Do tadpoles move throughout all a pond, or do they restrict themselves to certain microhabitats?

BIOS 569: Practicum in Field Biology

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Abstract:

We tested the movement of tadpoles (*Rana Sylvatica*) for three different types of ponds: complex irregular shape, oval perfectly shape and different canopy cover. The factors used to answer the major question are vegetation, predators, center and shore and water depth; our response variables are diurnal and nocturnal movement. Tadpoles were injected with VIE in order to track their movement at night. We used ArcGIS to analyze a map for the visual movement between each pond and statistical tests to look for relationship over the different variables. There was no evidence or sufficient data to find a pattern in the movement of tadpoles but there was a difference in the movement between the three different forms of pond. We found that for bigger ponds the average of distance travel was farther and in for complex ponds there was almost no movement. Tadpole activity has a significant change in the night period, when they were most active.

Introduction:

Amphibian studies of the last twenty nine years have acknowledged the importance of these creatures. They have also made the scientific community aware that amphibian decreasing its population. Many factors are responsible for the decline of amphibians such as: ultraviolet radiation, food sources, viruses, introduction of other species to their ecosystem; as well as habitat destruction and chemical pollution (Beebee and Griffiths, 2005). These factors influence the habitat, which is rapidly changing and being destroyed. Approximately 50% of wetlands in U.S.A. are lost each year; meaning that 50% of the habitats of different organisms have been filled with sediment, contaminated, and dried out. This is one of the main factors contributing to the declining of amphibians' population. Amphibians have been used for many different analysis benefiting human beings; and are major contributors to the pond ecosystem. Let us realize that we want to conserve and protect them. (Harding 1997).

The interaction that tadpoles have with their habitat differ much in the needs like warming by the sun, the interaction with other species or the same species, sources of food.(Hampton and Duggan, 2003). The consequences of these interactions cause the tadpoles to regularly change their habitat. In previous experiments we have noticed that tadpoles prefer to remain in areas with complex structural features; but when predators are present they decide for the safest habitats. As a result, they reduce predation by broadening their range of habitat (McDiarmid and Altig, 1999). Another way to reduce predation is by the abundance of vegetation structure. It has been demonstrated that the abundance of aquatic vegetation has a potential effect in amphibians' larva survival. (Purrenhage and Boone, 2009).

A fundamental goal in ecology is to understand how these organisms circulated in their habitat; their dispersion in a pond, the environmental variation influence in the distribution of individuals of a population and how they respond to their environment in different times of day and night. We will use field experimentation to understand some of these questions. We chose to work with the family Ranidae, specifically with their young stage tadpoles. This is a typical frog also known as the wood frog; his scientific name being *Rana sylvatica.* We used an old yet extremely effective method for valuable ecological information, but that is not very common in larval anurans: marking groups. (Anholt, Negovetic and Som, 1998). Marking group has been useful for understanding home ranges of different vertebrates; since the capacity of movement affect their behavior with their habitat it's important like ecological studies.

The purpose of this experiment is to know how much they move between the pond; and different variables that can affect this movement predators, vegetation, profundity. If tadpoles prefer certain microhabitat in two different parts of the pond; vegetation near the shoreline or the deep center of the pond, if they activity behavior change in a diurnal or nocturnal preference. My hypotheses are (*i*) tadpoles will stay in the same microhabitat therefore will not travel large distance in a pond. (*ii*) They will be found in the shore were more vegetation and warmest water to regulate the body temperature. (*iii*) Their activity will be more activated during the night given that there poor visibility can disperse over the lake. (*iiii*) vegetation, predators , water depth will affect the presence of tadpoles. . For one week we will be studying three different ponds; and we will try to prove our hypothesis.

Study sites:

All three ponds included in this study are located on privately research owned land UNDERC at Land O' Lakes in Michigan. These ponds we identified like: Woodduck 1 Woodduck 2, VP-9B; there are three different long lasting ponds through the summer. The shape Woodduck 1 of the pond is the most irregular part; since it doesn't have center. It has different levels of depth because it irregular covered by vegetation (complex vegetation structure). However the other two ponds have perfectly oval shapes, differing in the canopy shade; inasmuch as Woodduck 2 has more canopy shade than VP-9B. The areas and profundity range from; Woodduck 2 with an area 234.13 m^2 and a maximum depth of 28.20cm, Woodduck 1 an areas of 188.07 m^2 and maximum profundity of 48.20 cm and VP9B area is 179.84 m^2 and a maximum profundity of 33.00cm.

Materials and Methods:

The wood frog larva will be appropriate for our project because they have tadpole size more beneficial for the study and in this time they will be reproducing and it can take them a further 61 to 115 days to undergo metamorphosis and become frogs. The tadpoles are about 4.2 - 4.8 in length it will make it easier to inject them. (Roger Conant, Joseph T. Collins 1998).

Sites location in the three pond were chosen arbitrary; being that a fully randomized sample sites might have resulted in poor coverage of the habitat we want to study through ponds. These sites were chosen to capture the major diversity of habitat through the entire pond; dealing with gather different types of profundity (shore, middles area and deepest) and abundance of vegetation. We placed approximately to nineteen to twenty traps in each pond; with a minimum distance of two meters apart from each other. The tadpole's traps were metal cylinder with two funnel opening cone-shaped of 4.6 diameter on both sides, for the tadpole to come in but not be able to get out, this traps have tree buoys in both side so that traps will float in the water.

For the identification method we used a modern method for of marking called Visible Implant Elastomer Tags (VIE). This is some kind of substance containing a two-part silicone based material that is mixed immediately before use. The colors that we have for this experiment are: the fluorescent ones are yellow, pink, orange, which can be easily noticed by VI light; and non-fluorescent black, white, and purple, blue. All of these colors give a total number of 49 unique combinations of color; therefore we can make one unique combination for each trap; each site with a trap had a label flag with the combination of color.

For the field was needed a cooler with ice for the needles, for the reason that the VIE must be in refrigeration after being mixed, a square with floating to facilitate the injection process, data sheet with; date, time, weather, pond, sites, number of tadpoles, number marked, number recapture, recapture color and predators and the VI light. The procedure on the field was to put the tadpoles of the trap in the floating square we verify if we had any recapture if they were no; next step was implanted the VIE. We injected them beneath translucent tissue above the musculature of the tail that remains externally visible. Size of the marks was 0.2 mm wide and 1.0 mm, since the needle was 19mm long and .4 mm diameter. This was done in both side of the tadpole: left and right; according to the combination that was in the flag of the site. This procedure was done for the Woodduck 1 and Woodduck 2 every day and night for 6 days; for VP9B we did it once a day during six day.

Data analysis:

(*i*) For the first hypothesis we want to know: tadpoles move between the ponds? If they did: how far was the movement? We will measure the distance and compass direction from one of the traps to all other. With this data we work in the GIS program and get a visual distribution of the traps in the pond and the distances between each one. We marked all the traps with recapture and the distance traveled; to get an average of how much they move and compare to the area of the pond. (*ii*)The second hypothesis will be use Wooduck2 and VP9B ponds; given that Wooduck one have an irregular shape and different variation of water depth. We use a statistical test two-sample T-test to see if there is any difference in the presence of tadpoles between the shore and center of the pond. (*iii*)We will be proving our diurnal and nocturnal activity hypothesis with pair-t-test. In this case we only use Woodduck 1 and Woodduck 2, since the recollection of data for VP9B was between a periods of 24 hour. (*iv*) For our final hypothesis we want to test if there is any relationship between the different variables which are: tadpoles, predators, stems and water depth; so we did correlation between al of these variables.

Results:

During six days we got twenty-two different recaptures in all three ponds. Eleven of these were found in the same trap and the other eleven were found in a different habitat. In Woodduck 1 with an area of 188.07 m^2 were nine tadpoles move and four stay in the same site have an average movement of 0.99m^2 and a Standar Deviation 1.71. Woodduck 2 within an area of 234.13m^2 there were six tadpoles move of habitat and one stay in the same one it have a movement average of 4.68m and a Standar Deviation of 3.16 In VP9B the total area is 179.84 m^2 had one tadpole that shift from habitat and one that didn't move with an average of 3.93m^2 and a Standar deviation 5.55. In the second hypothesis we find that for Woodduck 2 there wasn't any statistical difference in the presence of tadpoles in center neither in shore but it is marginally significant ($p=0.06$, $df=11.71$); on VP9B did have a significant relationship between the difference of habitat that Tadpoles prefers ($p< 0.05$, $df= 11.26$). According to our statistical test the activity of tadpoles differs during the day and night in the pond for both of the pond; Woodduck 1 ($p=.002$, $df= 19$) and for Woodduck 2 ($p<0.05$, $df= 18$). Trying to find relations between the variables tadpoles, stems, water depth, predators per pond, we found that for VP9B the correlation between tadpoles and predator have a statistical significance ($p=.009$, $df= 6$) and for tadpoles and water depth ($p=.004$, $df= 6$); but for Woodduck1 and Wooduck 2 none of this variables have a statistical significance relation ship between them.

Discussion:

The movement of tadpoles between a pond doesn't demonstrate a significant patter in they movement between Woodduck1 (Figure 1), Woodduck 2 (figure 2), VP9B (figure 3). We can explain these different by the habitat structure; we can notice that in VP9B (3.93 m^2) and Wooduck 2 (4.68m^2)there average for the distance traveled are very close to each other; meaning that the pool shape and the poor complex vegetation structure is increasing the tadpoles movement .We most be familiar with the fact that tadpoles are most common stationary, and movement can cost them lost of energy and exposure predation. So there must have a good motive for changing and traveling between the pond; to shift patches of habitat mostly for food sources. On contrary, some of the reason that tadpoles didn't move as much ($0.99m^2$) in Woodduck 1 can attribute to the cause that tadpoles don't want to be exposure to drought and other climatic conditions; since the habitat doesn't have a center and differ many in the water depth though all the pond. (Kentwood David Wells, 2007)

Our statistical result for our second hypothesis has rejected our prediction about the preference of the shore. There have been many studies proving the preference of tadpoles for a complex habitat where they can camouflage and regulate body temperature. This wasn't the case for VP9B that have statistical significance (Figure 4) in the preference of the center of the pond; although Woodduck 2 doesn't have a sadistically significant is in the merge of significance and (figure 5) we can notice that have a trend to the center. A big difference between two pond is in the abundance of tadpoles in the pond and the canopy cover. In support for the abundance of tadpoles in VP9B is that an open canopy cover are associated with the performance and abundance of amphibians, since an open canopy have highest temperature that accelerates growth rates of amphibians (Skelly, Freidenburg and Kiesecker, 2002). Therefore Woodduck 2 and his closed canopy cover relate that there were fewer tadpoles so this leads us that there wasn't sufficient data for Woodduck 2 to be statistical significance.

The grates relationship and significant that we found was the activity during the night. Like we predicted the data support our hypothesis for Wooduck1

(Graph 6) and Woodduck 2 (Graph 7) and there is more activity during the night. This hypothesis can be related to studies in the past as evidence that the animals in a pond increase their activity during the night in fishless ponds; begin more specific that tadpoles prefers to move in the night, one of the top reason is avoiding predators and the shift of microhabitat for food sources. The loss of vision in predators can change the foraging strategy so they are more able to move through the pond. (Hampton, Duggan, 2003) (Friedenberg and Hampton, 2001). Also found a relationship between habitat preferences in the center and diel changes only for Woodduck 1(Figure 8), demonstrating that the preference of tadpoles to the center of the pond does not differ in day or night.

For our final hypothesis we wanted to know the relationships between tadpoles, predators, stems and water depth, with a simple correlation statistical test our hypothesis was rejected. For Woodduck 1 and Woodduck 3 we didn't have any relationship between the numbers of tadpoles with: water-depth, predators and stems. We don't have a statistical significance for any of our variables; so we can infer that none of these variables are affected by each other, they are independent of each one. The only pond that we find a statistical significance was for VP9B having a relationship between the number of tadpoles and the number of predators (Figure 9) meaning that were we find more predators we didn't find many tadpoles. The other relation was between tadpoles and water-depth (figure 10) which it make sense since we' found the most number of tadpoles in the center of the pond.

This experiment can serve as a starting point for future experiments in the study of amphibian tadpole movement. Future experiment would be needed in order to know with certainty what the tadpoles are doing during the night: perhaps they are eating more, or shifting their habitat for more protection during the day. We recommend to extend the days of field work to get more data to work with and see if there is a pattern in the movement of the tadpoles. It would be more interesting if we knew the home range of *Rana sylvatica* tadpoles so we can have an idea how much they like to move in their habitat. This knowledge is of value because during the next few years the climate will continue to change so the amphibians habitat; we will need to improve and conserve habitat for nex generation of tadpoles.

Figures:

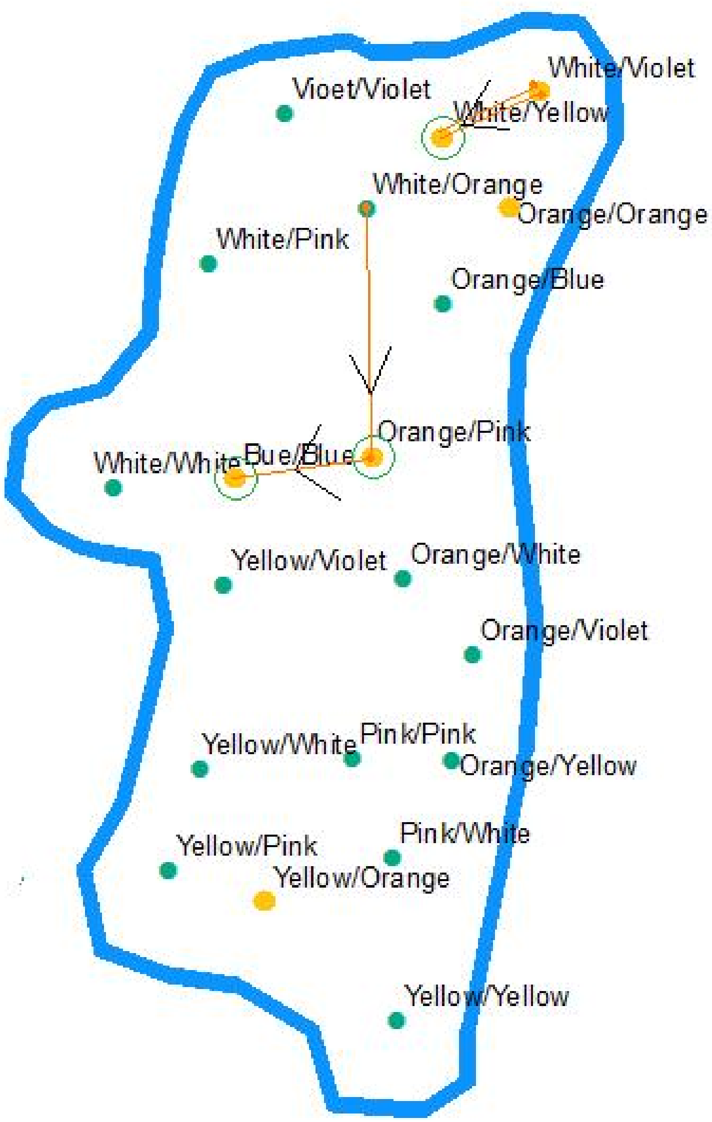

Figure 1: GIS map with the distribution of the traps and movement of tadpoles for Woodduck 1. Yellow circle represent one recapture from the same site, yellow and green circles represent two recaptures from the same site and the yellow lines with the arrows represents the movement of tadpoles from the original site to the recapture site.

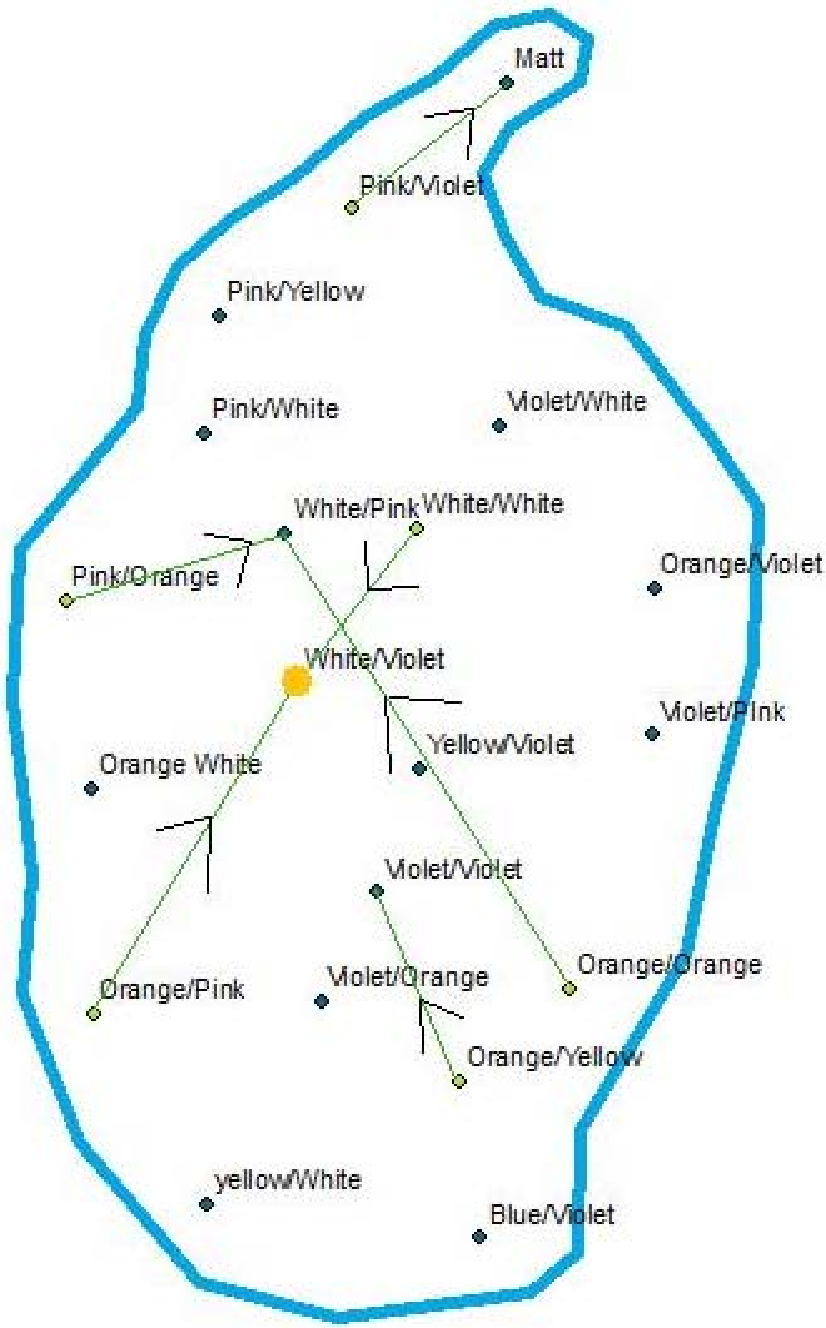

Figure 2: GIS map with the distribution of the traps and movement of tadpoles for Woodduck 2. Yellow circle represent one recapture from the same site and the green lines with the arrows represents the movement of tadpoles from the original site to the recapture site.

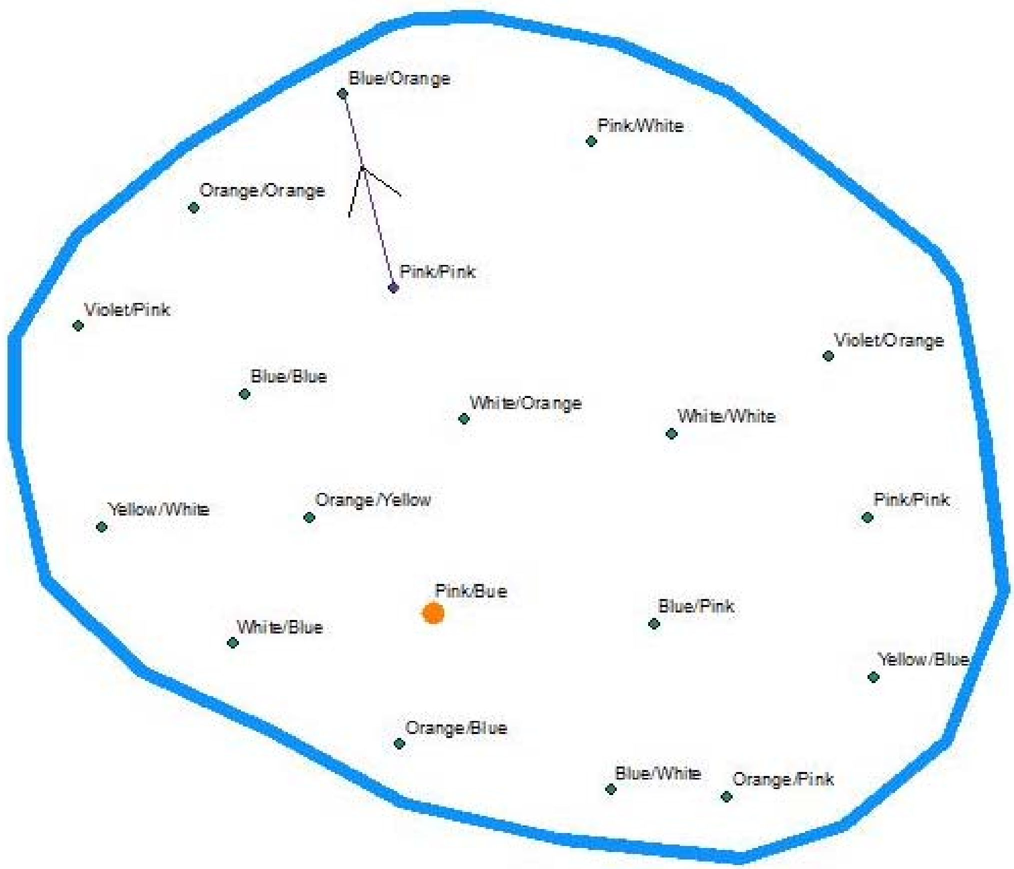

Figure 3: GIS map with the distribution of the traps and movement of tadpoles for VP9B. Orange circle represent one recapture from the same site and the purple line with the arrows represents the movement of tadpoles from the original site to the recapture site.

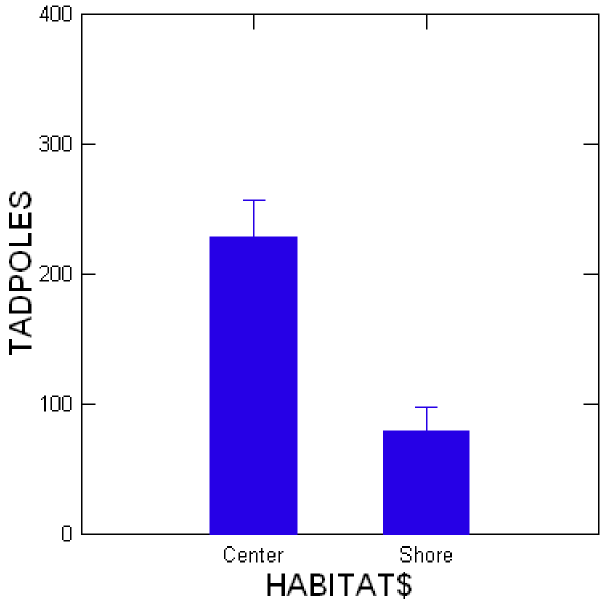

Figure 4: Bar graphs represent the number of tadpoles presence by habitat in VP9B.

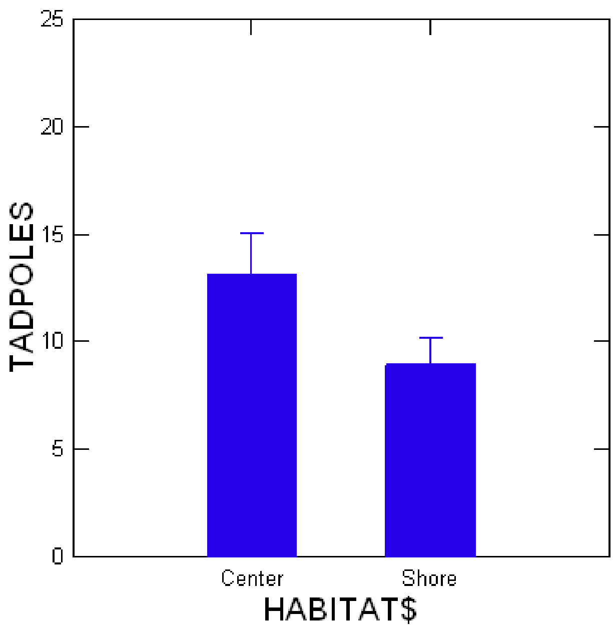

Figure 5: Bar graphs represent the number of tadpoles presence by habitat in Woodduck 2.

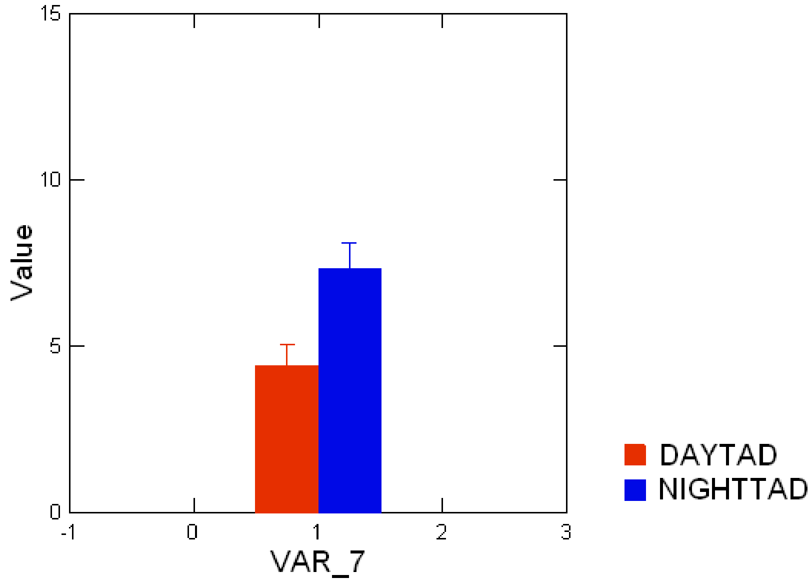

Figure 6: Bar chart represent the activity of tadpole in nocturnal and diurnal periods for the Woodduck 1 pond.

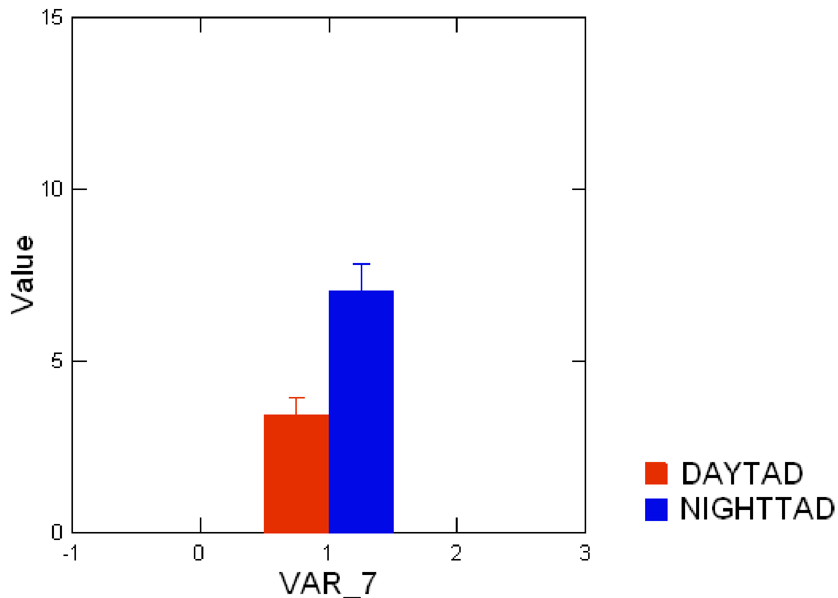

Figure 7: Bar chart represent the activity of tadpole in nocturnal and diurnal periods for the Woodduck 2 pond.

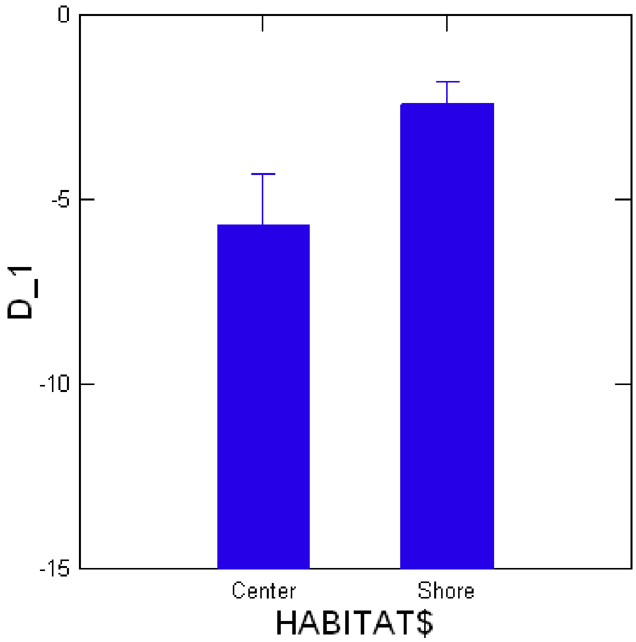

Figure 8: Relationship between preferences of habitat and day or night activity for Woodduck 2. The y-axis is the difference between (# tad. Day - # tad. Night) negative value means that their activity was mostly during the night.

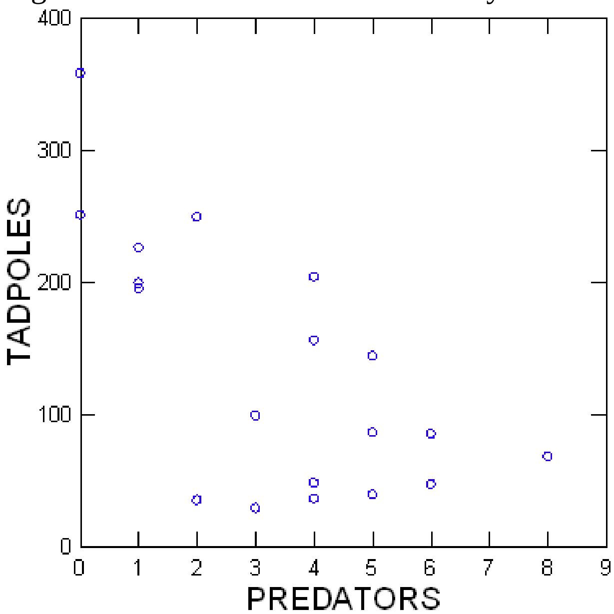

Figure 9: The relationship between the number of tadpoles and predators.

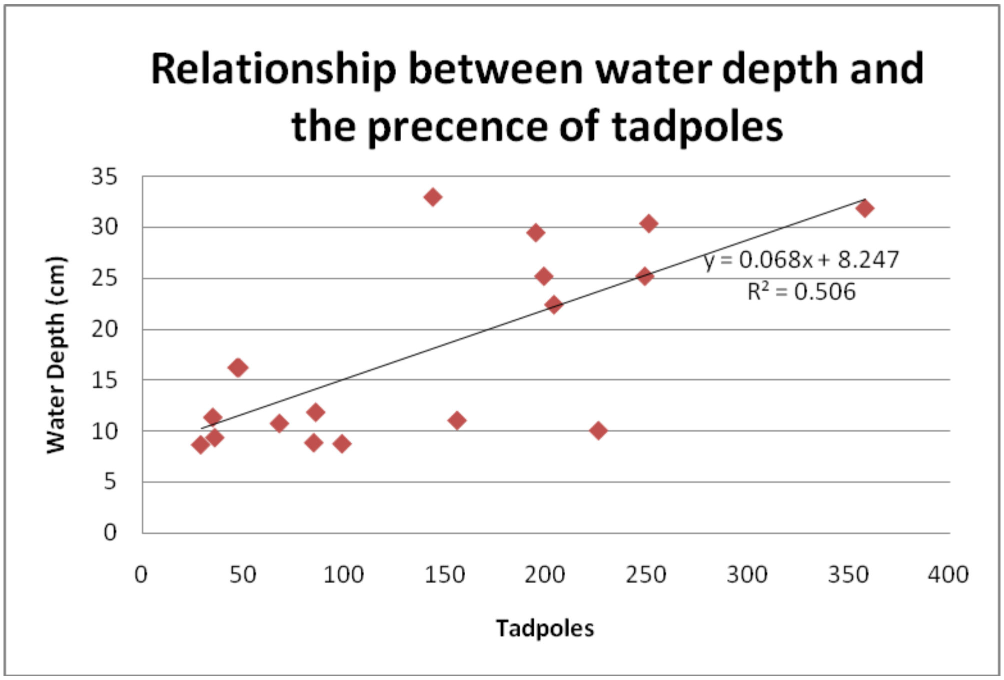

Figure 10: The graph represents the relationship between the number of tadpoles and the water depth.

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