

INTESTINAL PARASITES IN THE CANTABRIAN CAPERCAILLIE *TETRAO UROGALLUS CANTABRICUS*: A COPROLOGICAL STUDY

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SUMMARY.—*Intestinal parasites in the Cantabrian Capercaillie, Tetrao urogallus cantabricus: a coprological study.* The intestinal parasites of the Cantabrian Capercaillie were studied by counting the eggs of parasitic species found in 154 faecal samples from 34 localities in the Cantabrian mountains. Prevalence was 58% for *Eimeria* sp. and 25% for *Capillaria* sp.; however, both intensity and mean intensity of these parasites were very low if compared to other populations of Tetraonidae. Other parasites were infrequent and, specifically, we found no cestodes which are characteristic parasites of the genus *Tetrao* (*Raillietina* sp. and *Davainea* sp.). We conclude that it is unlikely that intestinal parasites cause the decline of Capercaillie populations in the studied localities of the Cantabrian range.

Key words: *Ascaridia*, Cantabrian range, Capercaillie, *Capillaria*, *Eimeria*, faecal analysis, intestinal parasites.

RESUMEN.—*Parásitos intestinales en el Urogallo Común Cantábrico Tetrao urogallus cantabricus: un estudio coprológico.* Los parásitos intestinales de los Urogallos Cantábricos Comunes se estudiaron analizando el número de huevos de estos parásitos que aparecieron en 154 muestras fecales correspondientes a 34 localidades de la cordillera Cantábrica. La prevalencia fue del 58% para *Eimeria* sp. y del 25% para *Capillaria* sp. No obstante tanto la intensidad como la intensidad media fueron muy bajas comparadas con las que pueden encontrarse en otras poblaciones de Tetraonidae. Otros parásitos fueron muy poco frecuentes y en concreto no se encontraron los céstodos típicos del género *Tetrao* (*Raillietina* sp. y *Davainea* sp.). Se concluye que es improbable que los parásitos intestinales sean la causa del declive observado en las poblaciones cantábricas de Urogallos Comunes.

Palabras clave: análisis fecal, *Ascaridia*, *Capillaria*, Cordillera Cantábrica, *Eimeria*, parásitos intestinales, Tetraonidae, Urogallo Común.

INTRODUCTION

Diseases and parasites have been proposed as factors associated to the decline in numbers of several Tetraonidae species. For example, Red Grouse *Lagopus lagopus scoticus* often have outbreaks of «grouse disease», when adults die in poor condition, parasitized by the caecal threadworm *Trichostrongylus tenuis*, whose prevalence is almost 100% in adults (Watson & Shaw, 1991). Population studies on this species also show a negative correlation between breeding success and the intensity of infection by *Trichostrongylus* (Hudson, 1986b; Shaw & Moss, 1989, 1990). It seems that infected Red Grouse could undergo an increase in their vulnerability to predators (Hudson,

1986a); however, this particular has not been confirmed by Moss *et al.* (1990). Within the *Tetrao* genus, the Black Grouse, *T. tetrix*, is parasitized by the protozoan *Leucocytozoon lovati* and microfilaria, probably produced by the nematode worm *Splendidofilaria tuvensis*. Höglund *et al.* (1992) found that parasites have no effect on adult mortality of Black Grouse males. Birds infected with microfilaria had shorter tail ornaments, which is compatible with the hypothesis of Hamilton & Zuk (1982). However, there is no evidence that parasitic infection can diminish mating success in *Tetrao* (Höglund *et al.*, 1992). This effect has been demonstrated in Sage Grouse (*Centrocercus urophasianus*) and in semi-captive Junglefowl (*Gallus gallus*; Zuk *et al.*, 1990). In fact, very

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little is known about the intestinal parasites of Capercaillie, *Tetrao urogallus*, which have been described by Bezubik (1969). Its nematode species throughout the Palaearctic Region were reviewed by Barus *et al.* (1984). De Franceschi (1994) asserted that parasites can increase Capercaillie mortality rate in the Italian Alps, where it suffers from the Nematoda *Ascaridia cylindrica* and the Mallophaga *Gonioides tetraornis*. However, there is no information at all about these parasites in the subspecies *T. u. cantabricus*.

The Cantabrian Capercaillie, *T. u. cantabricus*, population has declined during the last two decades and, although the available information on its population trends is still very scant, some studies have estimated about 25-50% population reduction in the last twenty years (Purroy, 1997, 1999). The most commonly reported limiting factors for Capercaillie are habitat reduction and fragmentation (Storch, 1991, 1997; Menoni *et al.*, 1997), predation, which might increase in fragmented habitats (Kurki *et al.*, 1997), competition with ungulates (Klaus & Bergmann, 1994; Moss & Picozzi, 1994; Picozzi *et al.*, 1996) and climatic change (Moss, 1985; Pulliainen & Tunkkari, 1991; Moss & Picozzi, 1994). The relevance of these factors varies according to geographical areas. In this study we examine the intestinal parasites found in the droppings to determine whether the infection by intestinal parasites might be a relevant factor for Cantabrian populations of Capercaillie.

STUDY AREA AND METHODS

Fresh droppings were collected in leks from the Cantabrian range between 25 March and 9 June 1998. This period was suitable to examine parasites in faeces because eggs laid by adult worms are voided in the droppings during the spring. Despite the droppings being very rare in the field, only fresh faeces were collected in order to avoid contamination by soil organisms. We collected 154 fresh droppings from 34 localities, 7 from northeastern León province and 27 from Asturias province (north of the Cantabrian range): Allande (1), Ibias (1), Degaña (1) and Cangas de Narcea (16) in the western Cantabrian range; Somiedo (2), Terverga (2), Lena (1) and Aller (1) in the center and Ponga (2) in the eastern Cantabrian range. The droppings

were introduced in plastic vials, kept in the refrigerator and sent to the laboratory and analysed within two days after collection.

Three grams of each sample were weighed and shaken in a saturated solution of potassium iodomercuriate, and the eggs of the parasites counted under the microscope. We assumed a positive relationship between the number of parasites and the number of worm eggs appearing in the droppings, as reported for captive Red Grouse (Shaw & Moss, 1989).

Because our method of evaluation of parasitic infection was indirect (droppings analysis), two or more samples might belong to the same bird. To avoid this source of error, one sample was taken from each group of droppings, and the samples were collected well apart (e.g. in different leks) to warrant that they belonged to different individuals. A second methodological problem may be related to the phenology of sample collection because the number of eggs laid vary with the phase of the life history of the parasites, which in turn may change from late March to early June. In this sense, we considered separately two phenological periods: 25 March to 30 April and 1 May to 9 June.

The prevalence (percentage of a host population infected with a specific parasite), intensity (number of parasites in a particular host) and mean intensity (mean number of parasites per host in a population of hosts, including non infected hosts) were calculated for each genus. The effect of geographical location (western vs. central-eastern Cantabrian range localities) and phenology on prevalence of infection was tested using chi-square tests. Two-way ANOVAs considering geographical location and phenological period as random factors (Model II), were used to test differences in mean intensity of infection between zones and periods. When only infected host were considered, there were no data for all cells and genera in two-way ANOVAs, so the intensity of infection was tested using one-way ANOVAs.

RESULTS

Nearly 69% of droppings were found to be infected by at least one species of parasite. We found one parasite genus in 44% of the droppings, two genera in 24% and the occurrence of more than two genera simultaneously in only

TABLE 1

Eggs of intestinal parasites appearing in droppings from western ($n = 63$) and central-eastern zones ($n = 91$) of the Cantabrian range. Prevalence (percentage of infected hosts), intensity (mean, SD, of eggs per infected host) and mean intensity (mean, SD, number of eggs per host population).
 [Huevos de parásitos intestinales encontrados en las muestras fecales del occidente ($n = 63$) y del centro-oriente ($n = 91$) de la cordillera Cantábrica. Prevalencia (en porcentaje), intensidad en los individuos afectados, (media \pm d.t.), e intensidad (media, \pm d.t.), en la población.]

	Western Cantabrian range [Occidente]			Centre-Eastern Cantabrian range [Centro-oriente]		
	Prevalence [Prevalencia]	Intensity [Intensidad]	Mean intensity [Intensidad media]	Prevalence [Prevalencia]	Intensity [Intensidad]	Mean intensity [Intensidad media]
Coccidia:						
<i>Eimeria</i> sp.	58.7	181.2 \pm 198.9	106.4 \pm 176.2	62.6	79.5 \pm 113.9	49.8 \pm 97.8
Nematodes:						
<i>Ascaridia</i> sp.	4.8	6.7 \pm 2.1	0.32 \pm 1.47	8.8	2.4 \pm 0.9	0.21 \pm 0.72
<i>Capillaria</i> sp.	22.2	1.93 \pm 1.27	0.43 \pm 0.99	29.7	8.7 \pm 8.9	2.60 \pm 6.20
<i>Heterakis</i> sp.	1.6	2.0	0.03 \pm 0.25	5.5	12.6 \pm 13.6	0.69 \pm 4.07
<i>Trichostrongylus</i> sp.	3.2	1.0	0.03 \pm 0.17	1.0	2	0.02 \pm 0.22
Unidentified parasites:	7.9	3.6 \pm 1.5	0.28 \pm 1.05	4.4	1.5 \pm 1.0	0.07 \pm 0.35

5%. The prevalence for each genus showed high variability (Table 1), being 57.7% for the Coccidia *Eimeria* sp. and 25% for the Nematode *Capillaria*. The prevalence for other helminthic parasites was very low. Neither geographical location ($\chi^2_4 = 2.96$, $P > 0.05$; Table 1) nor phenological periods ($\chi^2_2 = 5.2$, $P > 0.05$) had significant effects on the prevalence of the genera found in the samples.

Intensity of the infection was relatively high only in the case of *Eimeria* sp. (115 eggs per 3 grams of fresh faeces and nine samples with more than 500 eggs). Mean intensity was low for all specific parasites, and *Eimeria* sp. showed the highest values (Table 1).

Droppings from the western Cantabrian range showed significantly higher intensity of infection with *Eimeria* sp. than droppings from the central-eastern range (Table 1; $F_{1,92} = 9.936$, $P = 0.002$). However, the intensity of infection with *Capillaria* sp., although low in all sites, was significantly higher in the central-eastern zone than in the western zone ($F_{1,40} = 7.933$, $P = 0.008$).

The intensity of infection showed no significant differences between phenological periods for *Capillaria* sp. ($F_{1,39} = 0.959$, $P = 0.334$), and was only barely significant for *Eimeria* sp. ($F_{1,92} = 3.828$, $P = 0.053$), which exhibited slightly higher numbers of eggs in the droppings from the period May-June.

When mean intensity of infection was considered, two-way ANOVA results showed that neither geographical location ($F_{1,1} = 37.575$, $P = 0.369$ for *Capillaria* sp. and $F_{1,1} = 36.542$, $P = 0.104$ for *Eimeria* sp.) nor phenology ($F_{1,1} = 2.201$, $P = 0.096$ for *Capillaria* sp. and $F_{1,1} = 10.240$, $P = 0.193$ for *Eimeria* sp.) had significant effects on mean intensity of infection. Similarly, the interactions between the two factors were not significant ($F_{1,144} = 0.129$, $P = 0.065$ for *Capillaria* sp. and $F_{1,144} = 0.103$; $P = 0.369$ for *Eimeria* sp.).

DISCUSSION

The results suggest that the extent of infection by helminth parasites in the Cantabrian Capercaillies was relatively low when compared to other populations of Tetraonidae, where prevalences of 100% and intensities of thousands of eggs per gram of faeces have been

found (Watson & Shaw, 1991). Nevertheless, differences between species may be remarkable despite sharing the same habitat, as occurs in sympatric populations of *Lagopus mutus* and *L. lagopus scoticus*: the prevalence of *Trichostrongylus* in the latter is 100% and only 50% in the former species (Watson & Shaw, 1991). Prevalence found in this study was similar to that reported for *Tetrao tetrrix* in Norway (Höglund *et al.*, 1992), except for *Eimeria*, where we found higher levels of infection. Surprisingly we did not detect eggs of cestodes, *Railletina globocauda*, *R. urogalli* and *Davainea tetraonensis*, which are typical parasites of the genus *Tetrao*. In the same way, *Trichostrongylus* sp. only appeared in three droppings from two western and one eastern locality. However, it should be pointed out that estimated prevalence is a minimum value since eggs are laid by adult worms, and in some life history stages of the parasite only larvae are present.

The review by Barus *et al.* (1984) describes some nematode species parasitizing *T. urogallus* that were not found here: *Cyrnea aptero-cerca*, relatively widespread in the stomach of Tetraonidae, *Aonchotheca caudinflata*, cosmopolitally widespread and common intestinal parasite of *T. urogallus*, and *Subulura brumpti*, caecal parasite rare in *T. urogallus*. However, this review describes *Capillaria* sp. and *Ascaridia* sp. as common parasites of *T. urogallus* that were found throughout its range.

Differences between zones in both prevalence and intensity of infection might be attributed in the case of *Eimeria* sp. to the higher density of Capercaillie in the western zone, which might increase the probability of infection. Capercaillie populations are declining in eastern and especially central zones of the Cantabrian range at higher rates than in the western zones, where both population and range remain relatively steady (unpublished census, Consejería Medio Ambiente, Principado de Asturias). However, this association between prevalence and density of hosts is very speculative because differences in prevalence between localities seem to be an usual pattern in the Tetraonidae and there is no straightforward explanation for reported differences (Watson & Shaw, 1991).

We can conclude that intestinal parasites are probably not a limiting factor for the Cantabrian Capercaillie populations, at least in the localities considered in this study. However,

an estimation of worm eggs is still a valuable information about the body condition of the birds, and should be included in future monitoring of Cantabrian Capercaillie populations.

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