Ectoparasites in Lekking Sharp-tailed Grouse, *Tympanuchus phasianellus*

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To investigate the validity of assumptions based on the parasite avoidance model, fifty-two male Sharp-tailed Grouse (*Tympanuchus phasianellus*) collected in northern Ontario from six separate leks were examined. Ectoparasitic burdens were recorded along with traits (feather damage, hematomas, body condition, body mass) and cues (territorial position, age) which may be used by the female to discriminate among males for their parasite loads. Neither assumption of the transmission avoidance model was met. Little variation in ectoparasite number existed in the breeding population as a whole or within individual leks. None of the traits or cues measured were correlated consistently with ectoparasitic burdens. These results suggest that randomly mating females would, on "average," mate with lightly infested individuals. Therefore, benefit to a discriminating female Sharp- tailed Grouse would be negligible.

Key Words: ectoparasites, lek, Sharp-tailed Grouse, *Tympanuchus phasianellus*.

A lek can be defined as an area used for mating, where males establish territories to form a cluster. Females visit the lek for the sole purpose of mating; resources on the lek (e.g., food) are limited. Although females have the opportunity to select any one of the males present as a mate, they often show unanimity in their choice of mate, selecting males occupying centrally located territories on the lek (Lumsden 1965; Kermott 1982). In this simple mating system, female mate-choice is theoretically based only on the benefits derived from the male himself.

The "parasite" or "transmission avoidance" model suggests that females prefer to mate with males with low ectoparasite numbers to reduce the probability of becoming infested (Borgia and Collis 1990; Clayton 1990). Two important assumptions of this model are that enough variation in ectoparasite number per male exists in the breeding population (and more specifically on individuals within a lek) to make mate choice worthwhile (Reynolds and Gross 1990), and that a trait or cue correlated with ectoparasitic burden facilitates choice. In this study, we determined if these assumptions of the transmission avoidance model are valid by examining individuals from leks of the Sharp-tailed Grouse (*Tympanuchus phasianellus*).

Methods

Study sites were located in areas of muskeg near Fort Albany (52°15'N; 81°35'W) in the James Bay Region of northern Ontario. One researcher accompanied several Native North Americans on their spring hunt for Sharp-tailed Grouse and examined birds shot before they were processed for food.

Fifty-two males were examined from six separate leks during the 1990–1992 breeding seasons. The numbers of birds obtained and the total numbers of males at each lek were as follows: lek 1, 2 of 22; lek 2, 12 of 15; lek 3, 8 of 17; lek 4, 4 of 12; lek 5, 16 of 19; and lek 6, 10 of 13. Leks 5 and 6 were observed for 12 days during the morning display period prior to collection to record copulations by individual males. Yearlings were differentiated from adults using the characteristic of feather-wear (Ammann 1944). Males were scored in the field, before they were collected, as occupying central vs. peripheral territories. Central territories were defined as those completely surrounded by other territories whereas peripheral territories were unbounded on at least one side (Kruijt and Hogan 1967).

Upon being shot, individuals were placed separately in plastic bags to prevent migration of ectoparasites between hosts (Eveleigh and Threlfall 1976). A feather-by-feather examination was conducted and ectoparasites were placed in 70 % alcohol for subsequent identification (Ash 1960; Eveleigh and Threlfall 1976). Feather damage was assessed for each specimen with individuals being placed in one of three categories: 0 (no damage to minimal); 1 (average damage); 2 (severe damage) [Clayton 1990]. Cervical apteria of each individual were assessed for presence or absence of hematomas (Johnson and Boyce 1989).

Individuals were weighed to the nearest 1.0 g using a spring scale or triple-beam balance. The physical condition of each male was assessed using an index based on the shape of pectoral muscle from keel to sternum (Macdonald 1962). Condition of males was classified as follows: 0, in good condition (pectoral muscle distinctly convex and keel almost imperceptible); 1, in average condition (pectoral muscle flattened forming a planar surface between keel and thoracic ribs); 2, in poor condition (pectoral muscles concave and keel distinct). Spearman rank correlation analysis (r_s) was used to investigate the relationship between ectoparasite number and body mass among individuals of all leks.

Ectoparasite data, number of ectoparasites per individual, were pooled for all six leks and a frequency distribution was plotted. Frequency distributions, number of ectoparasites per individual, were constructed for individual leks at which more than 75% of males present on the lek were collected.

Data for ectoparasites were subjected to a Mann-Whitney U test between central and peripheral males for leks at which more than 75% of the males were examined and for all leks combined. In addition, ectoparasite data for all leks were subjected to a Mann-Whitney U test to determine whether adults and yearlings differed.

Results

Of the 52 birds examined, 40 were classified as

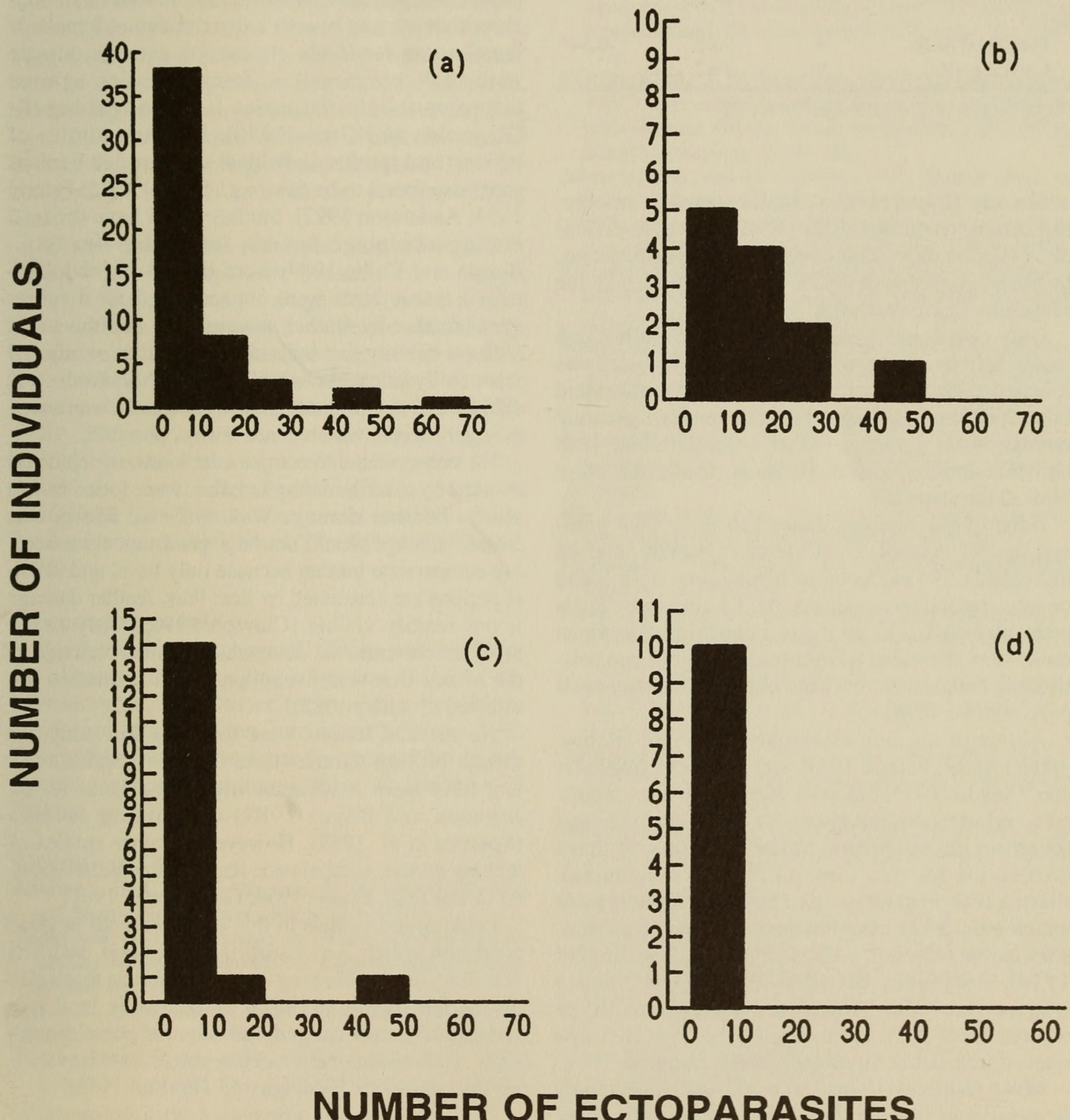

FIGURE 1. Frequency distributions of ectoparasites on lekking Sharp-tailed Grouse: a (all six leks combined), b (lek 2), c (lek 5), and d (lek 6).

TABLE 1. A comparison of ectoparasite number per individual male Sharp-tailed Grouse and its territorial location, peripheral or central on leks, using Mann-Whitney U tests.

	N	Ectoparasites per Individual $\bar{x} \pm SD$	Z^a
All leks			
Peripheral males	26	6±8	-2.37^*
Central males	26	13±14	
Lek 2			
Peripheral males	7	13±14	-1.07^{ns}
Central males	5	18±8	
Lek 5			
Peripheral males	8	4±3	-2.11^*
Central males	8	12±13	
Lek 6			
Peripheral males	4	5±2	-0.54^{ns}
Central males	6	4±2	

[a]Significance of Z: ^{ns}, $P > .28$; *, $P < 0.05$

adults and 12 as yearlings. Males scored as occupying central territories, 50% (N = 26) of all individuals, included only adult birds. The peripheral males, however, consisted of 46.2% (N = 14) adults with the remainder being yearlings.

Only two copulations were recorded during this study, both by central males. One of those males was infested with nine ectoparasites and the other had five. Neither individual had the least or greatest number of ectoparasites in their respective leks; both had infestations within the range found for other birds at the same lek.

None of the sampled males had more than minimal feather damage, even the most heavily infested individuals. No evidence of hematomas were found on any specimens examined. All lekking individuals were classified as being in good condition. Spearman rank correlation analysis showed no significant relationship between ectoparasite number and body mass ($r_s = 0.04$, $P = 0.76$).

Although the tick *Haemaphysalis* spp. (Baumgartner 1939; Peterle 1954) and the louse *Goniodes* spp. (Snyder 1935; Emerson 1951) have been reported to infest Sharp-tailed Grouse, only the latter was found on the specimens examined. The frequency distribution for data from all the leks (Figure 1a), illustrates the characteristic "hollow" curve type in which most hosts have few parasites and most parasites are on only a few hosts (Eveleigh and Threlfall 1976). Frequency distributions for lek 2 and 5 (Figure 1b,c) also showed the hollow curve type whereas data from lek 6 (Figure 1d) revealed low rates of infestation for all individuals sampled.

Mann-Whitney U tests showed that individuals possessing central territories had significantly more ectoparasites than males occupying peripheral territories in lek 5 and in all leks combined (Table 1). On leks 2 and 6, there was no significant difference in ectoparasitic burden between central and peripheral males (Table 1). Ectoparasite number did not differ significantly (P = 0.49) between adult and yearlings males for all leks combined (adults: N = 40, $\bar{x}$ = 10.65, SD = 13.25; yearlings: N = 12, $\bar{x}$ = 5.92, SD = 4.66). Also, it is noteworthy that peripheral males (independent of age) harboured fewer parasites than central males.

Discussion

In the present study, it was found that during the mating season, there appeared to be neither enough variation in ectoparasites per male in the lekking population, and more importantly, between individuals within a lek to benefit a discriminating female. If females can randomly choose, on average, a mate with few ectoparasites, female choice against ectoparasite-infested males is of no real benefit (Reynolds and Gross 1990). In other studies of lekking bird species, individual ectoparasitic burdens were also found to be low (e.g., Snyder 1935; Peterle 1954; Andersson 1992). Studies which have shown a mating advantage for non-infested males (e.g., Borgia and Collis 1989) were limited methodologically because birds were not sacrificed for a subsequent feather-by-feather examination, and there is a 10% probability that individuals scored as uninfested were really infested (Ash 1960). In other words, it is difficult, to quantify ectoparasite loads without sacrificing the birds, which is not always possible.

No traits, related to ectoparasite loads, which could be used by discriminating females, were found in this study. Feather damage was minimal. Moreover, feather damage would not be a good trait for assessing ectoparasite burden because only basal and medial regions are consumed by lice; thus, feather damage is not readily visible (Clayton 1990). Only in the most severe cases do ectoparasites tatter plumage to the extent that water repellency and insulation are affected (Soulsby 1982).

No cervical lesions were found in this study, although in Sage Grouse (*Centrocercus urophasianus*) lice have been associated with hematomas (e. g., Johnson and Boyce 1989) and mating success (Spurrier et al. 1989). However, in other studies of lekking grouse, ectoparasitic lesions have been reported as rare (e.g., Peterle 1954; Gibson et al. 1991).

Lekking individuals in this study were all in good condition which is not surprising as good health is necessary in establishing and maintaining territories on the lek (Kermott 1982). Ectoparasitic load was not significantly related to body weight although such relationships have been reported in other studies (Snyder 1935; Eveleigh and Threlfall 1976).

Cues consistently correlated with ectoparasite numbers were not evident in the present study. Although occupancy of central territories in Sharp-tailed Grouse leks has often correlated with male mating success (e.g., Lumsden 1965; Kermott 1982), in the present study, pooled data revealed that central males had significantly larger ectoparasitic burdens compared to peripheral individuals. Within individual leks, only lek 5 showed a similar trend, with lek 2 and 6 showing no significant differences. Perhaps, the relatively large number of individuals examined from lek 5 had a disproportionate influence on the Mann-Whitney U test, when all leks were combined. Nevertheless, central males may sometimes show higher parasitic burdens compared to peripheral individuals due to increased physical contact during the breeding season, as a consequence of small territory sizes (Lumsden 1965) increasing the chance of infestation (Ash 1960). Also, Borgia and Collis (1990) suggested that age-related grooming may be important in controlling louse populations in birds, decreasing loads being associated with increasing age. This was not true with the sharptails studied here as there was no significant difference between ectoparasitic burdens on adult and yearling lekking males.

In overview, it does not appear that the benefit of reduced risk of ectoparasite transmission to female sharptails during mating is a significant factor in mate choice. However, females nonetheless should keep ectoparasites in check because parents can transfer lice to offspring and offspring may be more sensitive to ectoparasites than adults (Marshall 1981; Clayton 1990). This may be the reason why female grouse of lekking species shake vigorously and preen themselves after successful copulation (e.g., Lumsden 1965), as it is known that lice can be transferred during copulation (Eveleigh and Threlfall 1976; Clayton 1990).

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Literature Cited

Ammann, G. A. 1944. Determining the age of Pinnated and Sharp-tailed Grouses. Auk 8: 170–171.

Andersson, S. 1992. Female preference for long tails in lekking Jackson's widowbirds: experimental evidence. Animal Behaviour 43: 379–388.

Ash. J. S. 1960. A study of the Mallophaga of birds with particular reference to their ecology. Ibis 102: 93–110.

Baumgartner, F. M. 1939. Studies on the distribution and habits of the Sharptail Grouse in Michigan. Transactions of the North American Wildlife Conference. 4: 485–490.

Borgia, G., and **K. Collis.** 1989. Female choice for parasite free male satin bowerbirds and the evolution of bright male plumage Behavioral Ecology and Sociobiology 25: 445–454.

Borgia, G., and **K. Collis.** 1990. Parasites and bright male plumage in the Satin Bowerbird (*Ptilonorhynchus violaceus*). American Zoologist 30: 279–285.

Clayton, D. H. 1990. Mate choice in experimentally parasitized Rock Doves: lousy males lose. American Zoologist 30: 251–262.

Emerson, K. C. 1951. A list of Mallophaga from gallinaceous birds of North America. Journal of Wildlife Management 15: 193–195.

Eveleigh, E. S., and **W. Threlfall.** 1976. Population dynamics of lice (Mallophaga) on auks (Alcidae) from Newfoundland. Canadian Journal of Zoology 54: 1694–1711.

Gibson, R. M., J. W. Bradbury, and **S. L. Vehrencamp.** 1991. Mate choice in lekking sage grouse revisited: the roles of vocal display, female site fidelity, and copying. Behaviour Ecology 2: 165–180.

Johnson, L. L., and **M. S. Boyce.** 1989. Female choice of males with low parasite loads in sage grouse. Pages 377–388 *in* Bird-parasite interactions. *Edited by* J. E. Loye and M. Zuk. Oxford University Press, Oxford, UK.

Kermott, L. H. 1982. Breeding behavior in the Sharp-tailed Grouse. Ph.D. dissertation. University of Minnesota, St. Paul, Minnesota, USA.

Kruijt, J. P., and **J. A. Hogan.** 1967. Social behavior on the lek of the black grouse, *Lyrurus tetrix tetrix* (L.). Ardea 55: 203- 240.

Lumsden, H. G. 1965. Displays of the Sharp-tailed Grouse. Research Report 66. Ontario Department of Lands and Forests, Research Branch, Toronto, Ontario, Canada.

Macdonald, J. W. 1962. Mortality in wild birds with some observations on weights. Bird Study 9: 147–167.

Marshall, G. 1981. The ecology of ectoparasitic insects. Academic Press, London, UK.

Peterle, T. J. 1954. The Sharp-tailed grouse in the upper peninsula of Michigan. Ph.D. dissertation. University of Michigan, Ann Arbor, Michigan, USA.

Reynolds, J. D., and **M. R. Gross.** 1990. Costs and benefits of female mate choice: is there a lek paradox? American Naturalist 136: 230–243.

Snyder, L. L. 1935. A study of the Sharp-tailed Grouse. University of Toronto Studies Biological Series 40: 5–66.

Soulsby, E. J. L. 1982. Helminths, arthropods, and protozoa of domesticated animals. Bailliere Tindall, London, UK.

Spurrier, M. F., M. S. Boyce, and **B. F. J. Manly.** 1989. Effects of parasites on mate choice by captive sage grouse. Pages 389–398 *in* Bird-parasite interactions. *Edited by* J. E. Loye and M. Zuk. Oxford University Press, Oxford, UK.

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