Early bird catches the WORM?

Learning about internal parasites.

Topic: Wildlife Research

Learning Objectives

1. Age quail by wings.
2. Identify internal parasitic worms by species.
3. Demonstrate proper microscope handling.

Lesson Concept

Internal parasites affect birds differently based on their age.

TEKS

(4) Scientific Investigation & Reasoning (A) use appropriate tools to collect, record, and analyze information, including **journals/notebooks**, beakers, Petri dishes, meter sticks, graduated cylinders, hot plates, test tubes, triple beam balances, **microscopes**, thermometers, calculators, computers, timing devices, and **other equipment** as needed to teach the curriculum; and (B) use preventative safety equipment, including chemical splash goggles, **aprons**, and **gloves**, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.

Grade: 6
Subject: Science
Time Required: 2 hours
Group Size: 2-3
Approx. Cost: $12*

Birds are often infected with internal and external parasites that can affect their ability to survive and reproduce. Generally, we hear about external parasites that often affect our own companion animals such as fleas and ticks. However, many animals, even our own can become infected with internal parasites such as worms through food consumption, social behavior, and other modes of transmission.

Internal worms termed "helminth" can be found throughout the body of a bird, for this lesson we will focus on quail. Many of these worms are organ specific meaning a particular species is found within a certain organ. For example, *Oxyspirura petrowi* are found within the eyes of birds. Knowledge of parasites that are infecting species of interest is important in managing the species and controlling parasites.

In Texas, there are three quail species that can be found depending on the location within Texas and habitat. The Northern Bobwhite (*Colinus virginianus)* can be found throughout most of the state whereas the Scaled Quail (*Callipepla squamata*) can only be found in West Texas. Lastly, the Montezuma Quail (*Cyrtonyx montezumae*) can only be found in a very small portion of Western Texas. Scientists often study these species through trapping and monitoring programs but also through donations provided by hunters.

A scientist removing worms from a quail's organs.

Photo Credit: Kelsey Bedford

In this activity, students will learn the process of aging quail by using harvested Bobwhite wings and looking at feather coloring and molt pattern. Then, students will get the chance to explore internal parasites (worms) often found in these quail using a microscope while gowned up and gloved up like a real scientist!

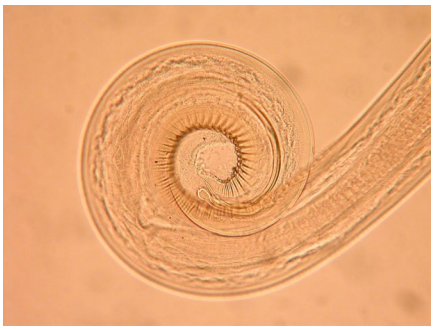
Materials

EXPLORE #1:

-"Aging Bobwhite Quail by Wings" PowerPoint
-Quail wings* (3/2-3 students)
-Juvenile and Adult identification cards (2/2-3 students)

EXPLORE #2:

-Light Microscope (1/2-3 students)
-Clean Microscope Slides* (3 slides/2-3 students)
-Worms in container* (Class Set)
-Tweezers/Forceps (1/microscope station)
-Small container with water (1/microscope station)
-Internal Worms ID Guide (1/3 students)
-"Bird Anatomy" Printout (1/3 students)
-Disposable Lab Coats (1/student) *optional*
-Nitrile Gloves (1 pair/student)



Oxyspirura petrowi
from Scaled Quail
Photo Credit: Kelsey Bedford

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Grade 6, Science

Keywords

Intensity of parasite infection: # of parasites found within host
Necropsy: opening and inspection of a dead animal for removal of organs or body parts and tissue collection
Carcass: dead body of an animal
Wet mount: a glass slide holding a specimen suspended in a drop of liquid for microscopic examination
Protocol: a standard procedure for conducting a task
Molt: to shed feathers periodically

Teacher Background

Molt is the process by which birds lose feathers and replace them. Young birds molt to get their adult feathers, and adults will molt seasonally to replace older feathers. In the change from young to older bird there is often a color change in the wing feathers of the bird– often going from lighter to darker. Also, as birds age their feathers often wear from use so they will appear ruffled, broken, and will even miss parts of the individual feather. You can often age a bird down to the day by the primary feather that is missing. This varies across species and is beyond the content for this lesson. Please refer to the "Aging Bobwhite Quail by Wings" PowerPoint for a few more details on feather molt. Depending on the level of your students, you may want to focus solely on buffy versus non-buffy primary coverts to identify juvenile versus adult. If your students are slightly more advanced and time allows, you can have them identify the feather they are currently replacing.

The degree of harm caused by parasites is exacerbated by drought or any stress-related condition. Wet conditions may actually increase transmission due to the increase in intermediate host (insect) survival. In Texas, the last few years have been heavily stricken with drought leaving quail species to decline. Much to our surprise, most adult quail are the ones most affected by the presence of internal parasites. These parasites are found throughout their body causing infection and reduced immunity in particularly stressed quail.

***Procyrnea pileata* from Scaled Quail**
Photo Credit: Kelsey Bedford

Website(s):
"Sexing and Aging the Northern Bobwhite"
http://agrilife.org/texnatwildlife/files/2010/09/A074.pdf
"Parasites and Diseases in Texas Quail"
http://www.ckwri.tamuk.edu/home/news/article/parasites-and-diseases-in-texas-quail/
"Research: Parasites Possible Cause for Declining TX Quail Pops"
http://www.fieldandstream.com/blogs/field-notes/2012/02/research-suggests-parasitic-worms-possible-cause-declining-quail-populatio

Engage

Teacher: "How many of you have a dog?"
Students raise hands.
Teacher: "Those of you that have dogs or have seen a dog, are there certain bugs that tend to be on them?"
Student: "Yes, fleas!"
Teacher: "Yes, fleas are called external parasites because they are on the outside of the body, but dogs can also have INTERNAL parasites like worms. Did you know that a lot of other animals can also have these same parasites? Even birds?"
Students: "Yes/No"
Teacher: "Yes they can! And today that's what we will be learning about, parasites in wild birds, specifically in quail. Do you all know what a quail is?"
Students: "Yes/No"
Teacher: ((Shows image of quail on projector)) "This is a Northern Bobwhite, a species of quail. And today we will be learning how to tell the age of these birds by using wings and tomorrow we will look at some worms (internal parasites) that they can be infected with using a microscope! Why are we looking at these two things? Well these are two steps that scientists take to learn more about parasites and how they affect birds of different ages. Are you all ready to get started?"

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Procedure

TEACHER	STUDENT	CONCEPT
EXPLORE #1 (DAY 1, 1 HOUR):		
1. Present "Aging Bobwhite Quail by Wings" Powerpoint to class. Be sure to move slowly and point out differences between adult and juvenile wings. Be sure to emphasize that you will be aging Bobwhite quail and their wings will look much different then other species of quail (different colors, patterns).		
2. Separate students into groups of 2 or 3. Pass out 3 wings (or more if available) and juvi/adult ID cards to each group for aging. Working as a group have them identify whether the wing came from a juvenile or adult quail by placing the identification cards at each wing.		Feathers and the molt pattern show scientists the age and often sex of a bird.
3. Once all have been identified, go through various wings to point out the differences in person while discussing with the class.		
4. End activity by mentioning that age is a determining factor in how they birds are affected by disease. For example, in humans, the old and the very young (babies) are most affected by disease due to their lack of/weakened immune systems. In quail, age also affects whether more internal parasites affect them. Older birds generally have more parasites then the young ones, ask students why they think that is?? ((older birds have more time to accumulate parasites))	"They're protecting their young more and probably fighting, so touching other infected birds." "They're older and aren't as strong as younger ones so they can get attacked more by the parasites?"	
EXPLORE #2 (DAY 2, 1 HOUR):		
1. Set up microscopes at various stations with about 3 mounted worms available per station. You can do this or have students wet-mount each worm from the container. Using tweezers remove a worm from the container and place is on a slide, using the dropper and water container, place one drop onto the worm on the slide. Keep a worm ID guide and quail anatomy printout at each station. If you are not allowing students to move microscope parts, focus a slide and tape knobs in place.		
2. As students come in allow them to pick up a lab coat and pair of gloves. Instruct them to gown and glove up.		
3. Separate students into groups of 2-3 and assign them a station.		Internal parasites have different characteristics that allow them to be identified to species.
4. Announce that today they will be looking at internal parasites/worms found in quail and they will be ID'ing the species and talking about the differences among their groups.		
5. Once they have all ID'ed their worms have them record the names and discuss them among the class.		
WRAP UP & FOLLOW UP:		
- End the lesson by asking the students which species did they get to identify from their samples. Did they get multiple species?	"We got 3 different ones!"	
-Were students able to sex the worms? What internal structures did they see under the scope?	"We could see eggs in this one, is it a girl?" "We can see the mouth!"	
-If preferred, have students help clean up. Have students dispose of their gloves and coats.		
- Follow up in a few days by quizzing the students on aging quail wings. Which age is most affected by internal worms? Do they think there would be a difference between males and females? ((M/F bobwhites spend most of their lives together)) Again, why do they think that is?	"The older quail get more worms!"	

Assessment

Pre-Assessment
Discuss the process of quail aging by use of wings and feather molt. (Objective 1)

Activity Embedded Assessment
Age wings of quail species (Objectives 1)
Identify internal worms by using the microscope and ID guide (Objective 2 & 3)

Post-Assessment
Discuss worm diversity and internal structure and how parasite number relates to bird's age (Objective 2)

Activity Extensions

Tally up the number of each worm species found in the class. Have students graph out the abundance of each species using the bar chart in Microsoft Excel. For further extension, have students determine the most and least common species. Based on what they saw under the scope students may also be able to identify a male versus a female worm, have them compare those by numbers as well. Students can also graph out the distributions of ages based on the quail wings.

Activity Scaling

For younger students, do not have them identify age of the birds by using the wings but rather have them discuss the differences between the wings given to their group. For worm identification, have slides mounted and in focus for them to look at but not to handle slides or microscope. Have students flip through the worm ID book and discuss differences between them all.

For older or advanced students and if a chemistry lab with proper chemicals is available, you can search for quail donations* to have students necropsy and remove organs to begin searching for worms. Students can then prepare worms for proper viewing on a wet mount under the microscope by following the protocol provided by K. Bedford at the end of this document. Of the worms removed from the quail, students can also begin identifying differences between nematodes (round worm) and cestodes (tape or segmented worm).

Donations*

Quail Wings

-Dr. Leonard Brennan of CKWRI at TAMUK

-Texas Parks & Wildlife

-Hunters

-Private Ranches

Worms/Internal Parasites

-Contact science faculty at various colleges and universities including Texas A&M University-Kingsville.

References

Bedford, K. 2015. Parasitological Survey of Scaled Quail from West Texas. M.S. Thesis, Texas A&M University-Kingsville.

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Protocol for Quail Necropsy and Helminth Parasite Preparation (K. Bedford 2015)

Preparation for Necropsy

Entire carcass should be sealed in individual zip-lock plastic bags and placed in a Styrofoam cooler with dry ice immediately after death. To accelerate the freezing process, 95% ethanol will be applied to the dry ice. Rapidly freezing the carcass insures helminths are immobilized in their current position and to reduce degradation of parasites. The cooler should be placed in a deep freezer until it is time for the necropsy.

Necropsy of Carcasses

Frozen carcasses should be placed in the refrigerator to thaw one day prior to necropsy. To prevent degradation of helminths, only carcasses intended for necropsy the following day should be thawed and specimens will not be frozen repeatedly. The heads should be removed and the surface of the eye and under the nictitating membrane and eye lid will be examined for eyeworms under a dissecting microscope. The eye should be removed to access the lacrimal duct, conjunctival sac, and associated tissues and examined. The nasal cavity, sinuses, and brain should be dissected and inspected for helminths. The respiratory tract (trachea and lungs) and viscera (heart, kidney, liver, gall bladder, esophagus, crop, proventriculus, gizzard, pancreas, spleen, small intestine, large intestine, and cloaca) should be dissected and washed thoroughly into sedimentation glasses and examined under a dissection scope for helminths. The crop should be opened and the contents inspected for helminths. The crop lining should be scraped and also examined. The gizzard should be opened, the grit and food removed, and inside lining of the gizzard separated from the organ. The resulting exposed surface of the gizzard lining should be examined for helminths. The proventriculus should then be opened and the mucosal glands should be squeezed with forceps to extract helminths within them. The intestinal tract (small intestine, ceca, and large intestine) should be removed, carefully opened with tweezers, and examined for helminths. Each organ, the body cavity, muscle tissue, and visceral sediment should be washed into individual sedimentation glasses. The contents should then be flushed until the sediment and helminths can be seen clearly through the water. The debris from each organ should then be flushed into a Petri dish and examined under a dissecting microscope. Any tissue damage (e.g. lesions, inflammation, etc.) observed during the necropsy should be noted and photographed. Following these methods will ensure a complete account of all helminths present within each bird.

Identify and Count Helminth Parasites

All helminth specimens should be kept in individually marked vials per microhabitat (location of helminth in the host) and host bird. Nematodes should be fixed in 95% glacial acetic acid for 1–5 minutes before being preserved in 70% alcohol and 8% glycerin. For identification and counting, they should be examined under microscope on alcohol-glycerin wet mounts. If further identification is needed, nematodes will be cleared with glycerin. Acanthocephalans, cestodes, and trematodes should be fixed in acid-formalin-ethyl alcohol (AFA) for several minutes and then preserved in 70% alcohol. They should be mounted on alcohol wet mounts for examination and identification. If necessary for identification, the acanthocephalans, cestodes, and trematodes should be stained with Mayer's carmine alum and mounted in Canada balsam on microscope slides.