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Abstract

Yellow-headed blackbirds are a common wetland breeding bird in Western North America. They depend on emergent insect communities – especially damselflies – to feed during breeding season. This study tested the hypothesis that nestling growth rates and overall reproductive success would increase with increased damselfly and total insect biomasses. No significant variation in growth was found, but reproductive success was negatively influenced by water depth. Contrary to previous studies, predation was the main form of nestling mortality, suggesting an ecological tradeoff between nest safety and food abundance.

Introduction and Background

Yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) are a common bird species in western North America from the Great Plains to the Rockies. Although they live and feed in a variety of habitats including wetlands, grasslands and agricultural areas for much of the year, they breed exclusively in wetlands. During the non-breeding season, these birds feed mostly on grains and seeds, but during breeding they feed primarily on emergent aquatic insects, which they also feed to their young. During this time, the females primarily capture prey and feed the nestlings, but males have been known to assist (Twedt and Crawford 1995, Wilson 1966).

While the primary source of food for both adult and nestling blackbirds is odonates – especially damselflies – these birds will feed on all insects, including but not limited to dipterans, lepidopterans, and mayflies. They have also been known to forage on terrestrial insects when there is a shortage of aquatic insects. The primary factor for foraging selection is size. Damselflies are preferred because they are large and easy to catch. It is energetically more favorable for an adult blackbird to pursue a large damselfly than, for instance, several small mayflies. The exception to this rule appears to be dragonflies, which blackbirds tend to avoid in favor of damselflies because dragonflies are fast and agile (Orians 1966, Richter 1984, Wilson 1966).

The emergent insects that these birds consume all have emergence periods that last around six months. These usually have a large peak at the beginning of the emergence period (April and May) and a smaller peak at the end (September and October). These peaks correspond with optimal weather conditions for the survival and reproductive success of adult insects. Most of these insects spend the majority of their lifespan in the larval stage. Once they emerge, they mate and die within a matter of days, sometimes hours. There are a few exceptions, including most odonates and a few dipterans which have long adult stages (Stagliano et al. 1998, Thorp and Covich 2001).

Further study of the relationship between yellow-headed blackbirds and the insects they rely on during breeding could be very important. A greater understanding of how insect species composition affects blackbird reproductive success could have a tremendous impact on wetland conservation. Specifically, it could illustrate the effects on the insect population in wetlands on secondary consumers. Further studies on the factors that affect insect populations in wetlands could be combined with this study to create a fuller picture of trophic interactions in wetlands. Furthermore, a comprehensive survey of the emergent insects in the study area would lead to a greater understanding of the wetlands in northwestern Montana.

I hypothesize that both damselfly biomass and overall insect biomass will have a positive correlation with nestling survivorship, growth rates, and production.

Methods

Study species

Yellow-headed blackbird nests are built in wetland vegetation over open water. This vegetation must be dense enough for nests to be stable, but open enough for water to flow underneath in order to provide protection from predators. Males will defend a small territory that can contain the nests of up to eight mating partners. The size of this area varies greatly depending on the density of male blackbirds inhabiting a particular wetland. Females begin to lay eggs soon after the principal prey – damselflies – begin emerging. While first year females will only breed once in May at the beginning of the breeding season, older females may lay multiple clutches all the way through June (Richter 1984, Twedt and Crawford 1995, Wilson 1966).

Clutches always consist of either three or four eggs. These eggs take 12.5 days to hatch on average, and once hatched it generally takes approximately 11 days for young blackbirds to fledge. The eggs hatch asynchronously, which means that nestlings hatch at different times, usually one per day and never more than two per day. It is believed that this behavior is a way of coping with food shortages. If extreme weather hits and food becomes scarce, the parents will concentrate on feeding the older nestlings while leaving the youngest to starve. In fact, the most common cause of infant mortality in this species is starvation (Orians 1966, Richter 1986, Wilson 1966).

Study sites

I surveyed five nesting colonies in five different wetlands in the Mission Valley in Northwest Montana: Herak, Leon, Johnson 80, Sandsmark, and an unnamed tribal wetland. Colony boundaries were estimated using nest proximity and adult bird behavior. In each territory, I labeled nests that contained eggs in order to measure nestlings from hatching to fledging or failing.

Bird surveys

I measured size of the nestlings in terms of both length (beak, wing cord, tarsus) and weight. I recorded these measurements every other day. I ceased measurements when the oldest nestling reached nine or ten days of age in order to prevent premature fledging, but I continued to track the nests to determine the fate of the nestlings. Nestlings were labeled using nail polish. I also measured water depth under each nest. I used Program MARK to estimate daily survivorship for each site. I determined growth rates for each nestling by running a linear regression of each growth variable against age in days and taking the slope of the trendline. I averaged these results for each site.

Insect surveys

In order to collect the insects, I used floating emergence traps. These traps were made of a 2.5 by 2.5 feet frame of PVC pipe with mesh tented over it and soldered to the frame. I attached a container near the top of each trap for insects to funnel into. I put ethanol at the bottom of each container to preserve the insects. To ensure that I caught both insects that emerge directly from the water and insects that crawl onto vegetation (specifically, odonates), I trimmed vegetation to fit under the trap. Two traps were used per site. Once captured, I measured the overall dry biomass of insects from each trap and separated them into four categories: dipterans, coleopterans, dragonflies, and damselflies.

Statistical analyses

I used regressions to compare survivorship, nests per territory, eggs per territory, fledged birds per territory, eggs per nest, fledged per nest, water depth, insect abundances, and insect biomasses. I used ANOVA to determine if there was any difference between growth rates and water depth in each territory.

Results

There was no significant difference between growth rates in each territory (f=1.48, p=0.22) (Figure 1).

Nonsignificant results were found when comparing daily survival to damselfly biomass (r^2=0.46, p=0.46) (Figure 2) or total insect biomass (r^2=0.20, p=0.82) (Figure 3). Average birds fledged per nest in each territory were not affected by damselfly biomass (r^2=0.61, p=0.12) (Figure 4) or total insect biomass (r^2=0.043, p=0.96) (Figure 5). Average eggs per nest were not affected by damselfly biomass (r^2=0.012, p=0.96) (Figure 6) or total mass (r^2=0.043, p=0.73) (Figure 7). Other insects also had no impact on reproductive success, with p-values all above 0.5.

Water depth had the most influence on reproductive success; having a negative correlation with survival (r^2=0.90, p=0.014) (Figure 8) and fledging per nest (r^2=0.98, p=0.0013) (Figure 9). However, it had no effect on total insect biomass (r^2=0.072, p=0.66) (Figure 10), damselfly biomass (r^2=0.5, p=0.18) (Figure 11), proportion of nests eaten (r^2=0.47, p=0.2)(Figure 12), or eggs per nest (r^2=0.6, p=0.12) (Figure 13).

Water depth between each territory was significantly different (F=6.25, p=0.0014) (Figure 14). However, a Tukey's post-hoc test revealed that the only truly significant differences were between Johnson 80 and the Leon (p=0.032), Sandsmark (p=0.069), and Tribal (p=0.0011) wetlands, as well as between Herak and the Tribal wetland (p=0.034).

Discussion

The results from this study did not support the hypothesis that increasing insect biomass would result in increased nestling growth rates, survivorship, and overall production. Growth rates did not differ significantly between wetlands. It is possible that there is a genetic component that stabilizes growth rates regardless of environmental conditions. It is also possible that prey differences were not substantial enough to merit growth differences, but with only one lump collection per territory, it is difficult to compare those numbers in a meaningful way.

Differences in insect population also did not affect daily survivorship or fledgling production, contrary to my hypothesis. Again, the limitations presented by my data make it difficult to tell if insect populations between wetlands were significantly different enough to have an effect on nestling survival. There is little to no information about this relationship in the existing literature. While it is known that damselflies are the preferred food source – so much so that yellow-headed blackbirds synchronize their laying with the emergence of damselflies (Richter 1984, Twedt and Crawford 1995) – no quantitative study has been published on the relationship between insect populations and blackbird nest success. It has been noted that extreme weather events that decimate damselfly populations often have an extreme negative effect on nestling survival (Richter 1984), but no comparison between wetlands, their insect populations, and blackbird nestlings has been seriously undertaken. No such weather events occurred during this study. I observed no noticeable decline in insect populations at any time during my study and I have no evidence that any nestlings starved to death. The two definite sources of nest failure were eggs failing to hatch and predation, which would likely not be influenced by prey availability.

As average water depth increased, survival and fledgling success decreased. However, there was no correlation between water depth and prey production or predation, suggesting that there are other variables affected by water depth that were not taken into account in this study. Vegetation variables including height, total cover, and density may all be affected by water depth. In addition, while the differences in depth between the wetlands may be statistically significant, I am hesitant to say if they are ecologically significant. Richter's 1984 and Orians' 1966 studies took place in deep water wetlands several hundred meters from shore. In these studies, starvation was the key factor in nestling mortality while predation was negligible. Richter hypothesized based on his results that there may be an ecological tradeoff at work. He conjectured that nests that are built in areas that are safe from predators will face low food availability while nests in high food areas are vulnerable to predation. Given that the nests in my study faced relatively high predation and low to no starvation, I believe my study supports this hypothesis. A future study that simultaneously compared(s) large, deep water wetlands – such as the ones surveyed by Richter and Orians – with smaller, shallower wetlands – like the ones I surveyed – could lend further support to this hypothesis.

This study was faced with severe limitations that limit its power. Future studies should examine more territories, undertake a more quantitative analysis of nest and adult population density, and consider more variables including vegetation, distance from shore, distance between nests, territory size, wetland size, and observed predators. Finally, a more long term study or a study between more drastically different wetlands would help illuminate the factors that play into yellow-headed blackbird nestling survival.

Acknowledgements

There are several people I would like to thank. First, my mentor, Dr. Page Klug, for guiding me throughout this process and putting up with my shenanigans. Gary Belovsky, for giving me this opportunity and continuing to run this great program year after year. Stefanie Strebel, for going above and beyond her duties as T.A. The UNDERC Class of 2012 for lending physical, mental, and moral support. And finally, The University of Notre Dame, for allowing UNDERC to continue and deciding that I do deserve a degree after all.

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Figures

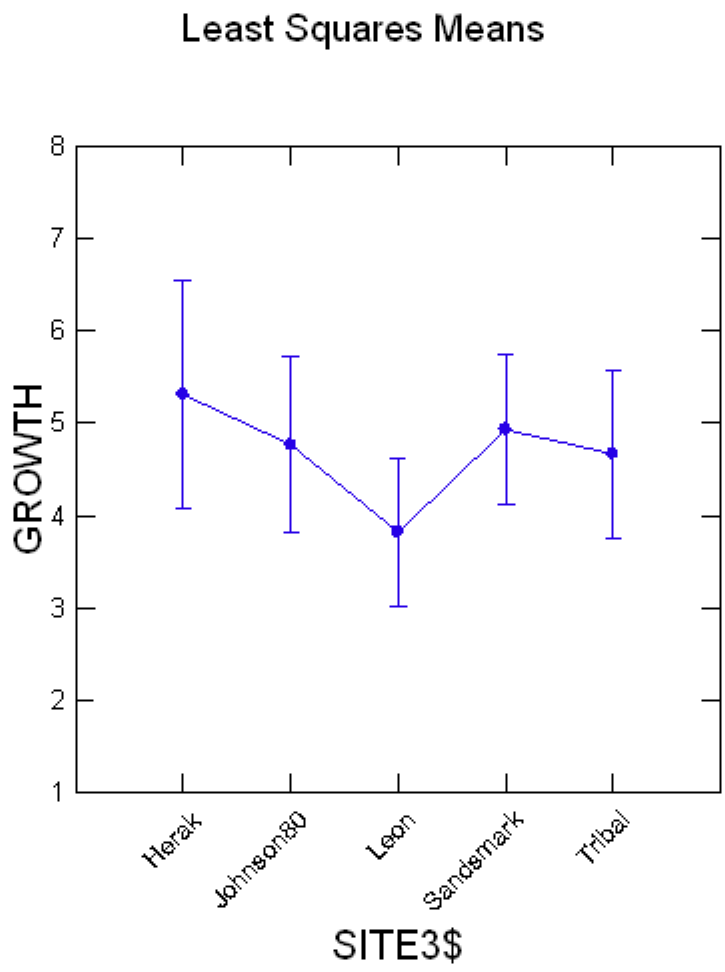

Figure 1. ANOVA comparing weight growth rates between sites. No significant differences occurred.

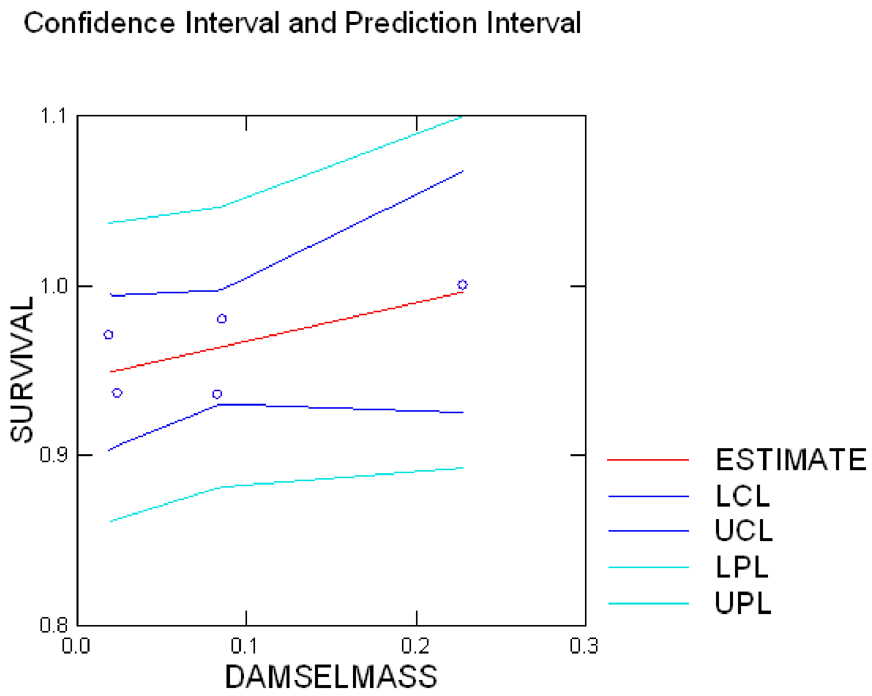

Figure 2. Regression comparing damselfly biomass and daily survival. No significant relationship was found.

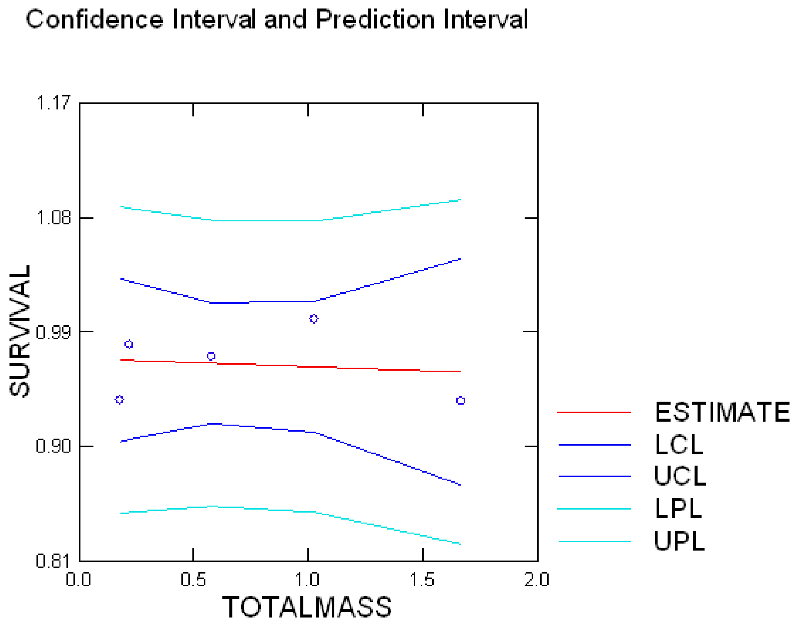

Figure 3: Regression comparing total insect biomass and daily survival. No significant relationship was found.

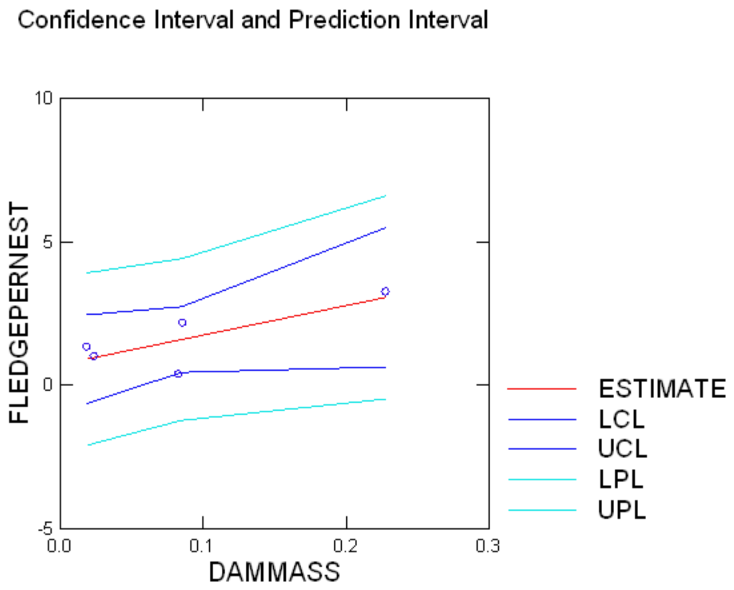

Figure 4.Regression comparing damselfly mass and average fledged nestlings per nest. No significant relationship was found.

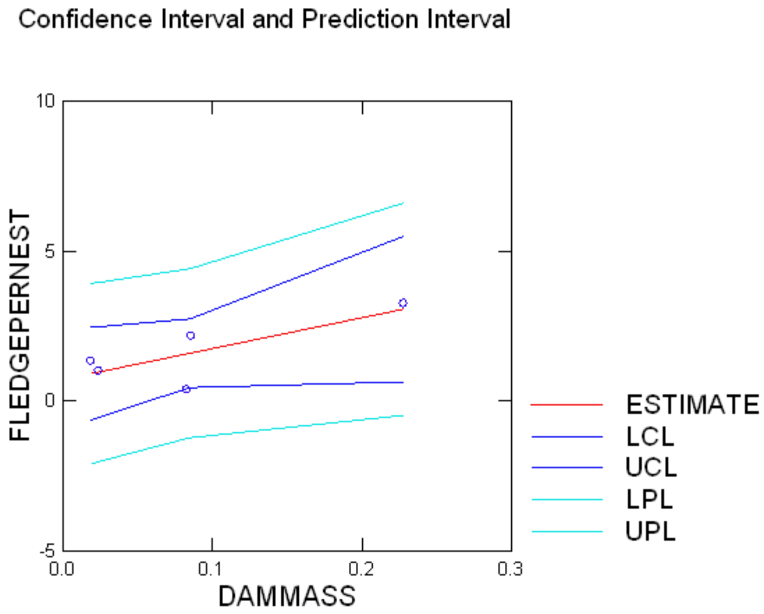

Figure 5. Regression comparing damselfly mass and average fledge success per nest in each territory.

No significant relationship was found.

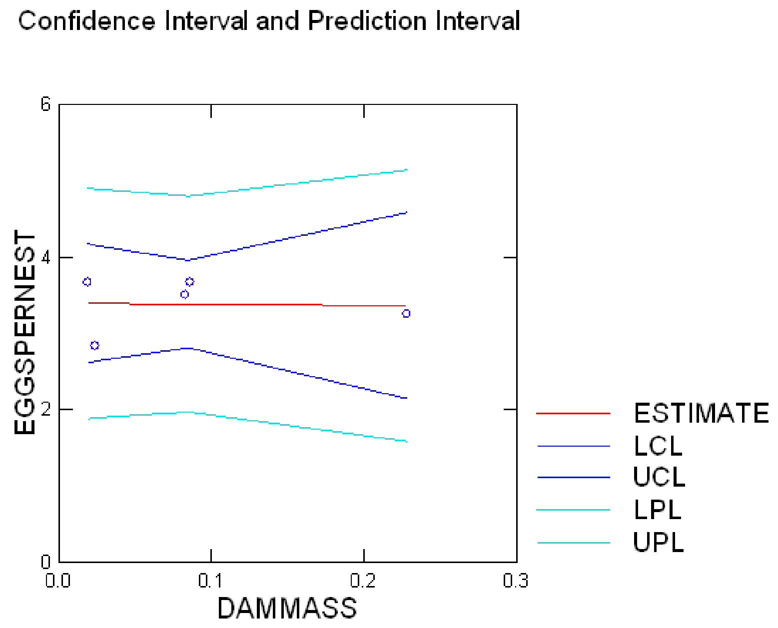

Figure 6.Relationship comparing damselfly mass and average eggs per nest. No significant relationship was found.

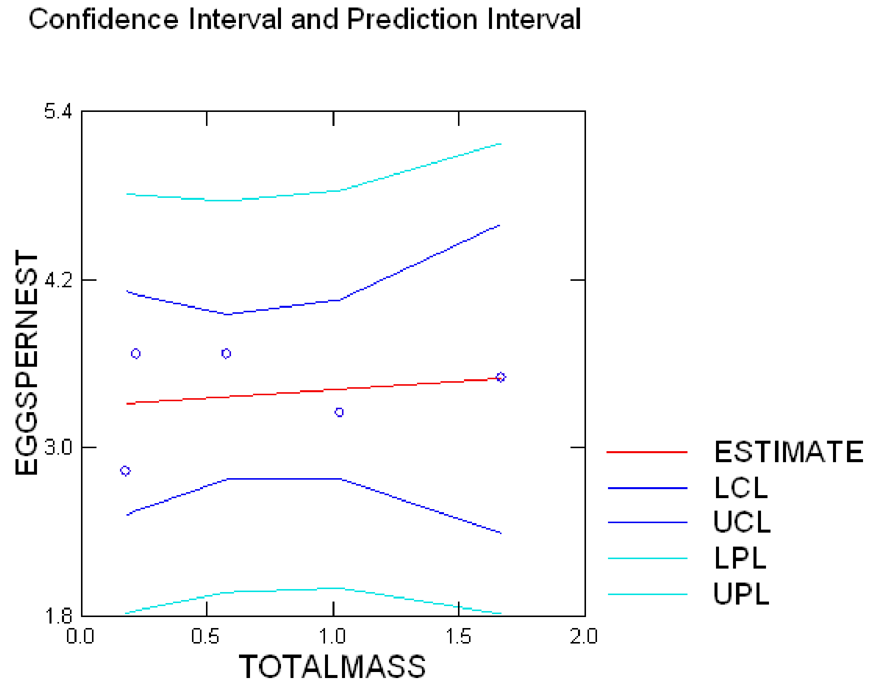

Figure 7.Regression comparing total mass and average eggs per nest. No significant relationship was found.

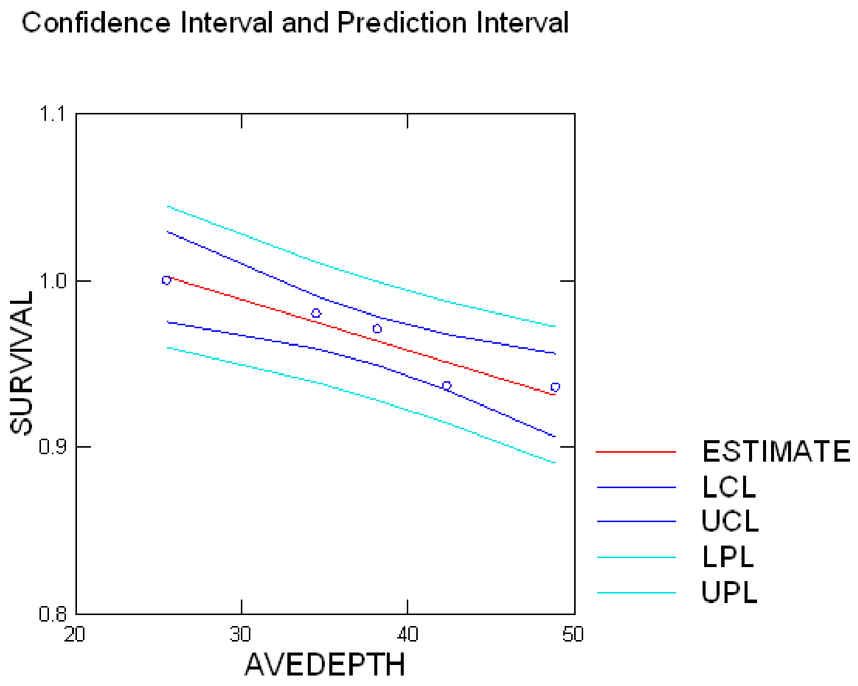

Figure 8. Regression comparing average depth and daily survival. A significant negative relationship was found.

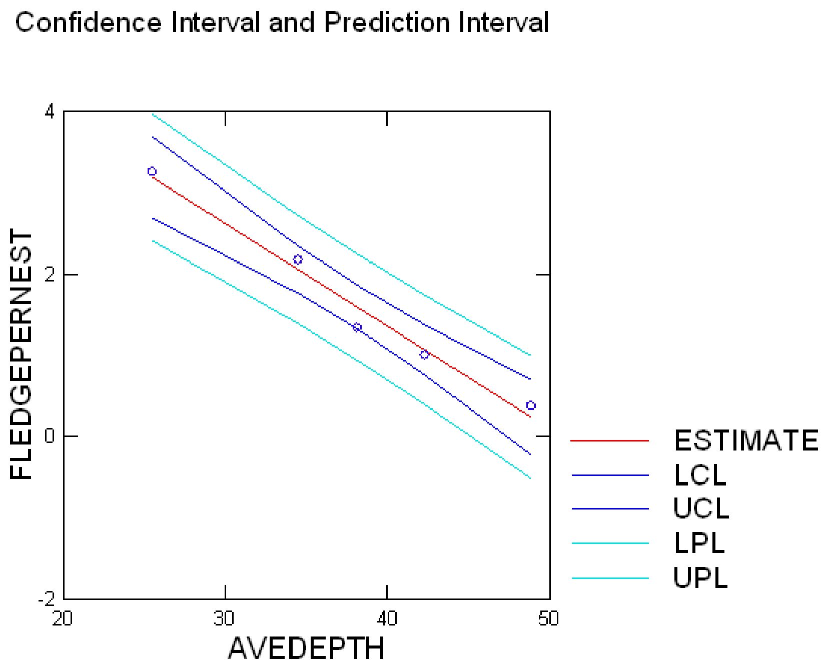

Figure 9. Regression comparing average depth and average fledge per nest. No significant relationship was found.

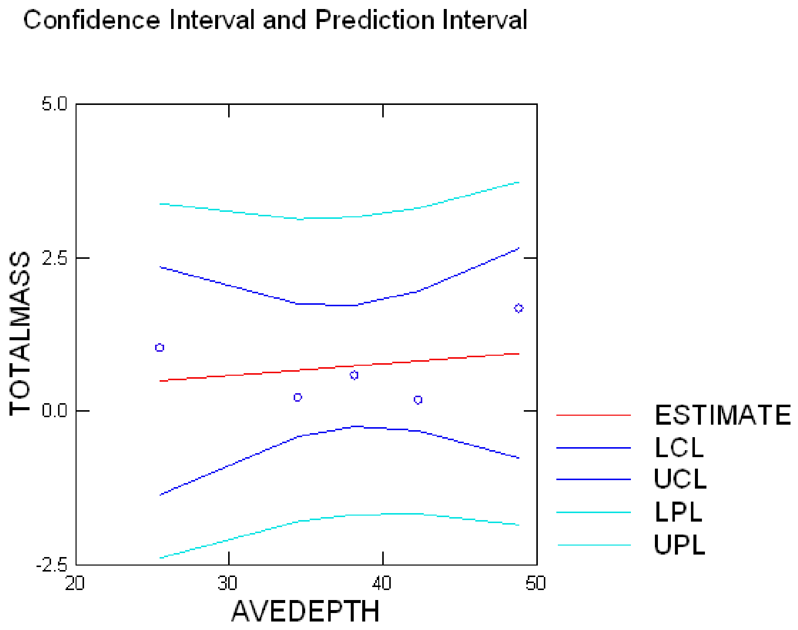

Figure 10. Regression comparing average depth and total insect mass. No significant relationship was found.

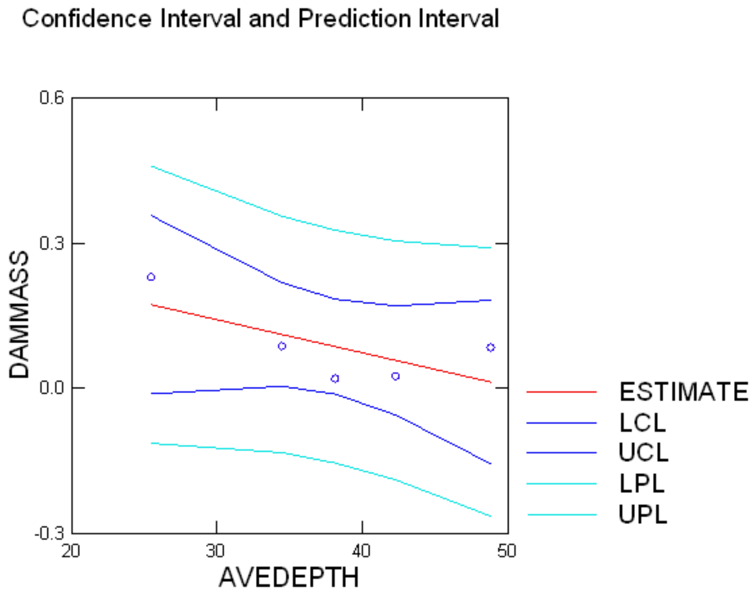

Figure 11. Regression comparing average depth and damselfly mass. No significant relationship was found.

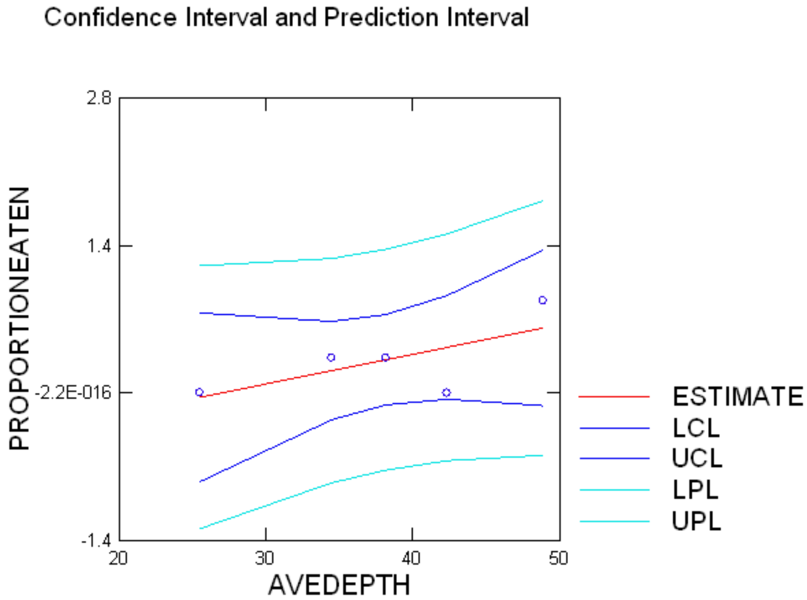

Figure 12. Regression comparing average depth and proportion eaten. No significant relationship was found.

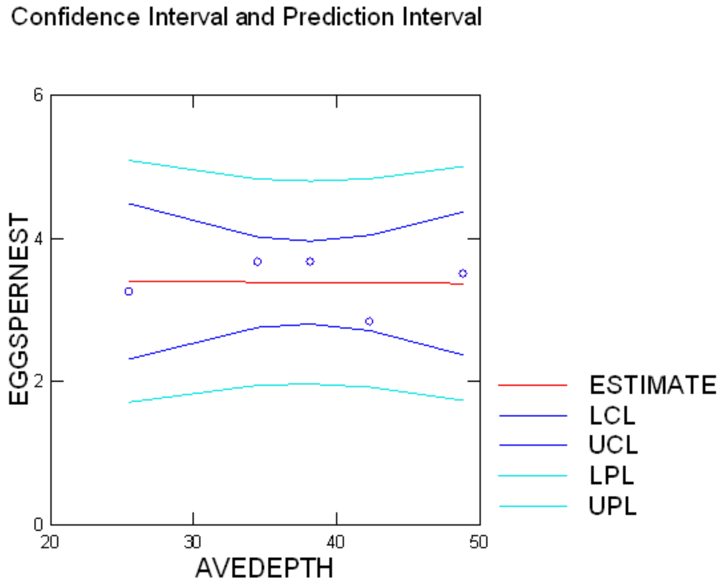

Figure 13.Regression comparing average depth and average eggs per nest. No significant relationship was found.

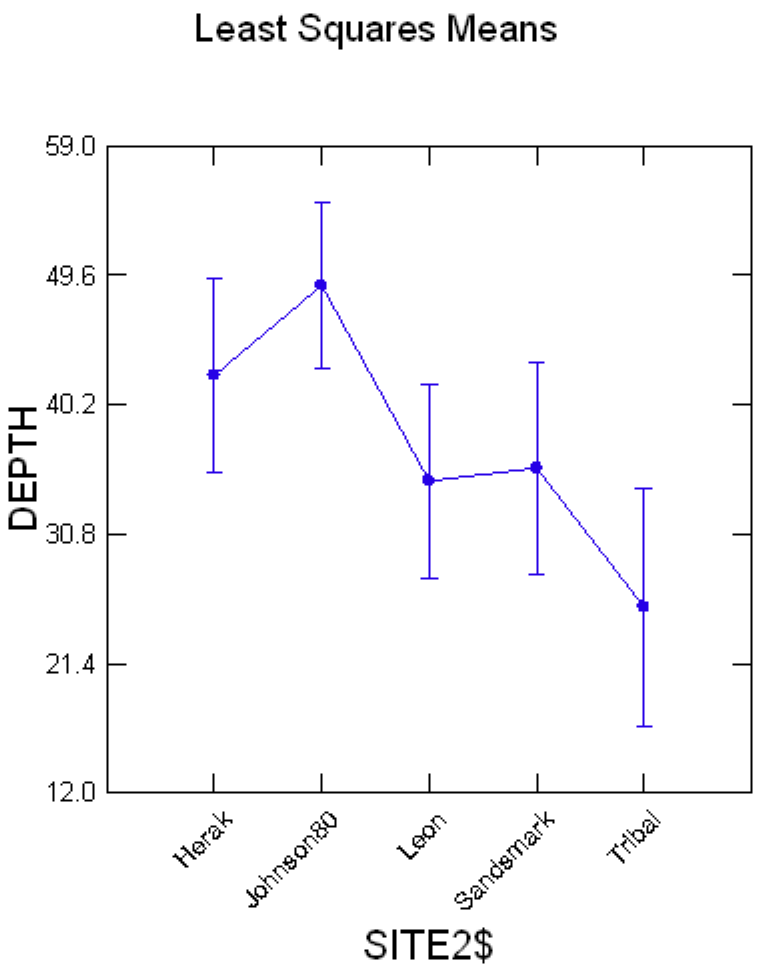

Figure 14. ANOVA comparing average depth between each site. Significant differences were found between Johnson 80 and Leon, Sandsmark and Tribal as well as between Herak and Tribal.