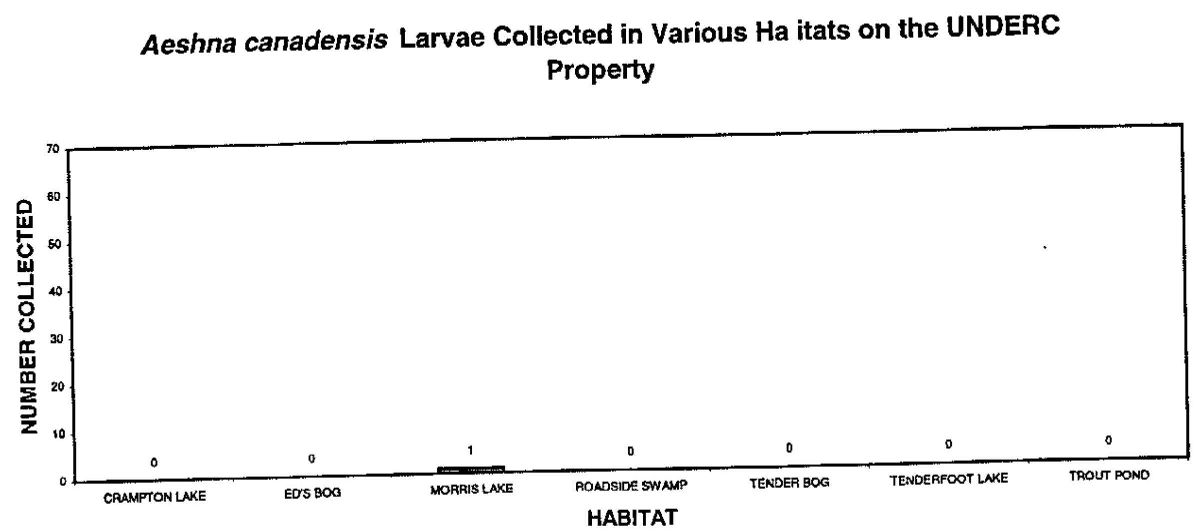


**Figure 10:** Number of *Aeshna canadensis* collected in each habitat.

existence, so they must choose a different location. The collection out of Morris Lake was taken from the Branches subhabitat. This selection may be due to one of the main differences between Morris Lake and the bogs—the presence or absence of fish. The larvae in Tender Bog and Ed's Bog do not have to encounter fish as predators because bogs are too acidic to have any fish present. On the other hand, the larvae found in lakes like Morris Lake have to deal with fish as a major predator. Therefore, the *Aeshna clepsydra* larvae may select Branches as the best subhabitat choice because it is the most restricting defense against their major predator.

The collected *Aeshna eremita* larvae seem to contradict the idea that there is defined species distribution within different subhabitats. There were three samples of this species collected, and all were found in Morris Lake. Two of these were collected from Grass Emergent Vegetation subhabitat and one was collected from Branches subhabitat (Figure 13-14). One thing that these two different subhabitats have in common is that they have the best shielding ability from predators compared to the other options. Because of the denseness of the wood or vegetation, the larvae are able to defend themselves from fish and other predators.

There were three total *Anax junius* larvae found within the habitats. All three were collected from Grass Emergent Vegetation subhabitat (Figure 15-16). This is because the larvae of the genus *Anax* most commonly inhabit areas were they climb on the vegetation (Hilsenhoff 1995). There seems to be a preference involved with this species because not only were the samples found in the Grass Emergent Vegetation of the Roadside Swamp where there are few choices in distribution, but they were also collected from Morris Lake within this subhabitat where there is a large selection of subhabitat types. The water chemistry data of these different habitats is very different which isolates subhabitat preference as the controlling variable for this specific subhabitat. Not only is the pH level different by about three points, but the temperature and conductivity are also extremely different (Table 2).

Another member of the Aeshnidae family deviates from the idea that species of dragonfly larvae have specific subhabitat distribution. *Boyeria vinosa* larvae were collected from three different subhabitats within two different habitats (Figure 17-18). The two different habitats, however, are the two larger lakes that

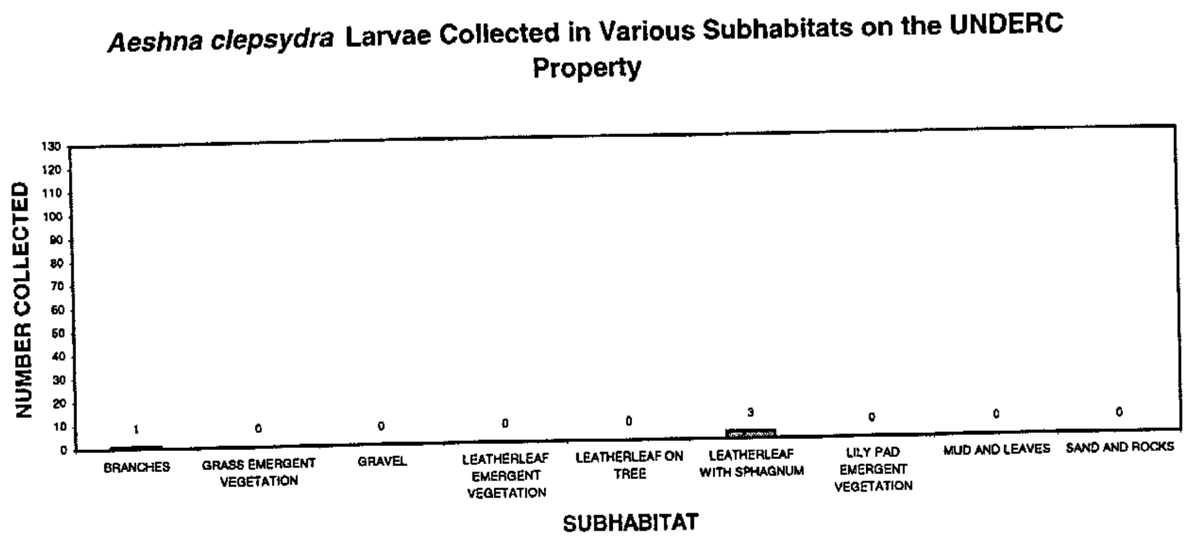


**Figure 11:** Number of *Aeshna clepsydra* collected in each subhabitat.

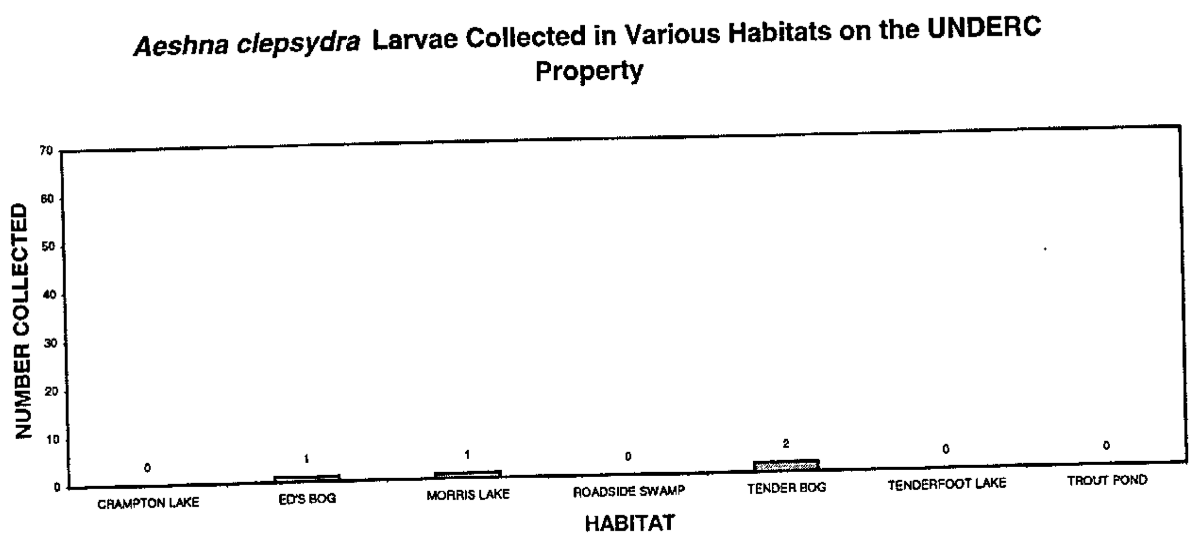


**Figure 12:** Number of *Aeshna clepsydra* collected in each habitat.

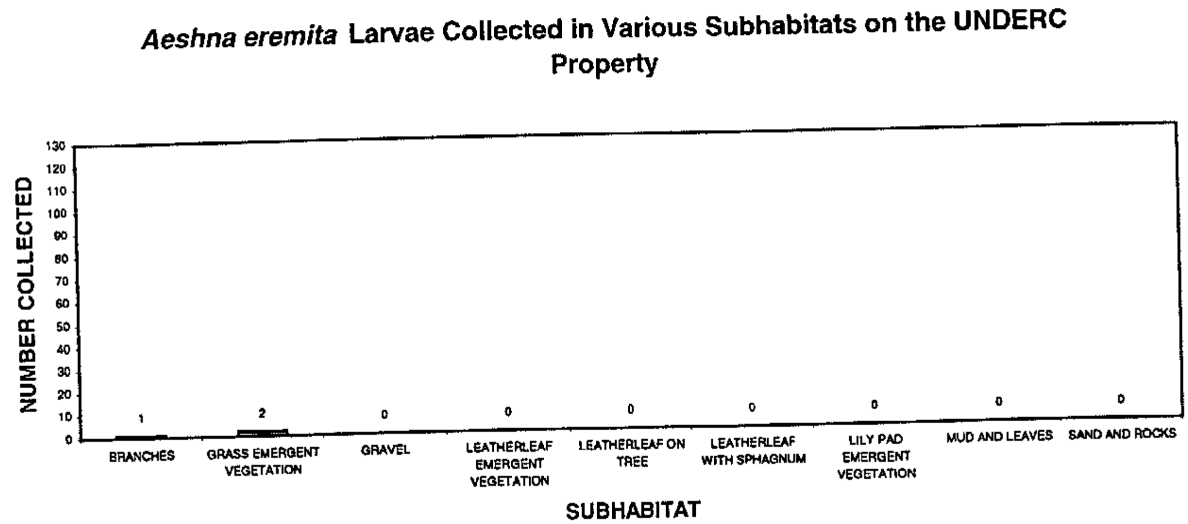


**Figure 13:** Number of *Aeshna eremita* collected in each subhabitat

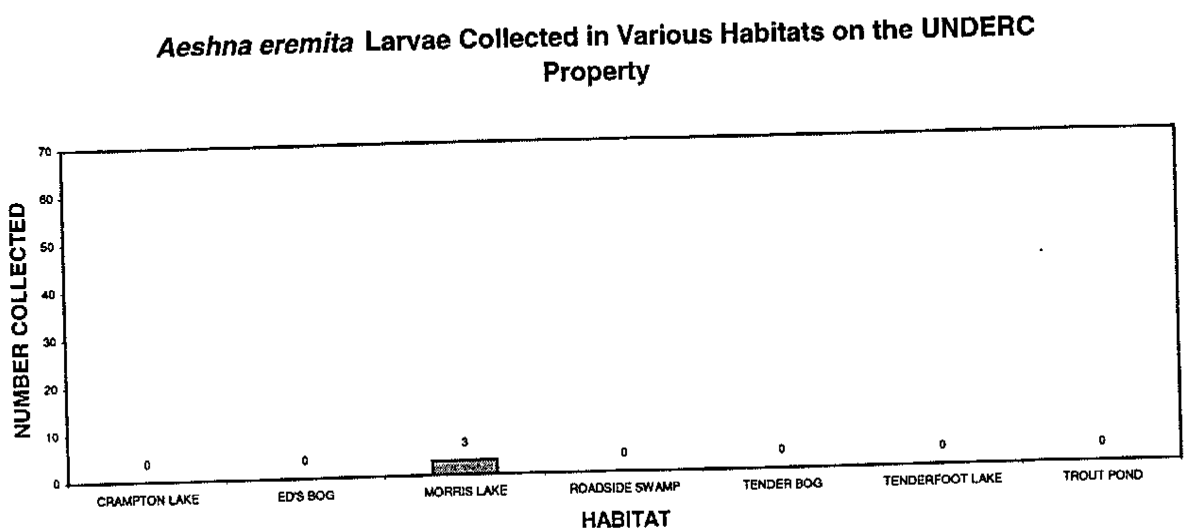


**Figure 14:** Number of *Aeshna eremita* collected in each habitat.

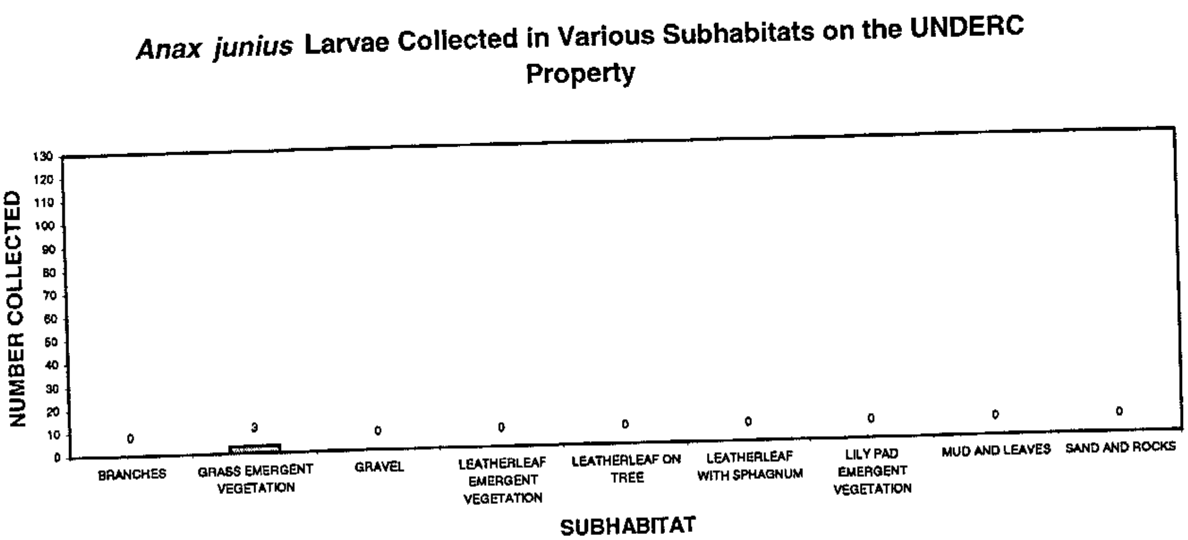


**Figure 15:** Number of *Anaz junius* collected in each subhabitat.

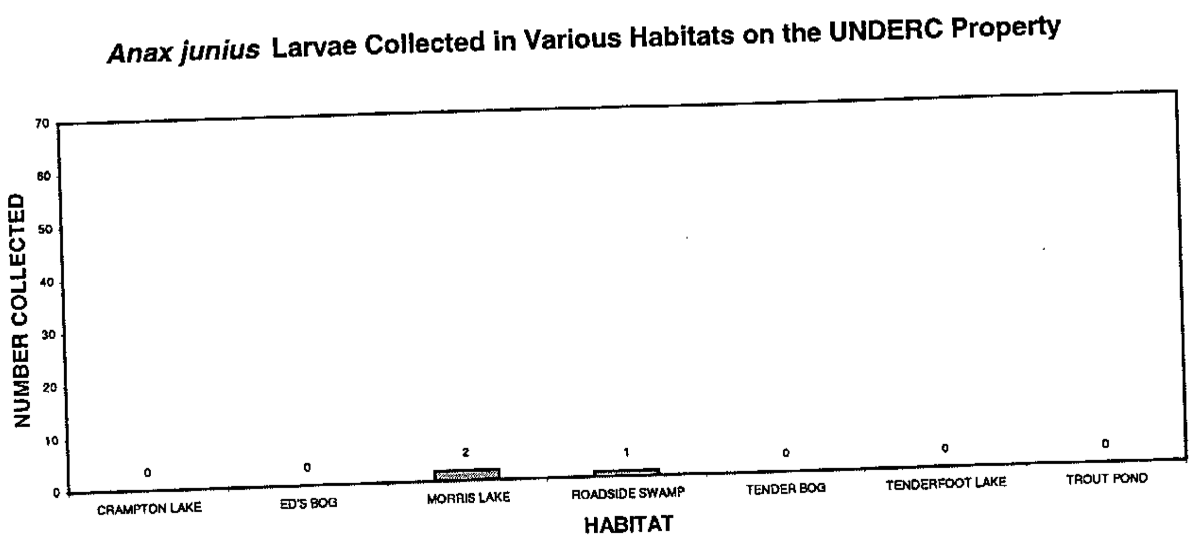


**Figure 16:** Number of *Anax junius* collected in each habitat.

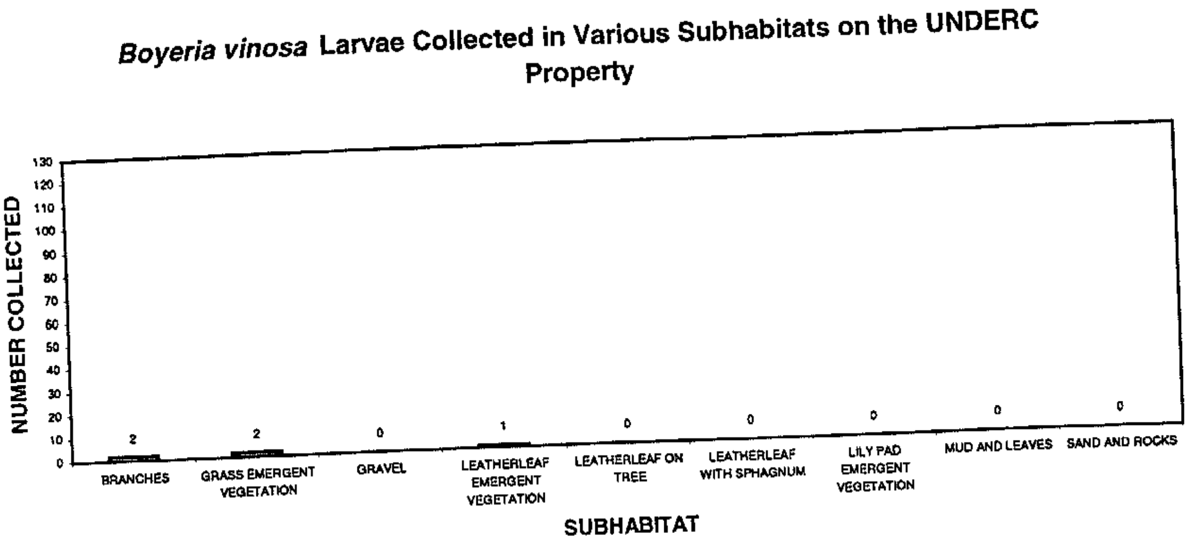


**Figure 17:** Number of *Boyeria vinosa* collected in each subhabitat.

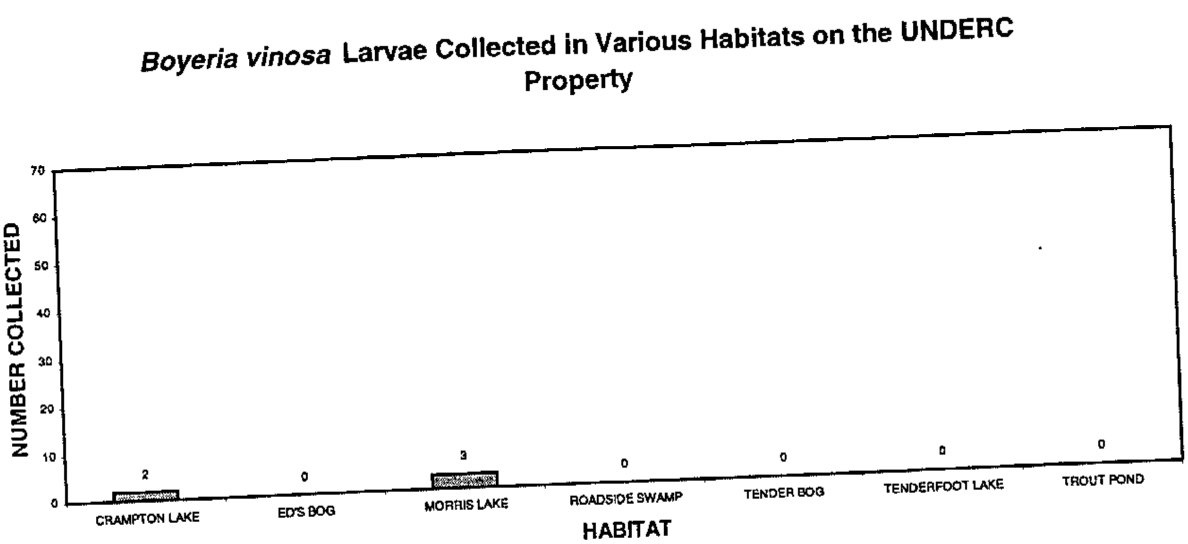


**Figure 18:** Number of *Boyeria vinosa* collected in each habitat.

have similar water chemistry and geographical properties. This tends to lead to the conclusion that this species does not seem to have a particular subhabitat preference as long as it inhabits an aquatic area of near neutral pH level and a specific temperature, but the specific distribution idea is not completely ruled out because there are still some major similarities among the chosen subhabitats (Table 2). One thing that may be shared by the three chosen subhabitats is that they are three regions that allow the larvae something to perch on. Even though many of the characteristics of these three subhabitats are very different, all three include shading from the sun, protection from predators, and hiding places from prey.

The final member of the Aeshnidae family that was collected is *Epiaeschna heros*. Only two samples were found, and they were both collected from the Branches subhabitat of Crampton Lake (Figure 19-20). While this small number does not allow for definite conclusions to be made, it does not digress from the expectation of dragonfly specificity within subhabitats. If there were more numbers that followed this existing pattern, it could be concluded that this species may prefer the woody areas of the larger lakes.

The Corduliidae family is quite abundant on the UNDERC property. For the *Cordulia shurtleffi* larvae that were collected, with the exception of one sample that was taken from the Branches subhabitat of Morris Lake, all samples were taken from the different vegetation subhabitats. Of the 65 total *Cordulia shurtleffi* collected, 50 of them were taken from one of the two leatherleaf subhabitats—this is almost 80 percent of the collected larvae (Figure 21-22). This abundant number lends great support of the preference of *Cordulia shurtleffi* toward leatherleaf vegetation. The two bogs contained a large number of the samples. If it is true that this particular species prefers leatherleaf, it would make the most sense that the majority of them were collected from the bogs considering the leatherleaf is the only type of subhabitat found in these type of regions. The Roadside Swamp provided one sample, and it was taken from Grass Emergent Vegetation. This can most logically be explained by the fact that the Roadside Swamp has no leatherleaf, so the larvae conform to the choice that has the most similarities. The remaining samples are a little more difficult to explain. Twelve of the sixteen samples taken from Trout Pond were collected from the Leatherleaf Emergent Vegetation which follows the conception that *Cordulia shurtleffi* prefer leatherleaf, but four of the samples were also taken from Grass Emergent Vegetation subhabitat. One forth of the samples from Trout Pond deviate from the hypothesis that leatherleaf is the place of choice for this species. Morris Lake has a similar pattern to Trout Pond; six of the fourteen collections were from Leatherleaf Emergent Vegetation as expected, but one was also found in the

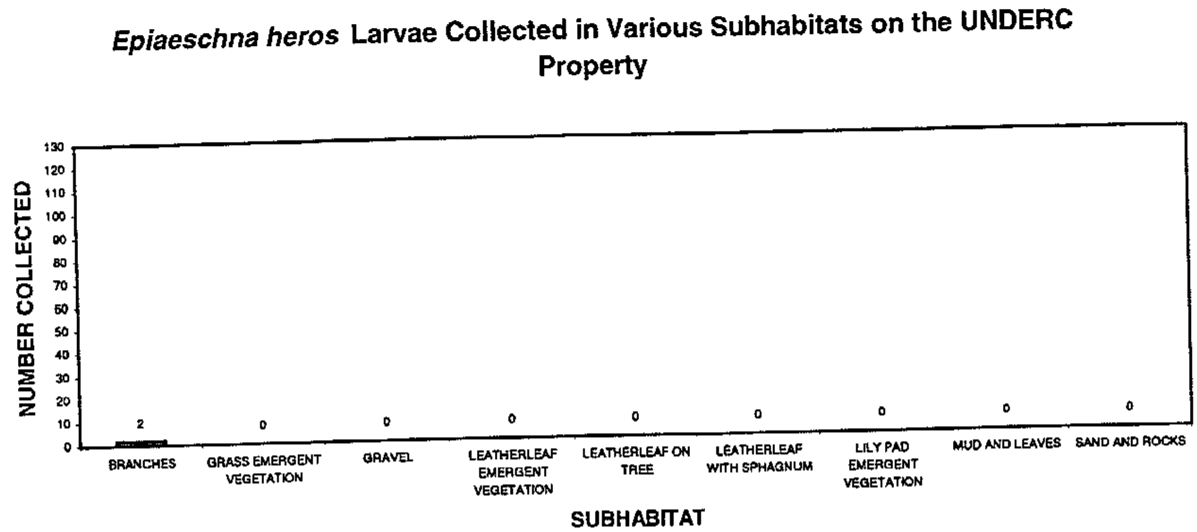


**Figure 19:** Number of *Epiaeschna heros* collected in each subhabitat.

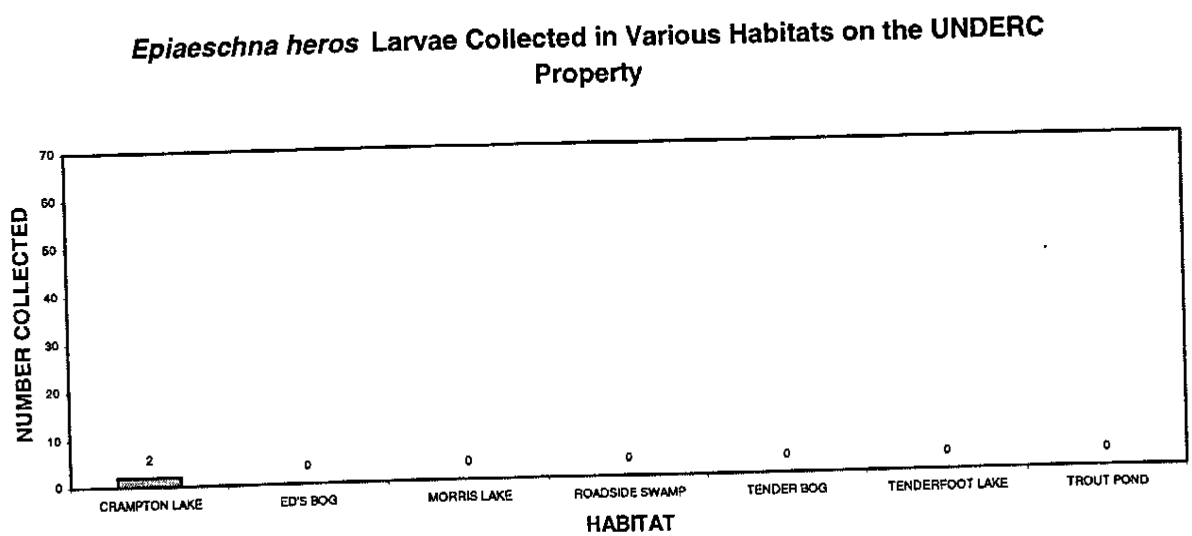


**Figure 20:** Number of *Epiaeschna heros* collected in each habitat.

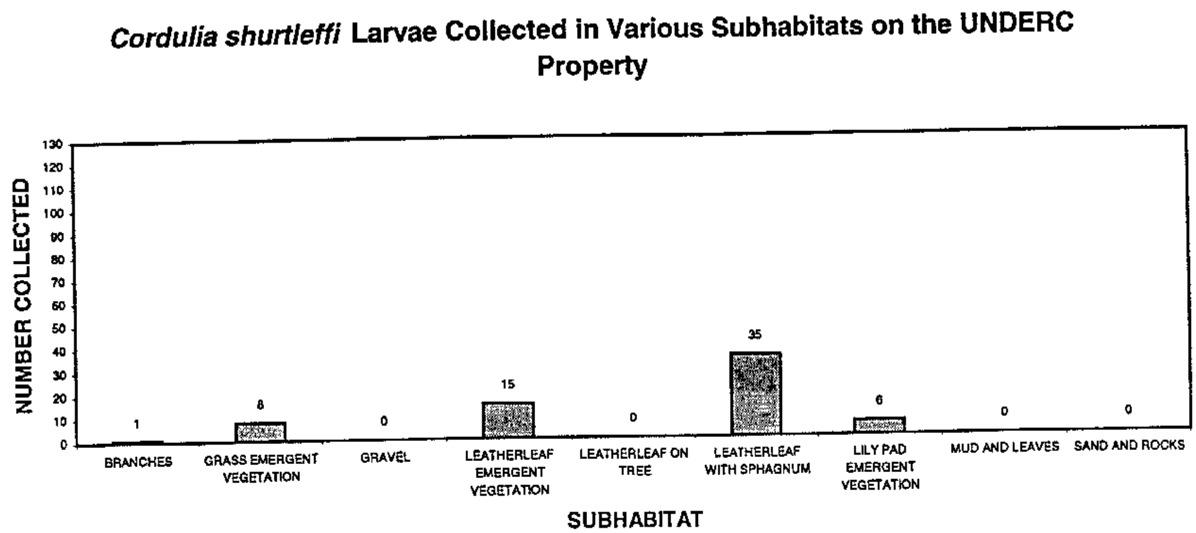


**Figure 21:** Number of *Cordulia shurtleffi* collected in each subhabitat.

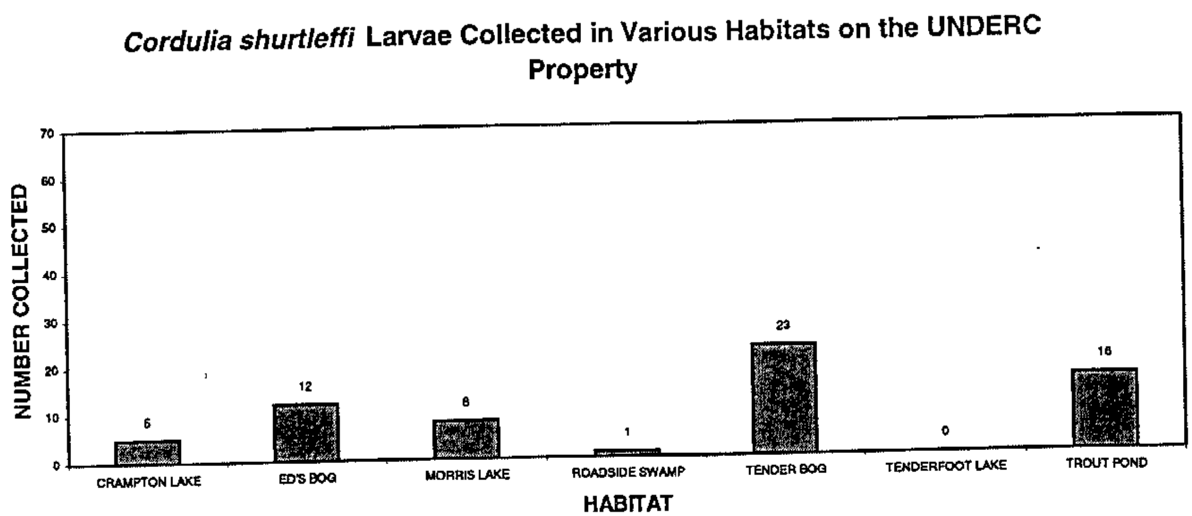


**Figure 22:** Number of *Cordulia shurtleffi* collected in each habitat.

Branches, one in the Grass Emergent Vegetation, and six in the Lily Pad Emergent Vegetation. Crampton Lake also shows that the larvae not only inhabited leatherleaf, but many also reside within Grass Emergent Vegetation subhabitat. These three examples seem to disprove the idea that *Cordulia shurtleffi* have a definite distribution preference toward leatherleaf. It is better supported that this species prefers vegetation subhabitats in general, while they may slightly prefer leatherleaf over alternatives like lily pads and grass. *Cordulia shurtleffi* larvae were found in all of the habitats with the exception of Tenderfoot Lake (which was only studied to the extent of its Gravel subhabitat). This rules out habitat type as the determinant of the distribution of larvae.

*Epitheca canis* does not show any patterns of distibution within the different subhabitats. Twenty-six of the twenty-eight samples collected were taken from Trout Pond in three different subhabitats. While half of these were taken from the Gravel subhabitat that contains no vegetation, the remainder were found in vegetated areas. The two remaining samples were taken from Morris Lake, and one of these was taken from Branches (Figure 23-24). This makes four differing subhabitats in which *Epitheca canis* were taken from. Trout Pond and Morris Lake do not have similar water chemistry, so it cannot even be concluded that this species has a specific type of aquatic area preference.

*Epitheca cynosura* also fails to support the hypothesis of this experiment. There were only three collections made, but all three were found in different subhabitat types (Figure 25-26). The two habitats were again Morris Lake and Trout Pond that have very different pH levels, conductivity, and even temperature (Table 2). The three subhabitats it was collected from complete oppose each other. One is a vegetated area, one is the woody area, and one is a rocky area.

*Somatochlora williamsoni* larvae were the final species of the Corduliidae family found on the UNDERC property (Figure 27-28). Even though both samples were taken from the Grass Emergent Vegetation of Morris Lake, it is difficult to make any definite conclusions because there are no comparisons available from other habitats. This species does fail to provide data against the hypothesis, because the two collections were taken from the same subhabitat.

The members of the family Libellulidae are very abundant in the area of study, and they are mainly found crawling on bottom among debris or within the weeds (Hilsenhoff 1995). *Ladona julia* samples were taken solely from Crampton Lake and Morris Lake (Figure 29-30). This seems to show a preference of this certain species to neutral, larger lakes with varying subhabitat choices. The majority of the samples were taken from the Grass and Lily Pad Vegetation of the two lakes. This seems to show that *Ladona julia* have a preference for vegetated and weedy areas. Even the one sample taken from Morris Lake's Leatherleaf Emergent Vegetation supports this conclusion. This preference could be due to a number of things including the fact that the female adults lay their eggs

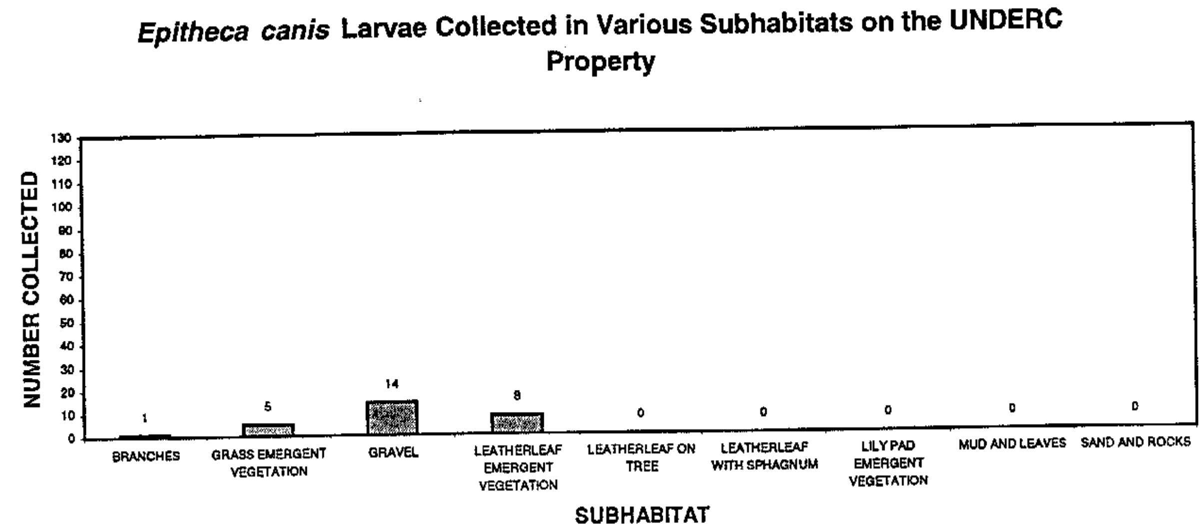


**Figure 23:** Number of *Epitheca canis* collected in each subhabitat.

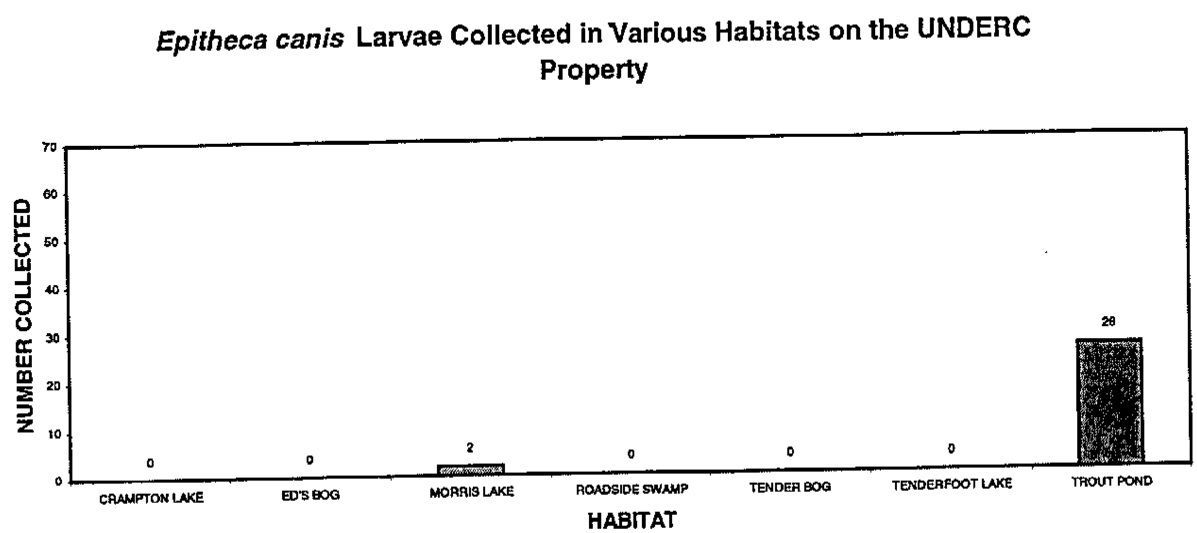


**Figure 24:** Number of *Epitheca canis* collected in each habitat.

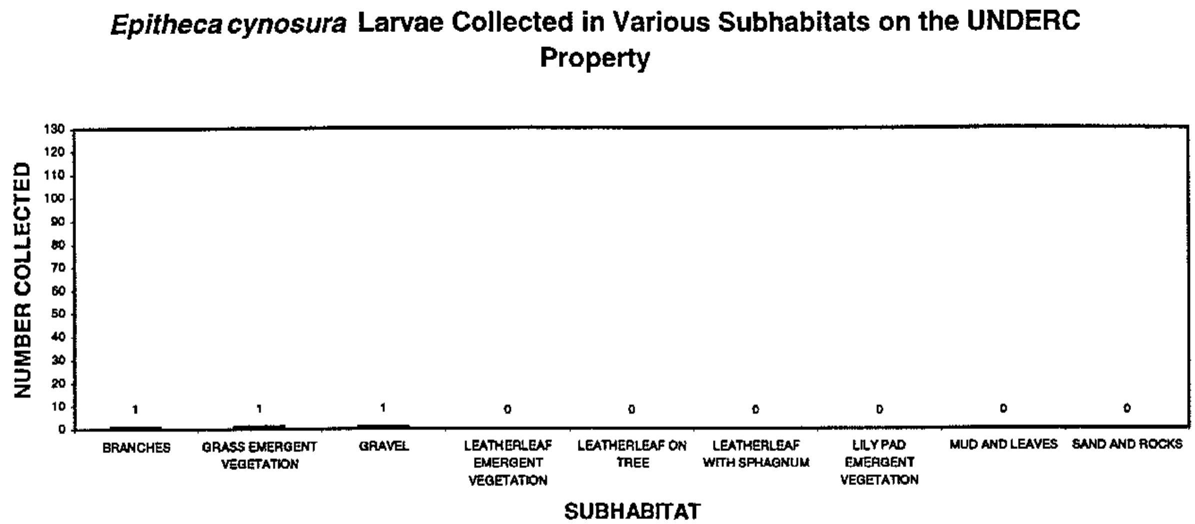


**Figure 25:** Number of *Epitheca cynosura* collected in each subhabitat.

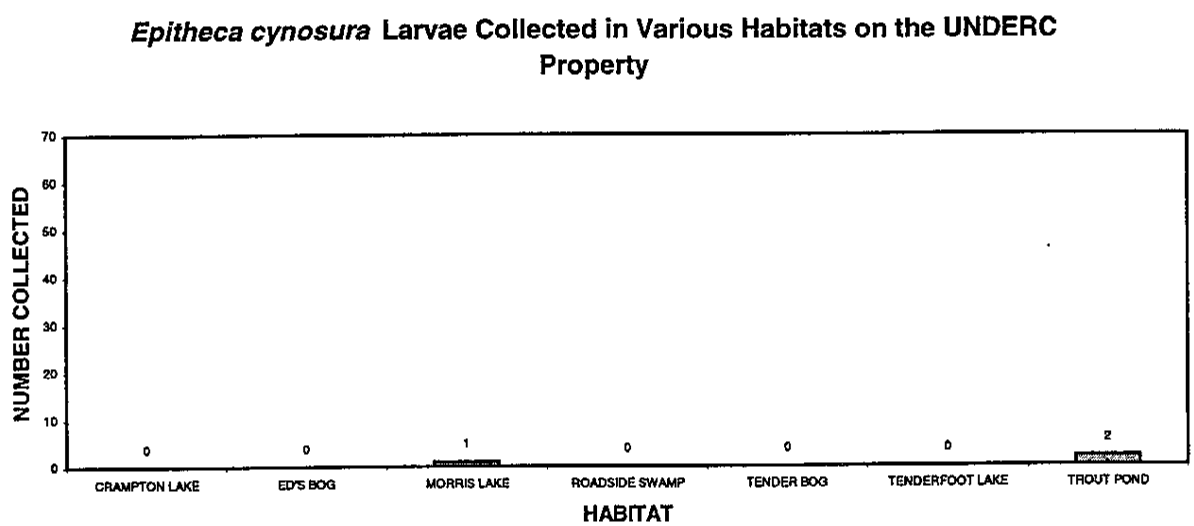


**Figure 26:** Number of *Epitheca cynosura* collected in each habitat.

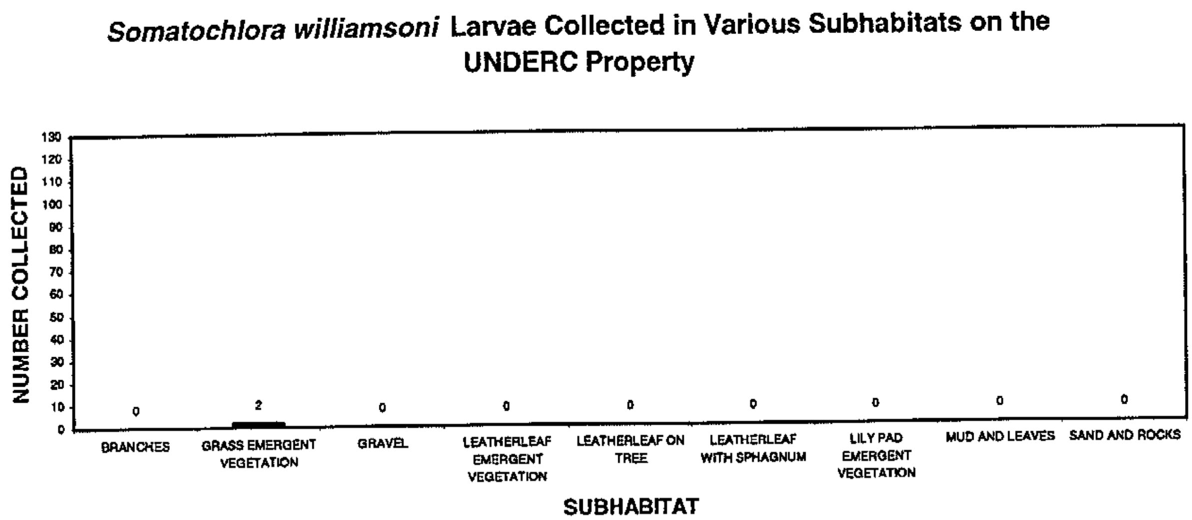


**Figure 27:** Number of *Somatochlora williamsoni* collected in each subhabitat.

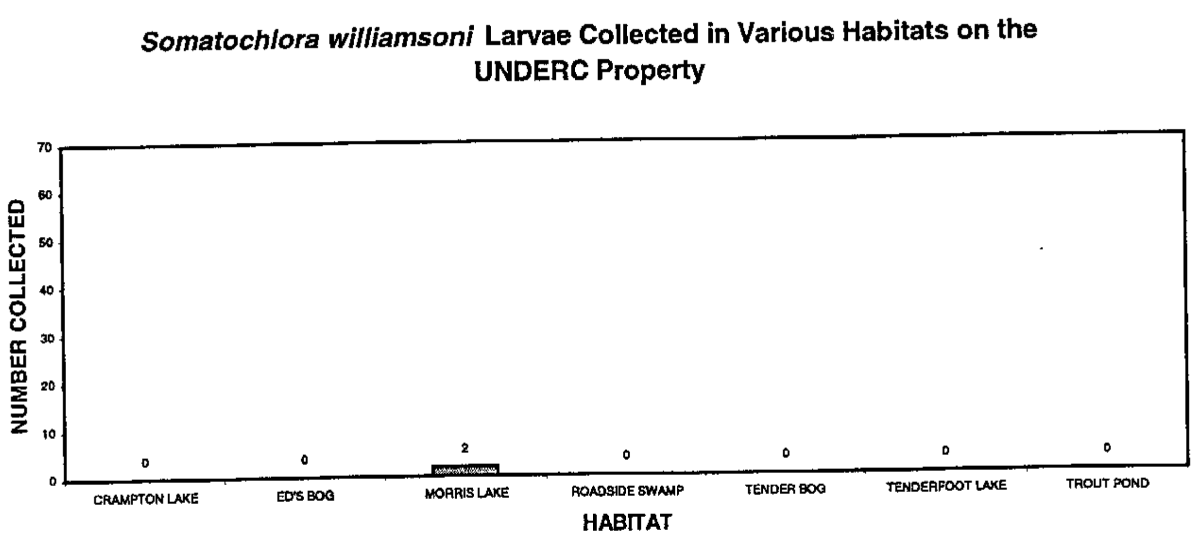


**Figure 28:** Number of *Somatochlora williamsoni* collected in each habitat.

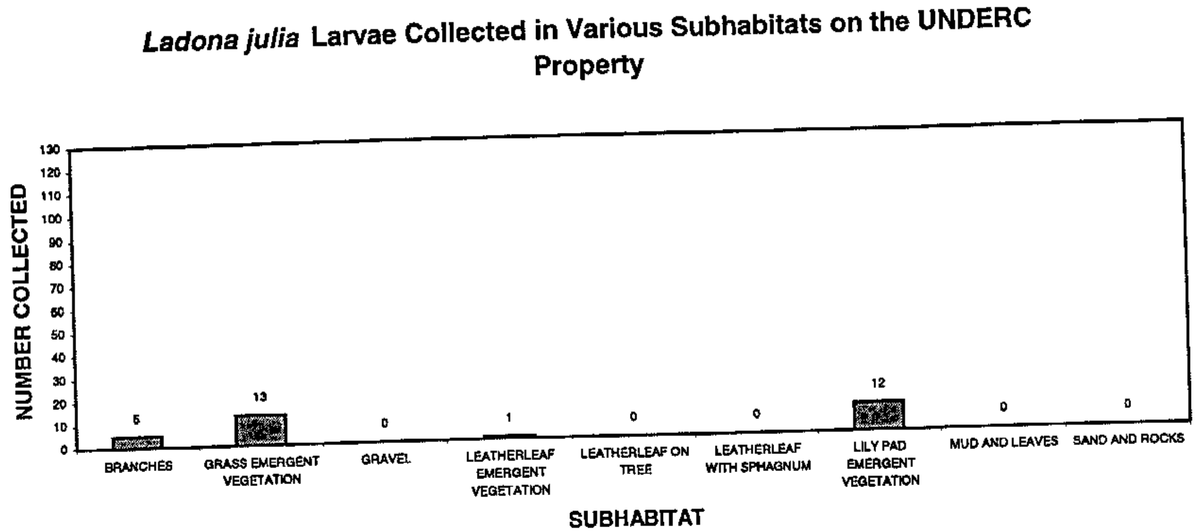


**Figure 29:** Number of *Ladona julia* collected in each subhabitat.

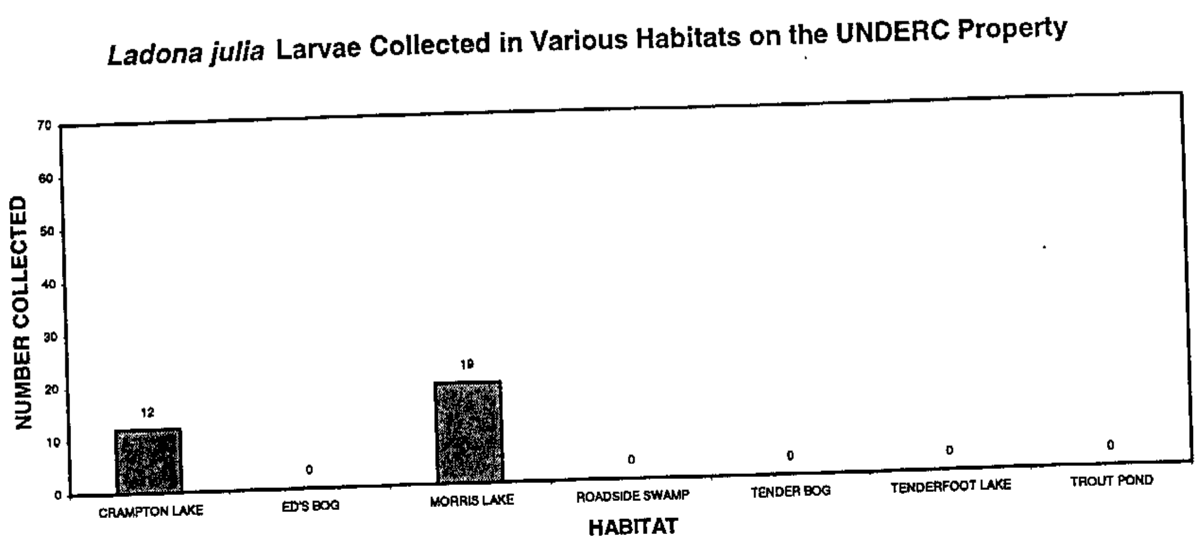


**Figure 30:** Number of *Ladona julia* collected in each habitat.

endophytically within plant tissue. These subhabitats could also serve as protection mechanisms. The problem with using this evidence alone to explain the subhabitat behavior of *Ladona julia* is that there were also five samples taken from the Branches subhabitat of Morris Lake that contains no vegetation. The only thing this subhabitat has in common with the three vegetative areas is that it, too, provides protection for the larvae. But, if this is the reason that *Ladona julia* reside in these four distinct areas of the two lakes, it seems that the larvae would also inhabit leatherleaf on Tree and Leatherleaf with *Sphagnum* because these also provide shielding protection. There were no *Ladona julia* found within these other subhabitats, so it is not conclusive that this species has a definite preference for a specific subhabitat type.

Trout Pond and the Roadside Swamp contained the biggest number of *Leucorrhinia frigida* larvae, while Crampton and Morris Lake also provided a small number of collections (Figure 31-32). The geographical factors of the Roadside Swamp and Trout Pond are similar in many ways. They are both continuously changing wetlands with shallow parameters and muddy bottoms. They are both dense with vegetation and highly shaded by surrounding trees. The pH levels of the two habitats are slightly acidic making fish presence slim to none in the two areas (Table 2). Within all four areas of collection, the majority of the samples were taken from the Grass Emergent Vegetation subhabitats. At first glance, this would strongly support this subhabitat as being the area of choice for *Leucorrhinia frigida*. Examination of the remaining sampled areas weakens this support. One-third of the *Leucorrhinia frigida* collected from Trout Pond were found in the Gravel. The subhabitat characteristics of these two choices are strikingly different. There are no obvious similarities between them. This makes it very difficult to find a connection between preferences of this species.

The dragonfly larvae found in most abundance were taken mainly from the two bogs (Figure 33-34). *Leucorrhinia hudsonica* seems to specifically distribute themselves in acidic conditions with relatively low conductivity among the Leatherleaf with *Sphagnum* subhabitat. There were also two collections of this species taken from Trout Pond. This raises questions to almost definite conclusion regarding the bogs. This may be explained by the underlying similarities between Trout and the bogs. Trout Pond does have an acidic pH level and slightly stained water color; these are two characteristics of bogs. The extreme number difference in collections from the bogs compared to the pond can be explained by at least two possible reasons. First of all, bogs are nearly predator-less. The extremely acidic levels within a bog prevent the accumulation of fish inhabitants. This allows larvae to thrive within these conditions. Trout Pond, on the other hand, contains vertebrate inhabitants that feed on dragonfly larvae, making survival more challenging. Another reason for the difference is

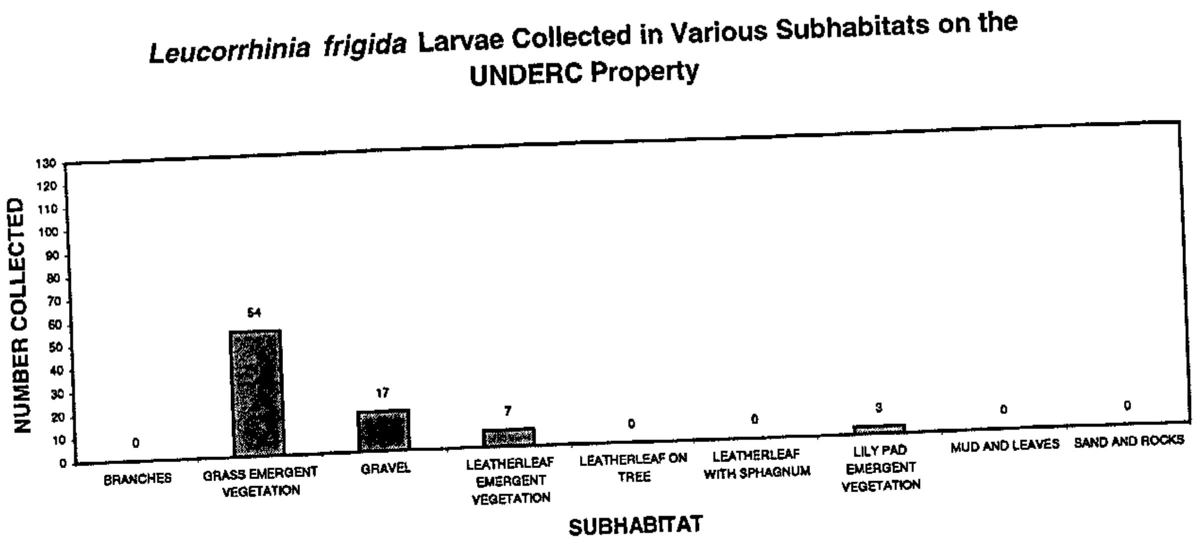


**Figure 31:** Number of *Leucorrhinia frigida* collected in each subhabitat.

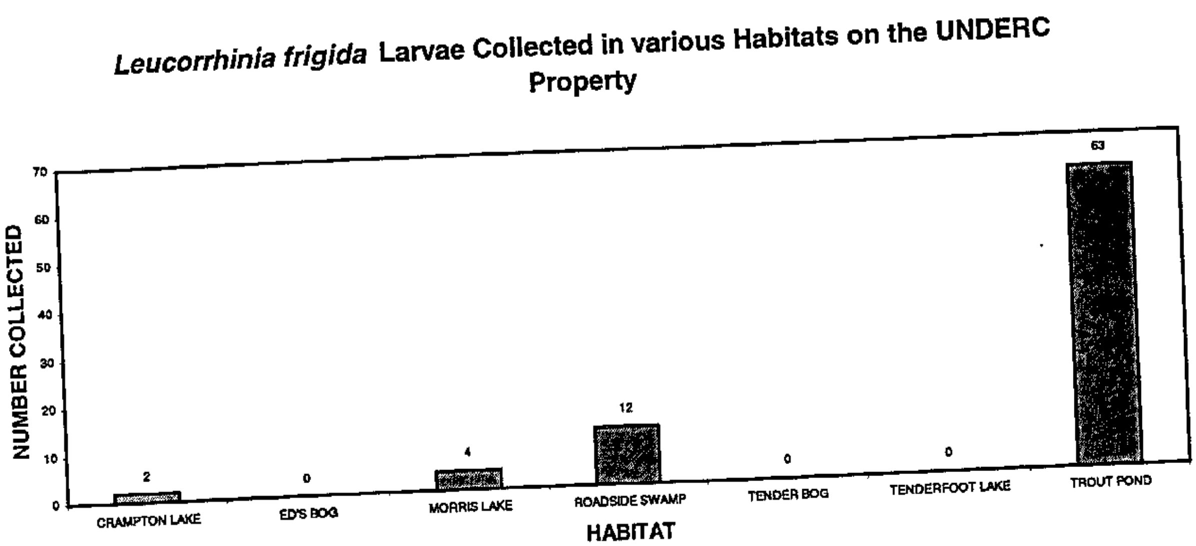


**Figure 32:** Number of *Leucorrhinia frigida* collected in each habitat.

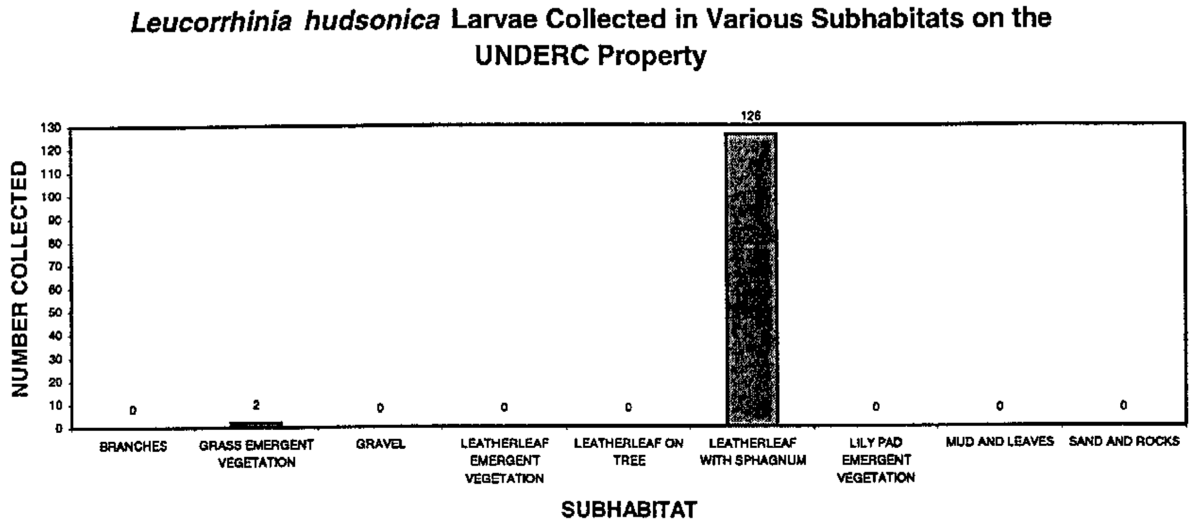


**Figure 33:** Number of *Leucorrhinia hudsonica* collected in each subhabitat.

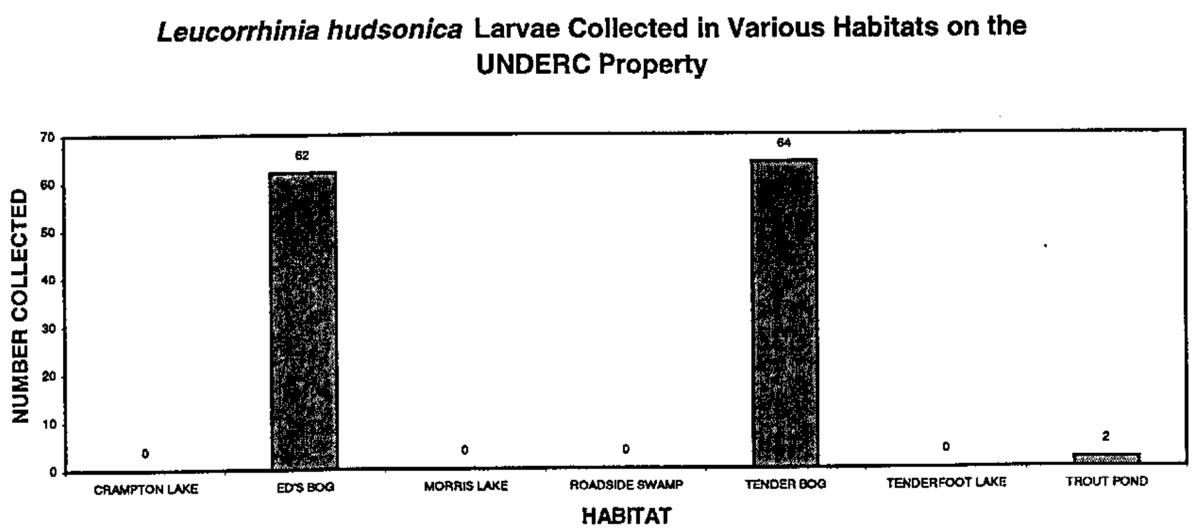


**Figure 34:** Number of *Leucorrhinia hudsonica* collected in each habitat.

because *Leucorrhinia hudsonica* shows a definite distribution preference toward Leatherleaf with *Sphagnum*. Trout Pond does not include this specific subhabitat choice; therefore, the larvae inhabit a different area in much smaller population size.

The final species type that was collected from the University of Notre Dame Environmental Research Center's property is *Libellula quadrimaculata.* This species only showed subhabitat preference within the Roadside Swamp, but the two samples taken from Trout Pond were taken from two different subhabitats resulting in this species being found in three distinct regions (Figure 35-36). While there seems to be no correlation between inner-habitat distribution, the two habitats that this species was collected from share many characteristics previously discussed.

There were three subhabitats in which no dragonflies were collected. The Leatherleaf on Tree subhabitat had no larvae present possibly because the roots of the plant barely submerged in the water. The larvae of dragonflies are totally aquatic, so this subhabitat restricts necessary water contact. Sand and Rocks and also Mud and Leaves subhabitats are the other two that lack dragonfly larvae inhabitants. The nonexistence in these areas is due to the lack of available nutrients and resources necessary for the survival of the larvae. Because there were no species found in these nonresourceful areas, it seems that the larvae have specifically not distributed themselves in these areas, providing a different type of selection.

There is another major factor that could cause dragonfly larvae to select a specific region within a habitat to live during the duration before adulthood. There is published information stating that dragonfly larvae species compete with each other for the essentials of life like food and shelter. According to one experiment, the co-existence of *P. obscurus* and *G. externus* in the same aquatic environment at relatively high densities is no doubt facilitated by the strong niche segregation between larvae. The spatial segregation may help relieve competition pressures between such species (Huggins and DuBois 1982). The number of different species found in a certain habitat is proportional to the number of available subhabitats (Figures 37-42). Crampton and Morris Lake, with eight and seven subhabitats respectively, have the largest variety of species inhabiting their parameters. As the number of varying subhabitats decreases, the number of coinciding species also decreases. Tender Bog and Ed's Bog, with only one subhabitat, each have only three different inhabiting species. The reason this trend is seen could be due to niche segregation. With more available subhabitats, more species are able to populate an aquatic area because they can spatially segregate to different regions within the area.

While there is some substantial inconsistencies when looking at each individual species, the accumulated data shows a definite trend in dragonfly

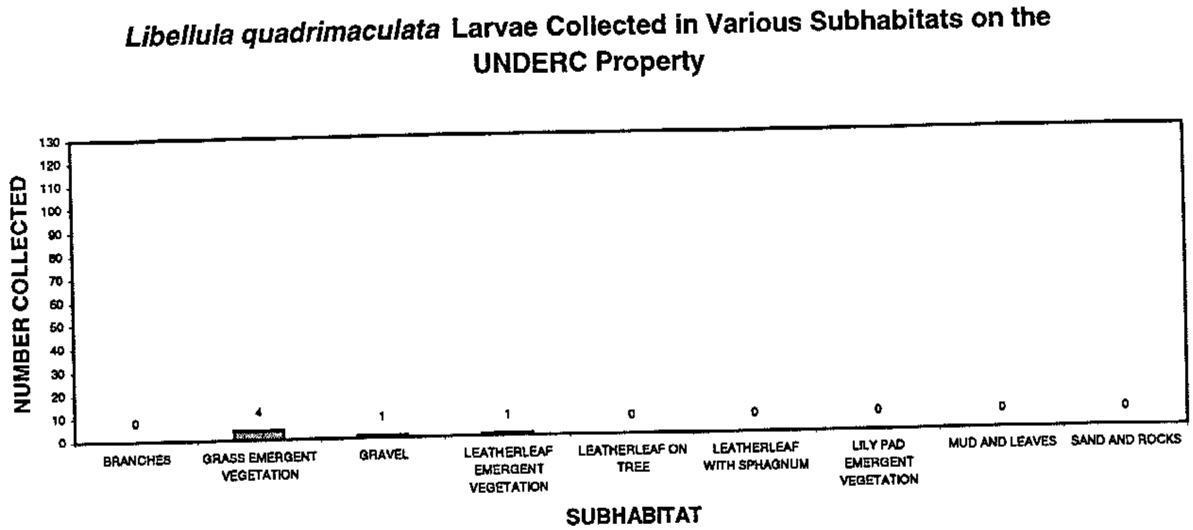


**Figure 35:** Number of *Libellula quadrimaculata* collected in each subhabitat.

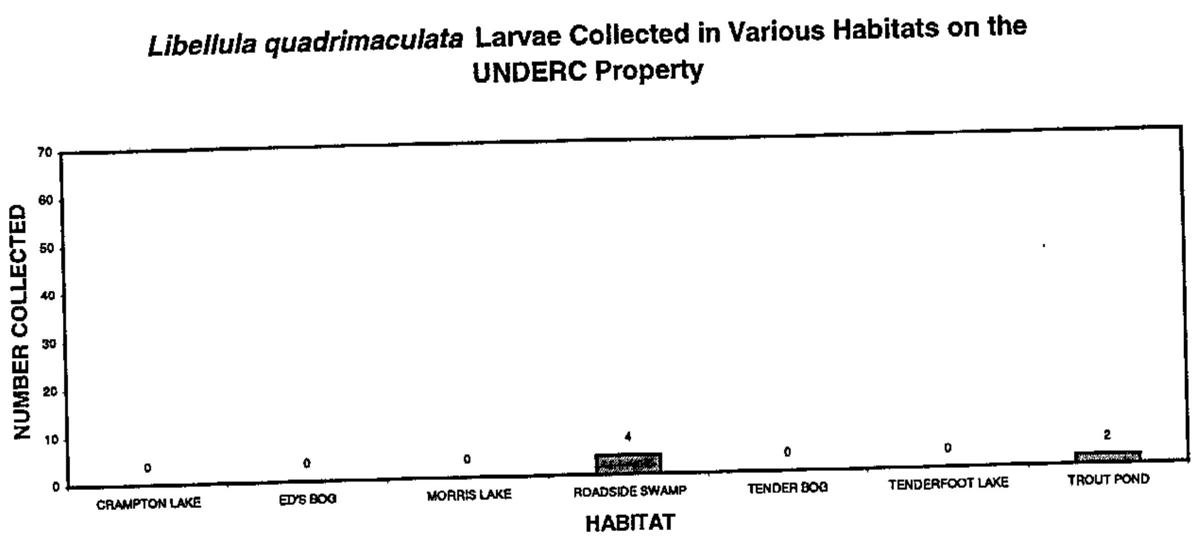


**Figure 36:** Number of *Libellula quadrimaculata* collected in each habitat.

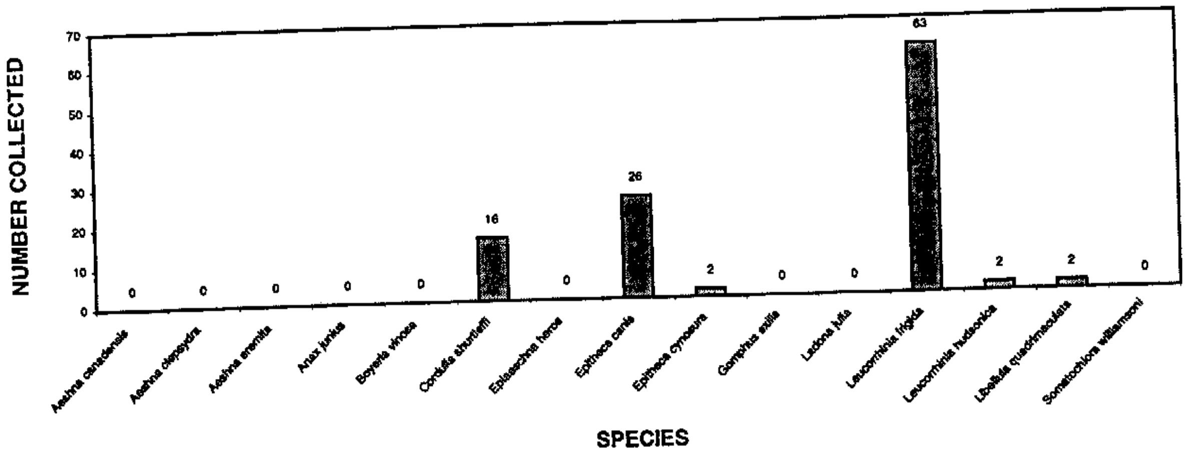


**Figure 37:** Odonata Larvae Collected in Trout Pond.

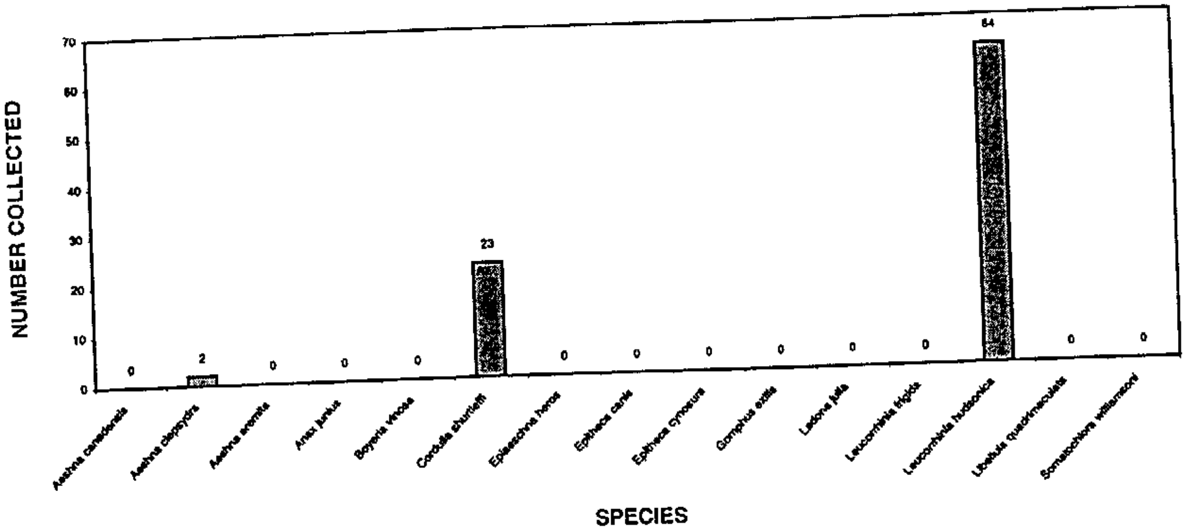


Figure 38: Odonata Larvae Collected in Tender Bog.

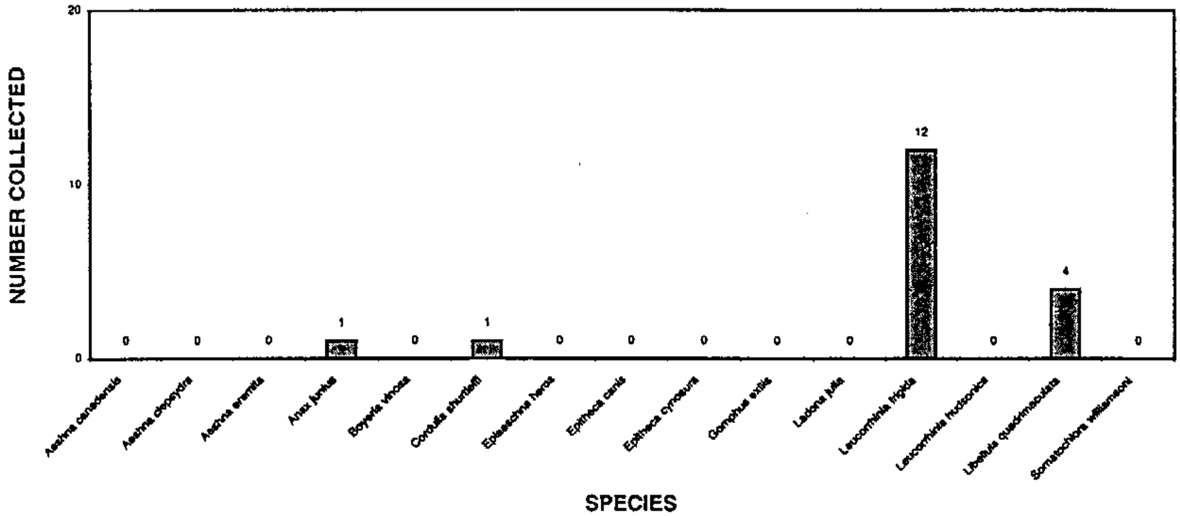


Figure 39: Odonata Larvae Collected in the Roadside Swamp.

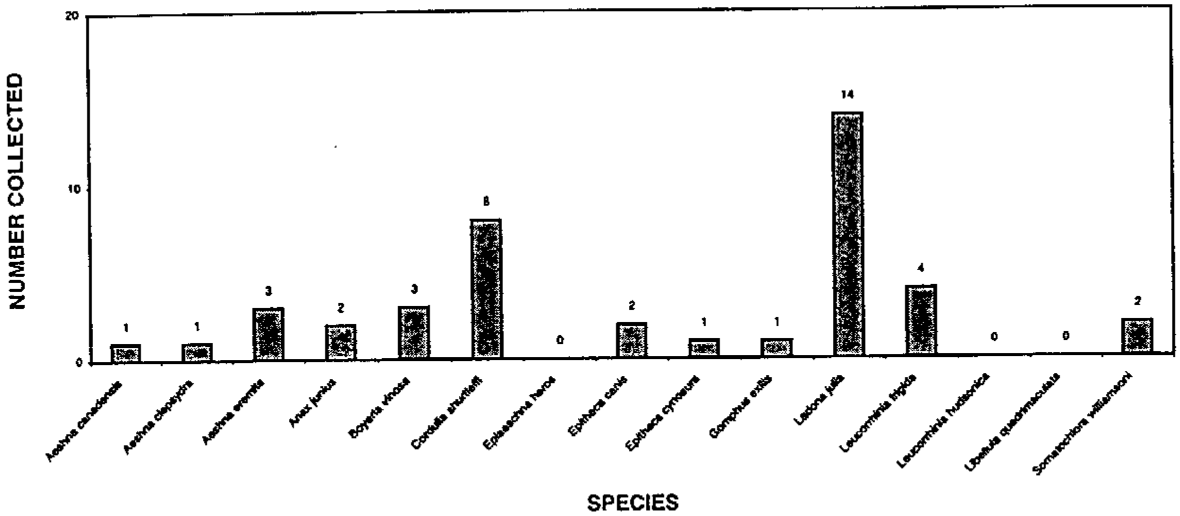


Figure 40: Odonata Larvae Collected in Morris Lake

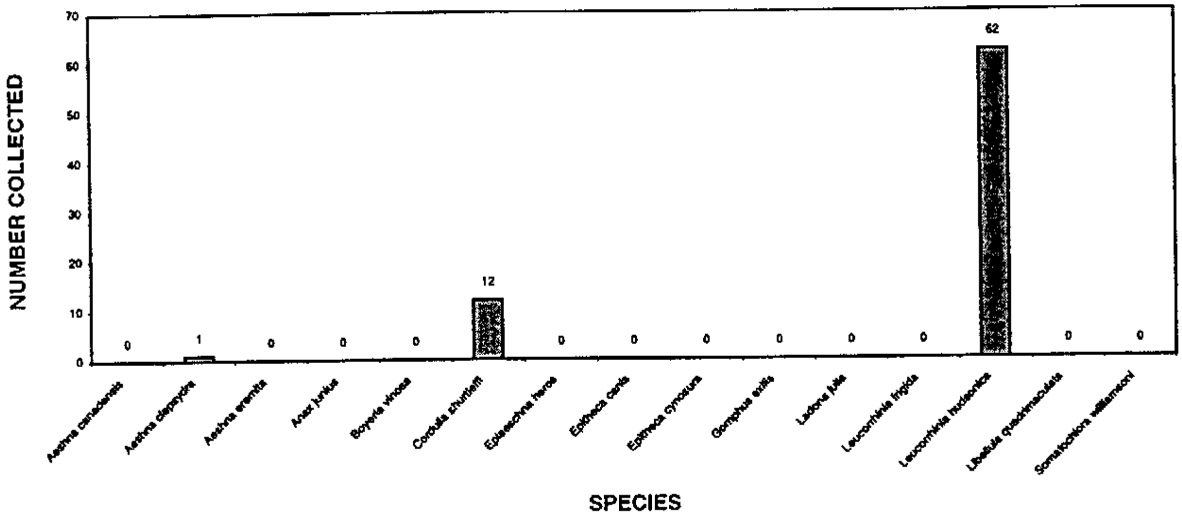


Figure 41: Odonata Larvae Collected in Ed's Bog.

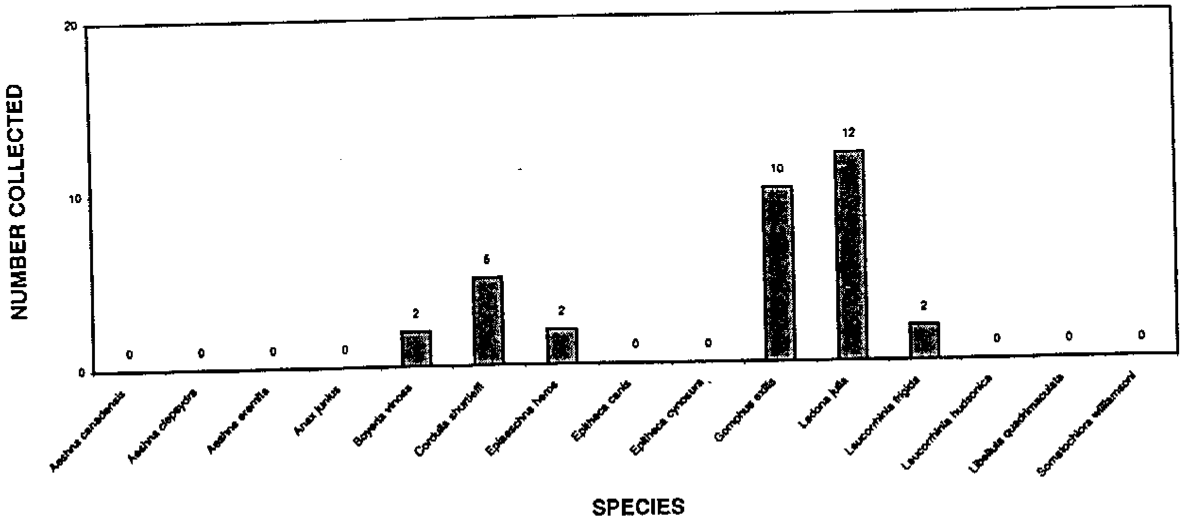


Figure 42: Odonata Larvae Collected in Crampton Lake.

larvae toward a specific distribution pattern among varying subhabitats. The species that do not follow a definite trend can be categorized as generalists; these include *Cordulia shurtleffi*, *Ladona julia*, *Aeshna eremita*, *Boyeria vinosa*, *Epitheca canis*, *Epitheca cynosura*, and *Libellula quadrimaculata*. The distribution of these species seems to be more dependent on habitat type than subhabitat type. The remaining species all seem to follow a specific selection toward certain subhabitat characteristics; they can be categorized as specialists because they are specialized toward specific regions. When competition within the Odonata order is also considered, it is impossible to deny the correlation between subhabitat segregation and species abundance. While there is not a defined explanation for the exact location of each species of dragonflies, the subhabitat characteristics play a definite role in the preferences of the larvae toward a certain area within a habitat. Factors like pH level, conductivity, temperature, predator presence, and interspecific competition are all viably explanations for the trend of certain dragonfly species to inhabit specific subhabitat regions within various habitats.

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