Use of a Holistic Approach to Study the Complex System of Bobwhites and Their Parasites Within South Texas

By Nicole J. Traub and Alan M. Fedynich

The northern bobwhite is a game species of ecological, economic, cultural, and recreational importance in Texas. South Texas is regarded as one of the last places in the state with suitable habitat for bobwhite populations; nevertheless, bobwhite populations have been declining. The underlying cause of the quail population decline has been attributed to habitat fragmentation and loss; therefore, most management efforts focus on improving existing habitat and developing new habitat. Despite these efforts, bobwhites have continued to decline, which has led quail biologists to explore other potential causes, such as parasitism, for declining quail numbers. Bobwhite populations in South Texas exhibit marked variations in abundance among years—a boom-and-bust phenomenon—that is attributed to fluctuations in weather conditions. When rainfall is abundant, vegetation is expected to be plentiful, populations of insects are expected to rise, and quail populations boom. How this cycle affects the parasite infections in quail is unknown. Our study concentrates on examining the interactions between precipitation and helminth population dynamics, so we can have a better understanding of the overall quail-parasite relationship. We are conducting a multi-year (2012–2019) internal parasite survey (with contributions from previous CKWRI graduate students Andrew Olsen and Stephanie Shea) from bobwhites hunter-harvested in South Texas in conjunction with a systems-based holistic approach to meet 3 main study objectives: (1) determine if parasite community structure and pattern is affected by host and environmental variables; (2) determine which insect species are used as intermediate hosts and the effect intermediate host density has on parasite community structure; and (3) create a simulation model to demonstrate the relationships between bobwhite density, insect

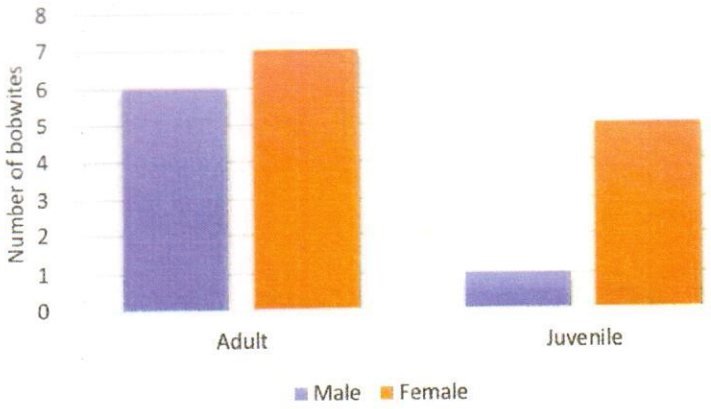
intermediate host abundance, parasite infections, and precipitation.

Although an essential component of the quail diet, insects can serve as intermediate hosts for helminth parasites. Helminth parasites of northern bobwhites in South Texas utilize indirect lifecycles, meaning the parasites require more than one host species to complete all life stages. Northern bobwhites are the definitive, or final, host and several insects are believed to act as the intermediate, or first, host(s). In conjunction with field collections of insects during summer months, we are examining bobwhite crops from hunter-donated birds to determine which insects are being eaten during the fall and winter period that possibly could be utilized as intermediate hosts for the nematodes *Aulonocephalus pennula* (cecal worm) and *Oxyspirura petrowi* (eye worm).

We began examining population dynamics of insects that serve as food for quail as well as intermediate hosts for parasites during the 2016–2017 Texas quail hunting season. One hundred and thirty-six bobwhites were donated during the 2016–2017 hunting season, of which 19 had insect species present in the crop at the time of necropsy (Figure 1). Insects were identified to order and stored in 95% ethanol for further investigation. Insects of 6 different orders were present (n=165; Figure 2). Order Coleoptera (n=94, 57%) was most dominant followed by Hemiptera (n=6, 4%), Hymenoptera (n=11, 7%), Lepidoptera (n=22, 13%), Orthoptera (n=30, 18%), and Parasitiformes (n=2, 1%). The most abundant insect (n=79) found was a larval Coleoptera species of the Chrysomelidae (Leaf beetle) family. In addition to the insects, two snails and one spider were also present within the crop contents.

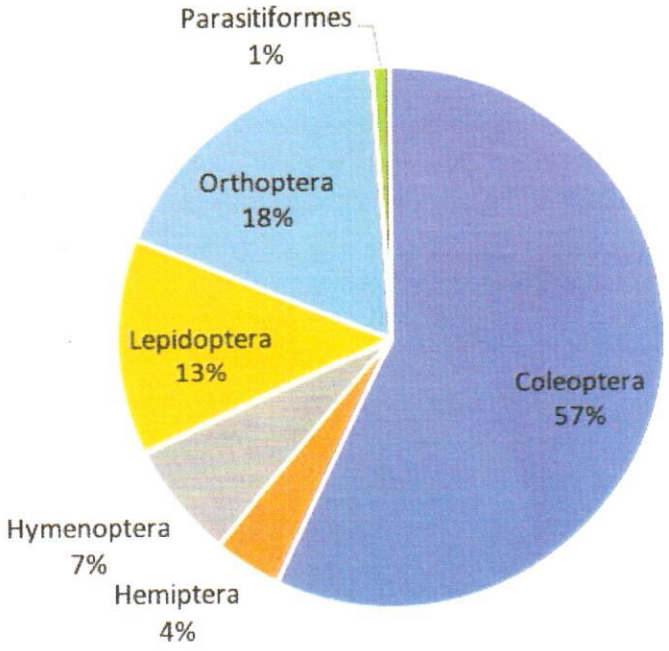
We are partnering with local ranches to collect various insects twice a month during each summer month (May-Aug) in 2019. We want to track insect abundance throughout the summer to (1) determine which insects are available as food for quail, (2) determine which insect species are being used as intermediate hosts by parasites, especially the cecal worm and eye worm, (3) determine the percent-

Figure 1



Number of northern bobwhites (n=19) with arthropods found in crop separated by age and sex from 2016–2017 hunting season.

Figure 2



Percent of insect orders found within northern bobwhite crop (n=19) during the 2016–2017 hunting season.

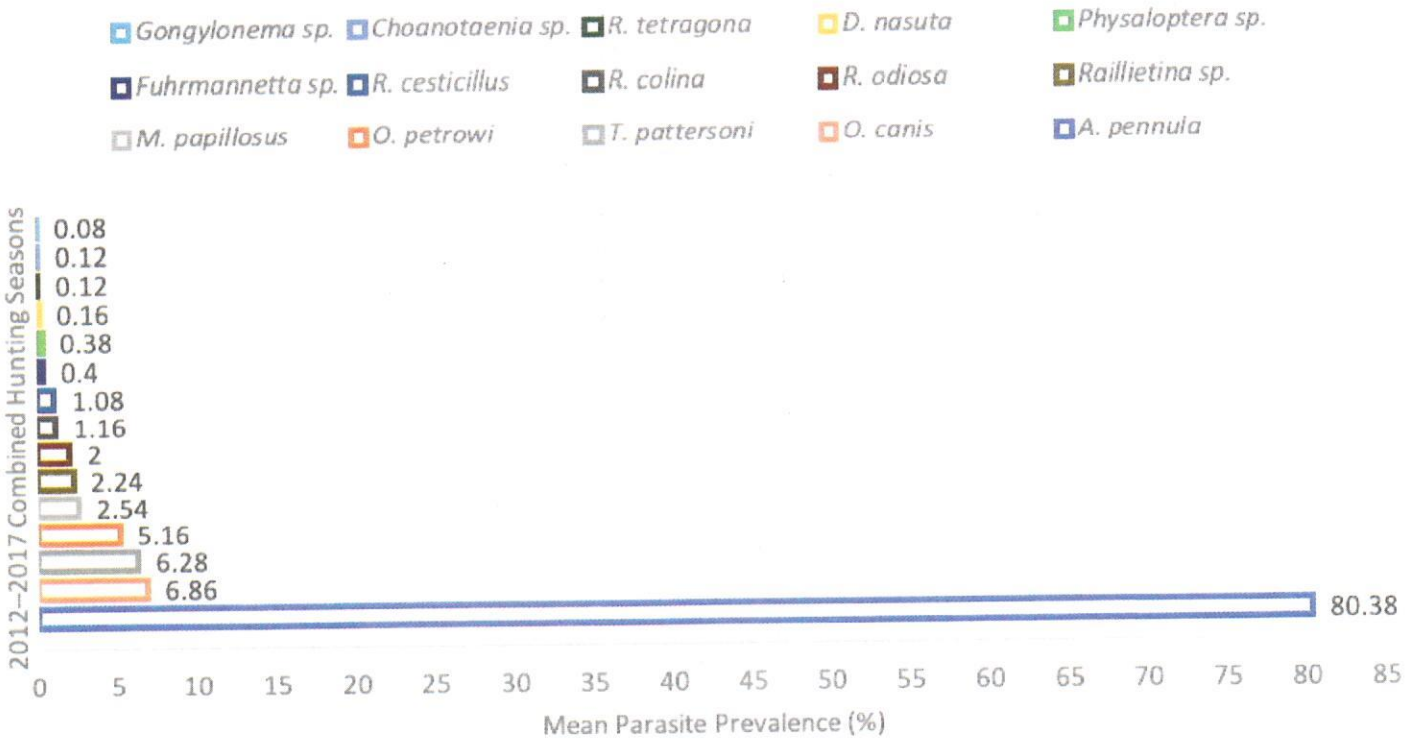


Figure 3 - *Prevalence (%) of parasite species found within northern bobwhites (n=734) from 2012–2017 hunting seasons.*

age of the insect population infected by larval stages of the cecal worm and eye worm, and (4) examine the relationship between insect abundance and rainfall.

Fifteen parasite species have been identified from the long-term internal parasite survey of bobwhites between 2012 and 2017. The cecal worm, *Aulonocephalus pennula*, was the most dominant parasite with a 5-year mean prevalence of 80.4%, followed by *Oncicola canis* (6.9%), Tetrameres pattersoni (6.3%), and Oxyspirura petrowi (5.2%). The remaining 11 parasites are considered rare and were found at less than 3% mean prevalence from 2012–2017 (Figure 3).

In addition to the long-term parasite survey data being collected, we have found a new parasite that has not been reported from South Texas. During the 2016–2017 quail hunting season, a scaled quail from Zapata County was found to be infected with a

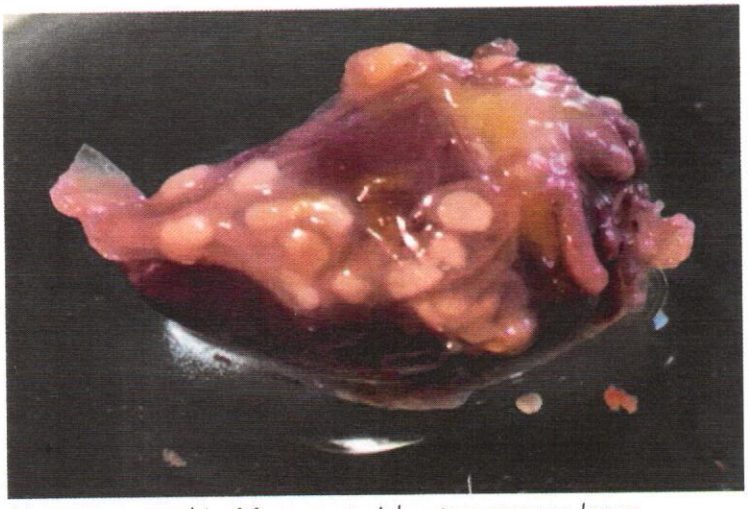
Pictures of Aulonocephalus pennula. Top: Picture of an extended bobwhite ceca caused by cecal worms. Right: Picture of A. pennula spilling out of the bobwhite ceca. Bottom: Picture of A. pennula being fixed in acetic acid after removal from bobwhite ceca. Pictures by Nicole J Traub, CKWRI

tapeworm previously unreported in scaled quail. This tapeworm, a species in the genus Mesocestoides, has an indirect life-cycle and uses 3 hosts: an insect, quail, and a carnivore (coyote, ocelot, or another four-legged carnivorous mammal). However, it is possible for this tapeworm to infect humans if the live larval stage is consumed. As of 2016, the CDC estimates 30 cases of human infections with adult Mesocestoides tapeworms have been documented worldwide, 10 of which occurred in the United States. We urge hunters to use caution when cleaning quail. If the quail has white or cream-colored rice-shaped spots on the flesh or organs (Figure 4), we suggest the quail be discarded and not eaten by human or animal. Discard the carcass in a place where other carnivores, including your hunting dogs, cannot eat it, and be sure hunters and ranch cleaners thoroughly clean their hands after touching an infected quail.

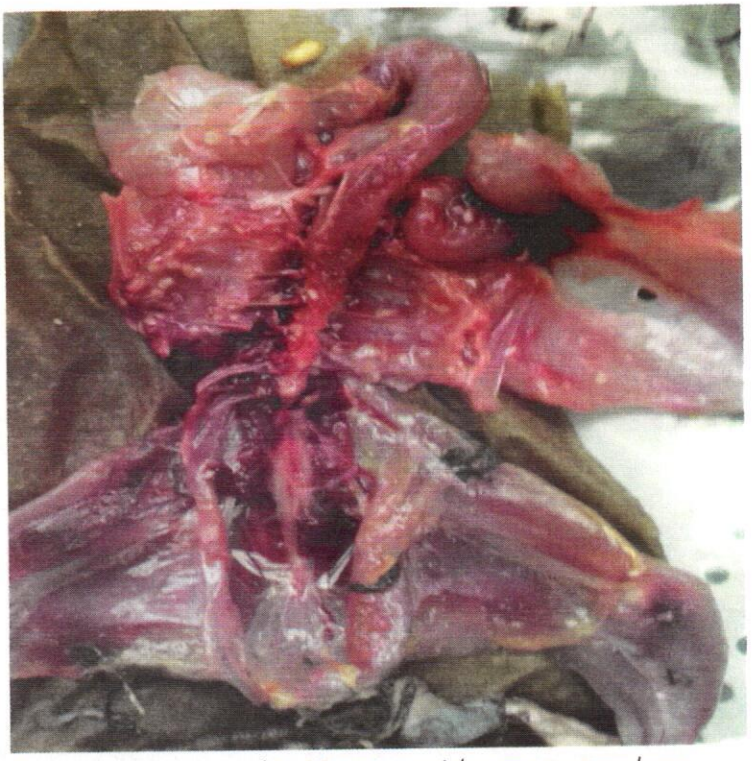
Studying relationships between precipitation and parasite population dynamics is needed to have a better understanding of host-parasite ecology. Understanding the life-cycle of an organism is important for conservation and management purposes, but for parasites, understanding the life-cycle and transmission dynamics is especially crucial since disrupting a portion of the life-cycle can effectively control the parasite. Parasitism in bobwhites has gained much attention over the past decade due to concerns about parasites negatively effecting declining bobwhite populations. Clearly, individual bobwhites can experience adverse effects due to parasites as found in a study conducted by Dr. Fedynich and then CKWRI graduate student Andrea Bruno. Unfortunately, very little research has been conducted on the pathogenicity of helminths occurring in South Texas quail, and it is yet unknown to what extent parasites negatively impact bobwhite populations. Much work remains to be done before a definitive answer to the question "Do parasites regulate bobwhite populations?" can be answered confidently.

Figure 4

Picture of Mesocestoides tapeworm larvae.



Heart covered in Mesocestoides tapeworm larva.



Body cavity covered in Mesocestoides tapeworm larva.