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The helminth fauna of the barbary partridge *Alectoris barbara* in Tenerife, Canary Islands

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Abstract

The helminth fauna of the barbary partridge (*Alectoris barbara*) in Tenerife Island (Canary Archipelago) was studied from 2001 to 2002, as there were no records of helminths from this host in the Canary Islands. Seven helminth species were identified: two cestodes *Choanotaenia infundibulum* and *Lyruterina nigropunctata*, and five nematodes *Aonchotheca caudinflata*, *Baruscapillaria obsignata*, *Eucoleus annulatus*, *Ascaridia galli* and *Heterakis gallinarum*. *Lyruterina nigropunctata*, *A. galli and E. annulatus* are recorded for first time in *A. barbara*. An analysis of available data on *Alectoris* spp. reveals the importance of intermediate hosts such as arthropods and earthworms in the diet of partridges. Terrestrial helminths are dominant species, with monoxenous and heteroxenous species being present in similar numbers in different *Alectoris* species along their geographical distribution. Helminth species found in Tenerife from *A. barbara* are poor indicators of the host colonization from North Africa because these helminths are species that are commonly found in fowl with a cosmopolitan distribution.

Introduction

The barbary partridge *Alectoris barbara* is distributed in North Africa, from the Canary Islands to north-eastern Egypt, the island of Sardinia and the southern Iberian Peninsula. In the Canary Islands, the subspecies *A. b. koenigi* was introduced from Morocco in the 18th century and can be found in the islands of Lanzarote, Fuerteventura, Tenerife and La Gomera.

The helminth fauna of six partridge species of the genus *Alectoris* (*A. barbara*, *A. chukar*, *A. graeca*, *A. kakelik*, *A. kurdestanica* and *A. rufa*) are well known, with *Alectoris graeca* and *A. rufa* being the most frequently studied species (e.g. Gozdev, 1956; Masala *et al.*, 1986; Perrucci *et al.*, 1997; Rizzoli *et al.*, 1999). Only one study has been carried out on the helminth fauna of *A. barbara* in Sardinia Island (Mediterranean Sea) (Masala *et al.*, 1986).

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There are few studies on the helminth parasites of birds in the Canary Islands (Gijón-Botella *et al.*, 1985, 1989; Castillo-Remiro & López-Román, 1989) and none of these include studies on the barbary partridge. In the present study, the helminth fauna of *A. barbara* is analysed for the first time in the island of Tenerife (Canary Islands) from a faunistic point of view.

Materials and methods

The study was undertaken in the Canary archipelago which is located between 13°23′ to 18°8′ W and 27°37′ to 29°24′ N in the eastern Atlantic Ocean. Tenerife is the largest island of the archipelago. For this work, 50 specimens of *Alectoris barbara* were collected from several farms between 2001 and 2002 in Tenerife.

The partridges were dissected and the digestive tract, lungs and liver were examined for helminths. Cestode and nematode species were recovered and preserved in 70% ethanol. Cestodes were stained with Semichon's acetocarmine, dehydrated sequentially in alcohols,

cleared in xylol, and mounted in Canada balsam. Nematodes were cleared in Amann lactophenol. Helminth identification was made following Madsen (1945), Lopez Neyra (1947), Skrjabin *et al.* (1957), Mozgovoi (1968), Spasskaya & Spasskii (1971), Illescas-Gómez (1977), Chabaud (1978), Moravec (1982), Bona (1994) and Khalil (1994).

Results and Discussion

Seven helminth species were identified, namely the cestodes *Choanotaenia infundibulum* (Bloch, 1779), Railliet 1896 (Dilepididae) and *Lyruterina nigropunctata* (Crety, 1890) Spasskaya & Spasskii, 1971 (Paruterinidae) and the nematodes *Aonchotheca caudinflata* (Molin, 1858), *Baruscapillaria obsignata* (Madsen, 1945), *Eucoleus annulatus* (Molin, 1858) López Neyra, 1947 (Trichuridae), *Ascaridia galli* (Schrank, 1788) Freeborn, 1923 (Ascarididae) and *Heterakis gallinarum* (Gmelin, 1790) (Heterakiidae). All species have previously been described from continental hosts but the insularity phenomenon could have played an important role in the composition of the helminth fauna (Mas Coma *et al.*, 1987).

No significant morphological and metrical differences in cestodes and nematodes compared to available data were found (Madsen, 1945; Skrjabin *et al.*, 1957; Mozgovoi, 1968; Fotedar & Chishti, 1974; Illescas-Gómez, 1977; Moravec, 1982; Barus & Sergejeva, 1989). Data on the helminths from *A. barbara* in Tenerife confirm that they are common species in *Alectoris* spp. in their distribution area (tables 1 and 2). All seven helminth species are found in other families of birds and show a

Table 1. Trematode and cestode species reported in *Alectoris* spp. worldwide.

	Alectoris species*				
	barbara	*chukar*	*graeca*	*rufa*	References
Trematoda					
Brachylaima fuscatus			Ka, It	It	Gozdev, 1956 (Ka); Perrucci *et al.*, 1997 (It); Rizzoli *et al.*, 1999 (It)
Conspicuum alectoris				Po	Varela, 1974
Corrigia corrigia			Ka, Tu		Gozdev, 1956 (Ka); Koroglu & Tasan, 1996 (Tu)
Corrigia skrjabini			Ru		Akhumyan & Khanbegyan, 1982
Dicrocoelium petroni		Bu			Vasilev, 1992
Hypoderaeum conoideum		Bu			Vasilev, 1992
Postharmostomum gallinum			Ka, It		Gozdev, 1956 (Ka); Rizzoli *et al.*, 1999 (It)
Tamerlania zarudnyi			Ka		Gozdev, 1956
Cestoda					
Choanotaenia infundibulum	It	Bu	Ru, Fr, Tu	Sp	Tarazona *et al.*, 1978 (Sp); Akhumyan & Khanbegyan, 1982 (Ru); Masala *et al.*, 1986 (It); Belleau & Léonard, 1991 (Fr); Vasilev, 1992 (Bu); Koroglu & Tasan, 1996 (Tu)
Hymenolepis spp.			Ka, Fr		Gozdev, 1956 (Ka); Belleau & Léonard, 1991 (Fr)
Hymenolepis carioca	It		It		Masala *et al.*, 1986
Hymenolepis graeca			In		Johri, 1960
Lyruterina nigropunctata			Ru, Ka	Po, Sp	Gozdev, 1956 (Ka); Tashliev, 1973 (Ru); Varela, 1974 (Po); Tarazona *et al.*, 1978 (Sp)
Mesocestoides sp.			Sp		Millan *et al.*, 2003
Metroliasthes spp.	It				Masala *et al.*, 1986
Metroliasthes lucida			Fr		Belleau & Léonard, 1991
Paradicranotaenia anormalis				Sp	Tarazona *et al.*, 1978
Raillietina cesticillus	It				Masala *et al.*, 1986
Raillietina circumvallata			Ka		Gozdev, 1956
Raillietina echinobothrida	It				Masala *et al.*, 1986
Raillietina friedbergeri	It		Ru		Akhumyan & Khanbegyan, 1982
Raillietina graeca			Ka		Gozdev, 1956
Raillietina korkei			Ka		Gozdev, 1956
Raillietina micracantha				Sp	Tarazona *et al.*, 1978
Raillietina skrjabini			Ru		Akhumyan & Khanbegyan, 1982 (Ru); Masala *et al.*, 1986 (It)
Raillietina tetragona	It		Tu	Sp	Masala *et al.*, 1986 (It); Koroglu & Tasan, 1996 (Tu); Reina *et al.*, 1999 (Sp)
Rhabdometra dogieli			Ru		Akhumyan & Khanbegyan, 1982
Skrjabinia bolivari			Ru	Po, Sp	Varela, 1974 (Po); Tarazona *et al.*, 1978 (Sp); Akhumyan & Khanbegyan, 1982 (Ru); Illescas-Gomez & Gomez-Garcia, 1987 (Sp)
Tetrathyridium variable			Ka		Gozdev, 1956
Variolepis farciminosa			Is		Smith, 1986

Bu, Bulgaria; Fr, France; In, India; Ir, Iraq; Is, Israel; It, Italy; Ka, Kazakhstan; Po, Portugal; Ru, Russia; Sp, Spain; Tu, Turkey.
* Additionally, *Cotugnia latiproglottina* was recorded in *Alectoris kurdestanica* in Iraq (Sawada *et al.*, 1990).

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Table 2. Nematode species reported in *Alectoris* spp. worldwide.

	Alectoris species*				
	barbara	*chukar*	*graeca*	*rufa*	References
Nematoda					
Acuaria spp.	It				Masala *et al.*, 1986
Acuaria gruweli				Sp	Tarazona *et al.*, 1978
Acuaria harmulosa			Fr		Belleau & Léonard, 1991
Acuaria spinosa			Ru		Akhumyan & Khanbegyan, 1982
Allopoda spp.	It				Masala *et al.*, 1986
Aonchotheca caudinflata	It		It	Sp	Tarazona *et al.*, 1978 (Sp); Masala *et al.*, 1986 (It); Rizzoli *et al.*, 1999 (It)
Ascaridia compar			Ka		Gvozdev, 1956 (Ka); Barus *et al.*, 1977 (Ru)
Ascaridia galli		US		It, Sp	Tibbits & Babero, 1969 (US); Macchioni & Marconcini, 1982 (It); Reina *et al.*, 1992 (Sp)
Avioserpens mosgovoyi				Sp	Cordero del Campillo *et al.*, 1994
Baylisascaris larvae			?		Sass & Gorgacz, 1978
Capillaria spp.		Gr	Fr	It, Sp	Govoni & Maestrini, 1979 (It); Githkopoulos, 1984 (Gr); Belleau & Léonard, 1991 (Fr); Reina *et al.*, 1992 (Sp)
Capillaria contorta		Gr		Sp	Githkopoulos, 1984 (Gr); Reina *et al.*, 1992 (Sp); Pizarro *et al.*, 2000 (Sp)
Capillaria obsignata	It			Po, Sp	Varela, 1974 (Po); Masala *et al.*, 1986 (It); Reina *et al.*, 1992 (Sp)
Capillaria phasianina		Gr			Githkopoulos, 1984
Cheilospirura gruweli			Ka	Po	Gvozdev, 1956 (Ka); Varela, 1974 (Po)
Cheilospirura spinosa			Tu		Koroglu & Tasan, 1996
Cyrnea eurycerca			Ka, Ru		Gvozdev, 1956 (Ka); Barus *et al.*, 1977 (Ru)
Cyrnea parroti				Po	Varela, 1974
Eustrongyloides mergorum				Sp	Cordero del Campillo *et al.*, 1994
Ganguleterakis sp.		Bu			Vasilev, 1992
Ganguleterakis altaica		Bu	Ka		Gvozdev, 1956 (Ka); Vasilev, 1992 (Ba)
Ganguleterakis macroura		Bu			Vasilev, 1992
Ganguleterakis tenuicaudata		Bu	Fr, It	Sp	Tarazona *et al.*, 1978 (Sp); Belleau & Léonard, 1991 (Fr); Vasilev, 1992 (Bu); Rizzoli *et al.*, 1997 (It); Rizzoli *et al.*, 1999 (It); Frosio *et al.*, 2000 (It)
Heterakis sp.		Bu			Vasilev, 1992
Heterakis dispar			Tu	Po, Sp	Varela, 1974 (Po); Reina *et al.*, 1992 (Sp); Koroglu & Tasan, 1996 (Tu)
Heterakis gallinarum	It		Ka, Fr, In, Tu, It	Sp, Po	Gvozdev, 1956 (Ka); Varela, 1974 (Po); Tarazona *et al.*, 1978 (Sp); Masala *et al.*, 1986 (It); Belleau & Léonard, 1991 (Fr); Reina *et al.*, 1992 (Sp); Koroglu & Tasan, 1996 (Tu); Mir *et al.*, 1996 (In); Rizzoli *et al.*, 1999 (It)
Oxyspirura schulzi			Ka		Gvozdev, 1956
Oxyspirura rijikovi			Ta		Borgarenko, 1970
Seudocyrnea colini			Tu		Koroglu & Tasan, 1996
Seudocyrnea eurycerca			Tu		Koroglu & Tasan, 1996
Streptocara crassicauda		Bu			Vasilev, 1992
Strongylida sp.				Sp	Reina *et al.*, 1992
Subulura brumpti			Ka		Gvozdev, 1956
Subulura coturnicis			Ru		Akhumyan & Khanbegyan, 1982
Subulura differens			Tu		Koroglu & Tasan, 1996
Subulura suctoria				Po, Sp	Varela, 1974 (Po); Tarazona *et al.*, 1978 (Sp)
Tetrameres timopheevoi			Ka		Gvozdev, 1956
Trichostrongylus tenuis	It				Masala *et al.*, 1986

Bu, Bulgaria; Fr, France; Gr, Greece; In, India; Ir, Iraq; Is, Israel; It, Italy; Ka, Kazakhstan; Po, Portugal; Ru, Russia; Sp, Spain; Ta, Tajikstan; Tu, Turkey; US, United States.

*Additionally, *Splendidofilaria gvozdevi* was recorded in *Alectoris kakelik* in Russia and Tajikstan (Sonin & Barus, 1978; Borgarenko, 1984).

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cosmopolitan distribution. Thirteen species of helminths are cited in *A. barbara* (tables 1 and 2). In the present study, *L. nigropunctata*, *A. galli* and *E. annulatus* are cited for the first time in this host. *Lyruterina nigropunctata* is a paruterinid which was reported in Europe and Asia, parasitizing Galliformes (Phasianidae, Meleagridinae and Tetraoninae) and Columbiformes (Pteroclididae) (Schmidt, 1986). *Ascaridia galli* is one of the most common nematodes in birds, mainly found in fowl (Mozgovoi, 1968). *Eucoleus annulatus* has been cited in hosts of the genera *Gallus*, *Numida* and *Meleagridis* in all continents (Richter, 1965; Mayaudon Tarbes & Cedeño, 1967/68; Barus & Herrera Rodriguez, 1969; Rickard & Pohl, 1969; Leon & Soldevila, 1978; Hurst *et al.*, 1979; Vattanodorn *et al.*, 1984; Oyeka, 1989; Permin *et al.*, 1997). All the species found in *A. barbara* in Tenerife are common parasites of fowl. In Tenerife, *A. barbara* frequently inhabits rural areas in contact with domestic birds, which could result in successful transmission of parasitic infections, although there are no studies on the helminth fauna of domestic birds in Tenerife.

In view of the low specificity of the helminth parasites of *A. barbara*, it is difficult to use the helminth fauna of this host as an indicator of its method of colonization to corroborate the hypothesis of its introduction from Morocco. Gardner & Campbell (1992) emphasized that parasites may be used as biogeographical markers, and this approach has been used by some authors in the Atlantic islands of Macaronesia where several species of mammals were introduced from Europe. Casanova *et al.* (1996) in a study of the helminth fauna of the black rat (*Rattus rattus*), the house mouse (*Mus domesticus*), the hedgehog (*Erinaceus europaeus*) and the rabbit (*Oryctolagus cuniculus*), postulated their introduction in the Azores from the Iberian Peninsula. Goüy de Belloq *et al.* (2002) using the neighbour joining method (Swofford, 1999) supported the hypothesis of an Iberian origin for Azorean mammalian populations (Casanova *et al.*, 1996). Recently, Foronda *et al.* (2003) in a study on the helminths of *O. cuniculus* in Macaronesia (Azores, Madeira and Canary archipelagos) demonstrated the introduction of the wild rabbit in these islands from Spain and Portugal, and this was confirmed by molecular studies (Foronda, unpublished data). No helminthological studies of *Alectoris* spp. have been undertaken in Africa, but all helminth species recovered from *A. barbara* in Tenerife, except *L. nigropunctata*, have been reported in African fowl (Oyeka, 1989; Little *et al.*, 1993; Permin *et al.*, 1997; Poulsen *et al.*, 2000; Mukaratirwa *et al.*, 2001).

Data shown in tables 1 and 2 could indicate the nature of the habitats and diet of *Alectoris* spp. Digenean species found in these hosts have terrestrial life cycles, with gastropods and arthropods being first and second intermediate hosts, respectively (Yamaguti, 1971). Dilepidid, hymenolepid, davaineid, mesocestoidid and paruterinid species constitute the cestode fauna of *Alectoris* spp. With regard to known life cycles of these species, terrestrial arthropods act as intermediate hosts and only in sporadic species (i.e. hymenolepidids), aquatic crustaceans could harbour infective larval stages of these species. The diversity of nematode species in *Alectoris* spp. is similar to that of cestodes, confirming the heteroxenous nature of their life cycles. The reported species of ascarids, strongylids and trichostrongylids present monoxenous life cycles (Anderson, 2000), whereas the trichurids of the subfamily Capillarinae found in *Alectoris* spp. have either monoxenous or heteroxenous life cycles. In the latter case, earthworms act as intermediate hosts (Anderson, 2000). In several studies (e.g. Vasilev, 1992; Rizzoli *et al.*, 1999), the presence of helminths with aquatic life cycles have been detected but their low number is not comparable to that of terrestrial helminths, probably because the diet of *Alectoris* spp. is mainly based on terrestrial prey despite their vegetarian regime. The present results confirm that the structure of the helminth fauna in *Alectoris* spp. in Tenerife is similar to that in other geographical regions.

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