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Amphibian population estimates and ecosystem assessment on the Durango Nature Studies property

**Introduction**

Durango Nature Studies (DNS) is a 140-acre hands-on outdoor education center established in 1998 that serves the Four Corners and the surrounding areas. Durango Nature Studies is a member of the Durango Science Collaboration and services more than 6,500 people annually with several different programs. As well as being open to the public, Fort Lewis College, Southwest Conservation Corp., Eagle Scouts, Colorado State University, 9R School District, and the Colorado Breeding Bird Atlas all use the Nature Studies land for research and education. The DNS property is located near Bondad, Colorado and houses many different habitats including meadows, oak woodlands, piñon-juniper forests, desert arroyos, a pond, and the Florida River. Many different animals inhabit the DNS property such as rabbits, prairie dogs, several species of birds, fish, and a wide variety of reptiles and amphibians.

Currently in Colorado, the bullfrog (*Rana catesbeiana*) is considered an invasive species. An invasive species is a species not native to the area that competes with and preys on the native species and whose presence could have a negative effect on the native species. If left unattended for an extended period of time, an invasive species can extirpate the native species that it is competing with. The bluegill (*Lepomis macrochirus*) is an invasive species of freshwater fish that feeds on the eggs of leopard frogs (*Rana pipiens*). The presence of both bluegill and bullfrogs in a leopard frog ecosystem can be especially harmful because both invasive species prey on the eggs on leopard frogs. Not only this, but the bullfrog competes with the leopard frog for food. Both of these factors combined could seriously harm the leopard frog population.

*Natural History*

The Northern Leopard frog (*Rana pipiens*) is native to the northern tier United States, western states, and the Canadian provinces. They are most easily identified by their greenish-brown coloring, irregularly shaped dark spots on their backs and legs, and light-colored dorsal ridges extending down either side of their backs. The northern leopard frog requires a variety of aquatic habitats to survive including slow-moving or still waters (typically along streams and rivers), wetlands, permanent or temporary pools, beaver ponds, or human-constructed habitats like earthen stock tanks and borrow pits.  *Rana pipiens* adults range from between two to five inches and usually live between two and four years. Adult leopard frogs consume a vast array of small vertebrates and invertebrates such as crickets, beetles, ants, flies, and small birds. Leopard frogs in their larval form will eat algae, plant tissue, organic debris, and small invertebrates.  *Rana pipiens* eggs hatch in thirteen to twenty days and the tadpoles metamorphose sixty to eighty days after hatching. At the moment, the northern leopard frog is a species of special concern, and is being threatened by habitat loss, disease, non-native (invasive) species, pollution, and climate change.

The *Rana catesbeiana*, or bullfrog, is one of the most prominent amphibious species in North America, being found in freshwater ponds, lakes, and marshes from Nova Scotia, Canada, throughout the continental United States and as far south as Mexico and Cuba. Some bullfrogs have even been found in Europe, South America, and Asia. Bullfrogs can be easily identified by their green or gray-brown coloring, large tympanic membranes (ear drums), and dorsolateral ridges around their tympanic membrane. Male bullfrogs are highly territorial and can typically be found along the water’s edge in larger, permanent bodies of water such as swamps, ponds, and lakes.  *Rana catesbeiana* females range from three and a half to six inches and males can be anywhere from three to eight inches. The average life span of a bullfrog is seven to nine years. Bullfrogs are nocturnal carnivorous amphibians and will feed on several types of creatures including insects, mice, fish, birds, and snakes. Tadpoles eat algae, plant tissue, and aquatic insects. Females can lay up to twenty thousand eggs at a time that hatch in three to five days; metamorphosis occurs anywhere from a few months after hatching in the southern range to up to three years in the northern range. Bullfrogs have a very distinctive call that can be heard up to a quarter of a mile away.

**Methods and Materials**

In order to estimate amphibian populations, three different methods were used: pitfall traps, visual encounter surveys, and one mark and one recapture session. Four five-gallon pitfalls were set up around the pond and river and were checked daily. Visual encounter surveys were conducted four times (once a day for four days). Pink elastomer was used to mark the captured frogs’ right hind legs during the one-hour mark session. Each frog that was caught in the one-hour recapture session was then checked for a pink elastomer mark.

Water samples were taken from the pond on the DNS property and the Florida River to conduct water chemistry tests for nitrates, phosphates, dissolved oxygen, pH, coliform, and temperature. To calculate plant diversity, four veg plots were conducted randomly on the property. Macroinvertebrates were collected from the pond using a dip net; a net was used to scoop up mud and vegetation from the bottom of the pond. In the river, macroinvertebrates were harvested using a kick method, where one individual held a net in the water and another individual stood between five to fifteen feet directly upstream and stirred up the river substrate by stomping.

**Results**

During the mark-recapture sessions, it was observed that a total of three leopard frogs were marked and captured during the first session. In the second session, one frog was recaptured (found with a mark) and four frogs were captured without a mark. Using the equation P= MC/R, where *P* is the total population, *M* is the number of animals marked in the first trapping session, *C* is the number of animals captured in the second trapping session, and *R* is the number of marked animals recaptured in the second trapping session, we can determine that the population of leopard frogs is equal to (3)(5)/1. Therefore, the total number of leopard frogs on the DNS property is fifteen. During the visual-encounter, one bullfrog was spotted on three out of the four days that a visual-encounter was conducted. Given that a visual-encounter is less precise, it can be estimated that there is one bullfrog currently living on the DNS property.

In order to calculate the diversity index of both the DNS pond and the Florida River, macroinvertebrates were collected from both bodies of water. It was found that the DNS pond had a majority of mayflies, though damselflies, dragonflies, and riffle beetles were also found. When the diversity index was calculated, it was shown that the pond had a satisfactory diversity index of 1.21. This is greater than the previous year’s diversity index, being 0.99. In the river, caddis flies were the dominant macroinvertebrate found alone with mayflies, midges, dragonflies, black flies, riffle beetles, and crane flies. When calculated, the diversity index was found to be 0.88; the previous year’s diversity index in the Florida River was 1.03.

Water quality tests in the pond and river measured a pH of 10 and 8, both considered alkaline levels. Nitrate levels of 6 and 10 were found and determined to be higher than normal. Low phosphate levels of 4 were found in both the DNS pond and the Florida River. When the test for dissolved oxygen was conducted, high levels of 1 and 3 were obtained. The DNS pond and the Florida River also both tested positive for coliform.

**Conclusion and Discussion**

Based on the data on amphibian populations, it can be concluded that the bullfrog is not greatly affecting the population of leopard frogs being housed at Durango Nature Studies. Given that there are not two bullfrogs present on the property, the bullfrog cannot repopulate the area and extirpate the leopard frog. However, genetic pollution (crossbreeding or hybridization) could threaten the leopard population should a bullfrog and a leopard frog mate.

The data collected on water quality in the DNS pond and the Florida River quality suggest several things. First, high pH levels (alkaline) can be considered corrosive and damaging to the ecosystem. At a high pH, ammonium in water is converted to toxic ammonium, which can be harmful to aquatic life. Phosphorus is a naturally occurring element in rocks and other mineral deposits. Rocks gradually release phosphorus into an ecosystem as phosphate ions through the natural process of weathering. phosphorus is often less present in well-oxygenated water. As a result, the high levels of dissolved oxygen found at DNS could explain the reduced levels of phosphorus. The positive coliform test could be an explanation for the high nitrate levels in the water; coliform is a bacteria that is an indicator of feces from a warm-blooded mammal such as a cow. Presence of coliform is essentially a sign of fertilizer in the water and could be a contributing factor in raising the nitrate levels. The high nitrate levels suggest that both bodies of water are at risk for an algal bloom. Algal blooms are caused when increased nutrient (nitrates and phosphates) levels cause an influx in plant growth on the surface of the water. As more algae and plants grow on the surface of the water, a lack of sunlight causes the flora below the water to die. This dead organic matter becomes food for bacteria that decompose it and result in an increase in food, followed by an increase in bacteria and an increase in the usage of dissolved oxygen in the water. When the dissolved oxygen content decreases, it becomes a risk for fish and other aquatic species such as insects. Algal blooms result in what is known as a dead area. Another possible area of concern surrounding algal blooms is the fact that some species of algal blooms can produce neurotoxins, which may have a severe impact on wildlife. Algal blooms can be prevented and maintained by the introduction of natural algal growth control products that check the growth of algae. It might also be necessary to introduce a species of herbivorous fish, such as carp, into the pond. Carp feed on algae, keeping the growth down. Introducing more underwater plants into the body of water could also be an efficient way to prevent an algal bloom. The new plants will consume more nutrients, thus reducing the amount of nutrients available for the algae to grow.

Data collection could be conducted in more efficient ways by giving each class specific areas of the property to conduct tests in. It could also be a positive idea to go at two different times of year. Would the results be different from autumn to spring? What could that indicate? If a plan was implemented to help better maintain the leopard frog/bullfrog population, it could be beneficial to revisit the property to check on the progress of the plan. The leopard frog population can be protected by frequent monitoring and proper maintenance and disposal of the invasive species (bullfrog). The bodies of water which the leopard frog inhabits should also be kept clean, being that pollution can threaten the population. Water chemistry tests should be performed on a bi-annual basis to ensure that the levels of nitrates, phosphates, pH, etc., are not harmful to the leopard frog.

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