Removal of Invasive Bullfrogs and Their Impact on Ecosystem Trophic Levels

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Abstract:

The Bullfrog (*Lithobates catesbeianus*) is an invasive species in many parts of North America that lacks natural predators creating an imbalance in the trophic levels of an ecosystem. Their introduction negatively affects native species via increased competition for habitat, resources and predation pressure. In a previous study Bullfrogs were eradicated from a section of the Mora River located in northeastern New Mexico, while leaving another section as a control where Bullfrog density was not altered. Stomach content of the removed Bullfrogs revealed that Bullfrogs exert a great deal of predation pressure on the invasive Northern Crayfish *Orconectes virilis (***Figure 1**). We hypothesize to find measureable differences in Crayfish population abundance and structure between the experimental and control regions. Our independent variable was the presence or absence of the Bullfrogs, while our dependent variables were Crayfish abundance and structure. The results indicate that there are demographical and population differences in both control and experimental sites.

Figure 1: Crayfish (*Orconectes virilis)*

Introduction:

Invasive species are known to cause drastic negative changes within ecosystems worldwide (Snow & Witmer, 2010), these species are often introduced into new habitats on purpose or accidentally. The Bullfrog is a known invader of many riparian habitats in the United States. (Rosen & Schwalbe, 1993) Bullfrogs are known to have a diverse selection of prey items and can adapt to many different types of habitats (Degenhardt, Painter, & Price, 1996). In a parallel study we eliminated Bullfrogs from a section of the Mora River in order to study its impact on local aquatic fauna. From the dissection of eliminated Bullfrogs (**Figure 2**) we learned that more than 87% of the diet of Bullfrogs in the Mora River is comprise of the invasive Northern Crayfish. Thus, these two invasive species seem to have established a very strong trophic interaction.

Different components of the trophic levels are kept in dynamic equilibrium by an interaction of top-down and bottom-up forces. Mesopredator release occurs when a predator is removed, eliminating top-down control on lower trophic levels that may then irrupt and become super abundant with the consequences of lowering diversity in the system. We expect that eliminating Bullfrogs may release Northern Crayfish which may in turn bring negative consequences to the ecosystem. The importance of this study is to provide insight pertaining to the interactions between native and non-native species as well as establish baseline information for possible management of invasive species removal within riparian habitats in the future.

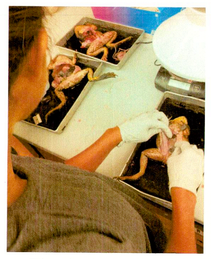

Figure. 2: Dissection of eradicated Bullfrog..

Methodology:

Study site: The Mora River is located in northeastern New Mexico and is a dominating feature of the ecosystem in the Rio Mora Wildlife Refuge (**Figure 3**). Using a Garmin GPS system ten sites separated by 200 meter segments in both the experimental and control regions were established.

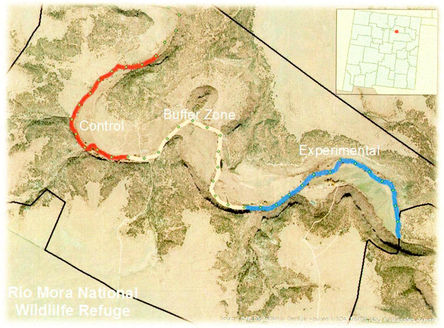

Figure 3 : Control Site: 2km, Experimental: 2km,Buffer Zone: 3.2km

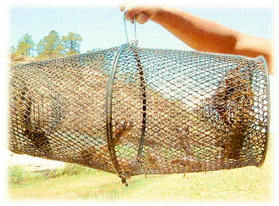

Figure 4: Minnow trap with Crayfish .

Sampling: Sampling consisted of using minnow traps baited with chopped up hot dog (**Figure 4**) which were set in the river for a duration of 24hours. Measurements taken from each crayfish included: carapace length, total body length, tail width, body mass, and sex (**Figure 5**). Crayfish were marked in the lateral region of the carapace with nail polish and released.

Figure 5 : Measuring Crayfish and marking.

***Statistical Analysis*:** The experimental and control sites were evaluated by the average number of Crayfish caught per trap per night. We also compared the average of Crayfish demographic structure for both experimental and control sites. A one tailed t-test was used to determine whether or not p-values were significant.

Results:

Abundance Results: In the control region we caught on average 2.06 Crayfish trap per night, while in the experimental region we captured an average of 2.33 Crayfish trap per night (**Figure 6**).

Structural Results: Measurements indicate that in the control region the average mass of the Crayfish caught was 21.65g while in the experimental region the average mass was 18.56g. The control region average total length was 8.40cm and 7.67cm for the experimental. For tail width the control average was 1.91cm and 1.73cm for the experimental. The final average calculated measurement carapace length was 4.24cm for control and 3.86cm for experimental (**Figure 7**).

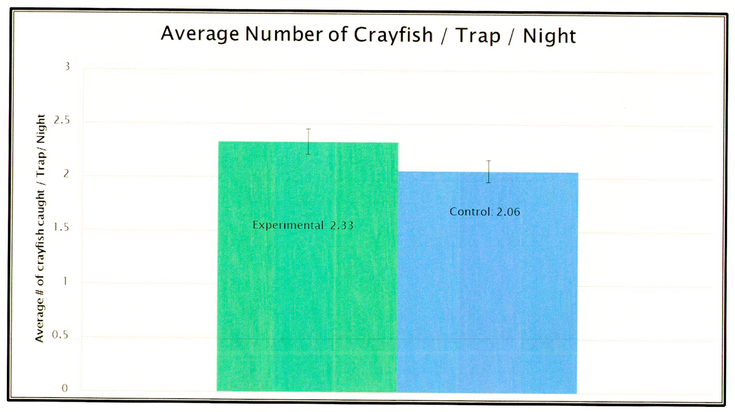

Figure 6: Graphical representation of the Average number of Crayfish caught per trap per night data collected from the experimental and control regions.

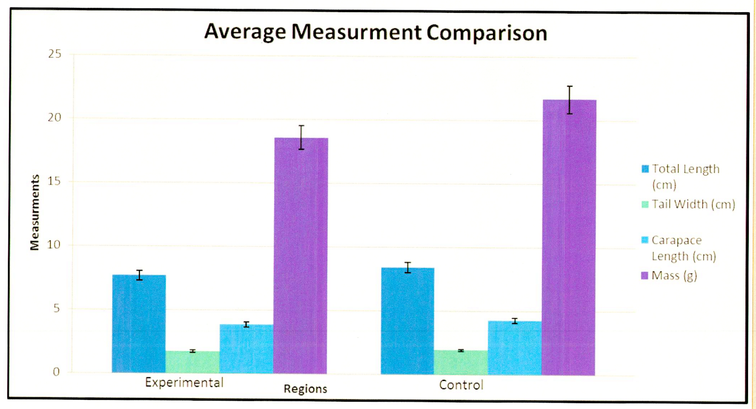

Figure 7: A graph showing average measurements of Crayfish Total length, Tail width, and Carapace length across both the experimental and control regions.

Discussion/Conclusion:

Based on the results we see that there is a slightly higher abundance of crayfish in the experimental region this maybe due to lower predation by Bullfrogs. However, crayfish from the experimental site seem to be smaller than the ones in the control site. This is likely due to increase recruitment of crayfish in the experimental area. Releasing crayfish from Bullfrog predation has likely caused an increase in the survival of offspring. Statistical analysis determined that all variables demonstrated p-values that were found to be less than 0.05, demonstrating statistically significant differences.

Image 1: Rebecca Vigil at the river measuring Crayfish.

Future Work:

A coexisting study is also evaluating the abundance of native fish (**Figure 8**) in order to assess the trophic impact of the removal of the Bullfrogs. Monitoring of the invasive northern crayfish population will be continued along with the eradication of the Bullfrogs.

Figure 8 : Native fish to the Rio Mora.

References

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