Kelly Miller

Abstract

Waterfowl make ideal final hosts for many types of parasites. Their reliance on marshy areas and bodies of water to live and breed causes them to live in areas thick with intermediate hosts. Three species of waterfowl were dissected and examined for parasites: *Anas crecca*, *Anas clypeata*, and *Anas strepera*, whose common names are Green-winged Teal, Northern Shoveler, and Gadwall respectively. All species studied were dabblers, live in marsh environments, and nest on the ground. These species are differentiated by their feeding preferences and migration patterns. Species that eat small swimming invertebrates like the Northern Shoveler, and plants, such as the Gadwall, have a greater chance of being infected than seedeaters such as the green-winged teal. Hosts that migrate increase the likelihood of contracting different species of parasites. The green-winged teal is the only species studied that lives year-round in Colorado and therefore one might expect to see fewer parasites in this species.

In all of the nine waterfowl dissected in this experiment multiple parasites were recovered. A chi-squared test revealed that there are significant differences in the frequencies at which parasites infect these three species. General trends show that Gadwalls are the most susceptible to acanthocephalan and trematodes and that tapeworms tend to invade Northern Shovelers more than Green-winged Teals or Gadwalls. Overall Gadwalls acted as finals hosts to more parasites than either of the other birds. One specimen of gadwall hosted 151 acanthocephalans.

Compared to the other waterfowl species the Green-winged Teal appears less prone to parasites. Studies have found that when corrected for population size, the number of parasite species found is positively correlated to the distance of geographic range (Gregory, 1990). There are a couple of theories for why this might be. From a parasites vantage point the lack of migration makes this species less appealing. Bird species that migrate have greater exposure to a diverse range of parasites and can spread parasites to other bird communities they encounter during migration. Since Gadwalls and Northern Shovelers come to Colorado to breed this increases the fitness (ability to spread) of the parasites, which proves to be evolutionary advantageous. Summer breeding of waterfowl and a host-parasite co-evolution explanation can account for why trematodes are most abundant in the summer (Kube et al., 2002).

Northern Shovelers had the largest total number of parasites if one discounts the extraordinarily high value of 151 acanthocephalans found in one of the Gadwalls. The Northern Shovelers' diet consists of small invertebrates, which is unique in the three studied species. This direct frequent consumption of intermediate hosts provides an easy avenue for parasitic invasion. This is especially true because certain species of trematodes and acanthocephalan can manipulate intermediate hosts' behavior, such as positive or negative phototaxis, to increase the likelihood of predation by a definitive host (Beisel and Médoc, 2010).

In addition to the chi-squared test multiple t tests were run. No statistically significant p values were found. Due to time and seasonal limitations the sample size in this study was rather small and before discounting any significance in means a larger sample size should be dissected. Gregory (1990) suggests that along with the previously mentioned biological explanations sample size can be a great determinate for differences in parasitic frequency.

References

Beisel, J. N. & Medoc, V. 2010. Bird and amphipod parasites illustrate a gradient from adaptation to exaptation in complex life cycle. *Ethology Ecology & Evolution*, **22**, 265-270.

Gregory, R. D. 1990. PARASITES AND HOST GEOGRAPHIC RANGE AS ILLUSTRATED BY WATERFOWL. *Functional Ecology*, **4**, 645-654.

Kube, J., Kube, S. & Dierschke, V. 2002. Spatial and temporal variations in the trematode component community of the mudsnail Hydrobia ventrosa in relation to the occurrence of waterfowl as definitive hosts. *Journal of Parasitology*, **88**, 1075-1086.

Waterfowl Behaviors that Enhance Parasitic Invasion

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Introduction

- Main Ideas:
  - Waterfowl act as final hosts for many types of parasites, which are often found in their intestine.
  - This experiment was to study which bird species are more susceptible to parasites and what behaviors contribute to becoming a host.

Hypothesis

- Birds that eat invertebrates and plants are more prone to hosting parasites than seed eaters.
  - Null: There is no difference in number of parasites found in invertebrates/plant eaters than seed eaters.
- Parasites are more likely to invade waterfowl that migrate over longer distances than waterfowl that migrate short distances or not at all.
  - Null: There is no difference in total number of parasites in birds that migrate to Colorado and birds that live in Colorado year round.

Background Information

	Green-Winged Teal	Northern Shoveler	Gadwall
Size	Small	Medium	Medium
Food	Seeds	Small invertebrates/ plants/seeds	Plants
Time in Colorado	Year round/Winter Non-Breeding	Summer (Breeding)	Summer (Breeding)

All About Birds. The Cornell Lab of Ornithology. 2009

Behaviors – Dabblers
Habitat – Marsh
Nesting – Ground

What We Know

- A study in England found that host body size, population density, nor social tendency correlate significantly with the number of species of parasites found in a bird species. They did conclude that in waterfowl there is a positive correlation between migration behavior, as well as diet and lifespan, and number of parasitic species found. (Gregory, 1990)
- Trematodes are most abundant in summer. (Kube et al., 2002) Northern Shovelers and Gadwalls migrate to Colorado during summers to breed.
- Certain species of trematodes and acanthocephalan can manipulate intermediate hosts' behavior, such as positive or negative phototaxis, to increase the likelihood of predation by a definitive host (Beisel and Médoc, 2009).
- Along with the previously mentioned biological explanations sample size can be a great determinate for differences in parasitic frequency. (Gregory, 1990)

Materials

- Nine total bird intestines obtained from hunting lodge
  - 3 Northern Shoveler
  - 3 Gadwall – Top right
  - 3 Green-winged Teal – bottom right

Materials Cont.

- Dissection tools
  - Small scissors
  - Tweezers (Forceps)
  - Dissection Microscope
  - Small vials
  - Dissection tray
  - Clear plastic trays
  - Gloves
  - 70% ethanol

Methods

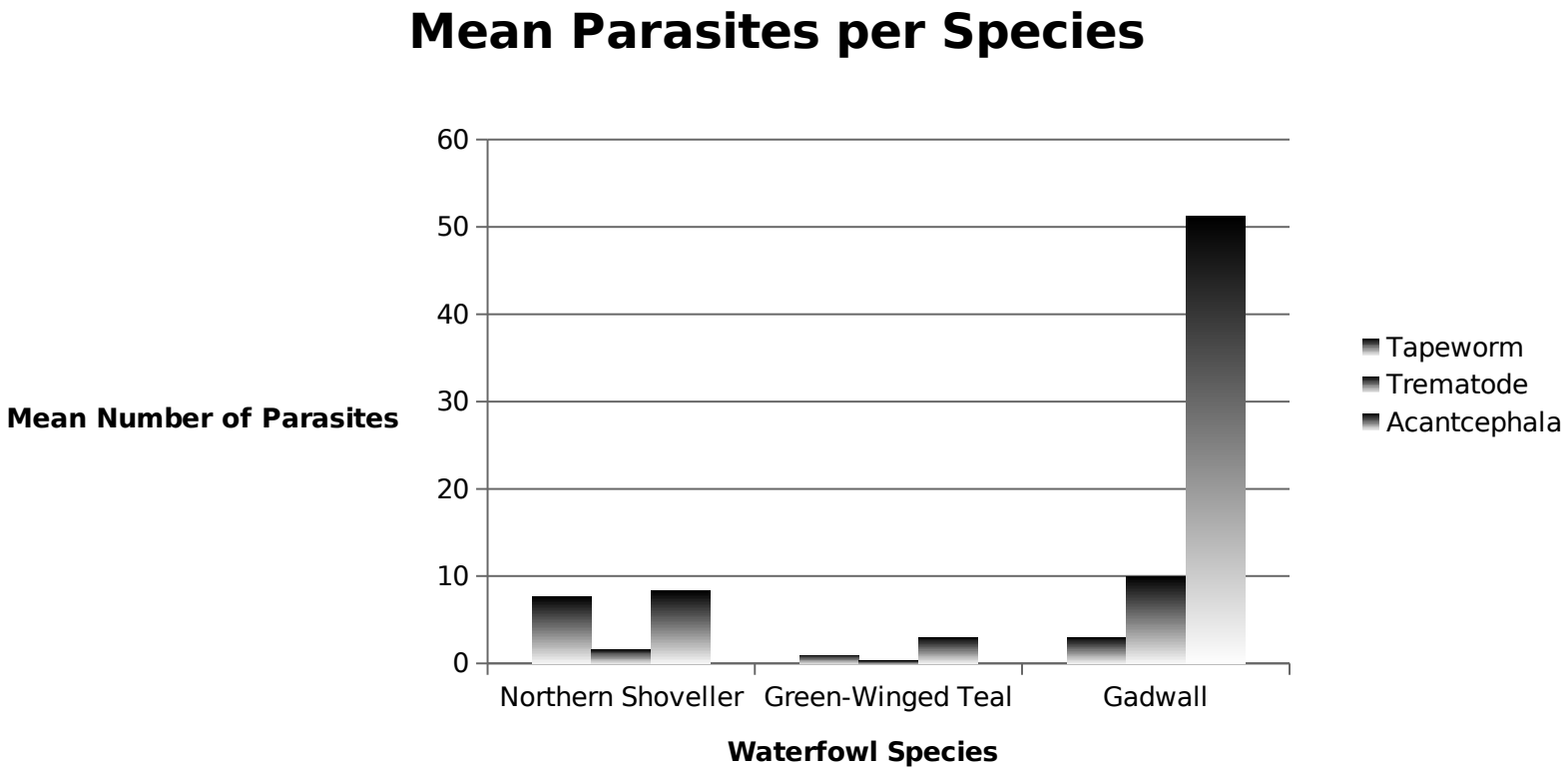
- Obtained bird intestines from a hunting lodge and preserve in ethanol.
- Carefully dissected three birds from three different species for a total sample size of nine:
  - Green-winged teal
  - Gadwall
  - Northern Shoveler
- Recorded every parasite found and placed in a small vial full of 70% ethanol
- Calculated a chi-squared value by summing: the observed results minus expected all divided by expected values
- If the chi-squared value is greater than that expected for the degrees of freedom at an alpha level of .05 then the pattern is non-random.

Results

	Northern Shoveler	Green-winged teal	Gadwall
Total Tapeworm	23	3	9
Total Trematode	5	1	30
Total Acanthocephalan	25	9	154
Mean Tapeworm	7.6667	1	3
Mean Trematode	1.6667	.3333	10
Mean Acanthocephalan	8.3333	3	51.3333

Acanthocephalan in Gadwall

Graphical Representation of Means



Chi-Squared Test

OBSERVED	Northern Shoveler	Green-winged teal	Gadwall	TOTAL
Tapeworm	23	3	9	35
Trematode	5	1	30	36
Acanthocephalan	25	9	154	188
TOTALS	53	13	193	259

EXPECTED	Northern Shoveler	Green-winged teal	Gadwall
Total Tapeworm	7.16	1.76	26.1
Total Trematode	7.37	1.81	26.8
Total Acanthocephalan	38.5	9.44	140

Chi-Squared and T Tests

- Chi-square = 54.7
- Degrees of freedom = 4
- Critical value from table with alpha of .05 and df 4:
  - 9.49
  - 9.49<54.7
- Probability = 0.000
- Multiple t-tests between mean parasites in bird species and number of parasites of specific types resulted in no significant statistical findings.

Discussion

- Critical value for chi-squared indicates pattern in data that is different than random.
- General trends:
  - Gadwalls had highest total frequency of parasites
  - Northern Shovelers had second highest (or highest if the 151 acanthocephalan are discounted)
  - Green-winged Teals had fewest number of parasites

Discussion Cont.

- Northern Shovelers eat small invertebrates which is unique in the three species studied.
  - Small invertebrates act as intermediate hosts
  - Species of trematodes and acanthocephalan manipulate the intermediate host behavior (Beisel and Medoc 2010)
  - Positive or negative phototaxis to bring towards surface during high feeding times and away from non-definitive host predators during low feeding times. (Levri 1998)
- Green-winged Teals were only species studied that lived year round in Colorado.
  - Had fewest number of parasites
  - There is a positive correlation for parasite species richness and geographic range of waterfowl (Gregory 1990)
  - Gadwalls and Northern Shovelers have exposure to greater diversity of parasites and have opportunity to spread parasites over larger distance and to a greater number of ecosystems.
- Co-evolution between hosts and parasites can help to account for both feeding behaviors and migration behaviors related to increased parasitic frequency

Discussion Cont.

- Findings support hypothesis
  - The frequency in which specific families of parasites show up in species of waterfowl is different than random
  - General trends show greater number of parasites in birds that migrate and in birds that eat invertebrates
  - Not mutually exclusive (Northern Shoveler)
- Follow up multiple t-tests did not provide statistically significant probabilities for non-random differences in means
- Along with host migration and eating behavior, sampling size is a huge factor in determining patterns in parasite frequency among bird species (Gregory 1990)
  - A larger sample size should be studied to see if t-tests provide significance.

References

- **Beisel, J. N. & Medoc, V.** 2010. Bird and amphipod parasites illustrate a gradient from adaptation to exaptation in complex life cycle. *Ethology Ecology & Evolution*, 22, 265-270.
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- **Levri, E. P.** 1998. The influence of non-host predators on parasite-induced behavioral changes in a freshwater snail. *Oikos*, 81, 531-537.

Questions?