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Helminth infracommunities of a population of the Gran Canaria giant lizard *Gallotia stehlini*

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Abstract

A survey of gastro-intestinal helminth communities of *Gallotia stehlini* (Sauria: Lacertidae) from Gran Canaria island (Canary Archipelago, Spain), was conducted to determine the prevalence, abundance and species diversity of intestinal parasites in these lizards. Pharyngodonid nematodes were the most common intestinal helminths, three species being *Gallotia* specialists. Helminth infracommunities of *G. stehlini* were rich and appear to be closer to the interactive end of the continuum isolationist–interactive helminth communities, according to the high values of helminth diversity. It is the first case of a saurian reptile showing this kind of diverse helminth infracommunity, produced by a large size, a wide-ranging plant diet and exposure to helminths with direct life-cycles.

Introduction

The Canarian Archipelago, located off the north west coast of Africa, at 27°37′ – 29°24′ N and 13°37′ – 8°10′ W, comprises seven main islands and a number of peripheral islets. Lacertids living in this archipelago belong to the endemic genus *Gallotia* (Arnold, 1973). Barahona *et al.* (2000) distinguished two morphological groups of these lacertid lizards. A group of small to medium-sized lizards includes *G. atlantica*, *G. galloti* and *G. caesaris*. Another group of living 'giant' lizards is composed of *G. stehlini*, *G. simonyi* and two other recently described species, *G. intermedia* (Hernández *et al.*, 2000) and *G. bravoana* (Mateo, 2002; Nogales *et al.*, 2001). *Gallotia stehlini* is only found naturally on Gran Canaria island, although there is an introduced population on Fuerteventura island (Naranjo *et al.*, 1991) the viability of which is not certain (López-Jurado, 1991). It is the only lacertid lizard living in Gran Canaria Island, and the largest species of all extant ones in the Canary Islands, reaching 26.5 cm snout–vent length, and 500 g in weight (López-Jurado, 1991).

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In the present paper, the prevalence, intensity, and diversity of helminths in a population of a living giant canarian lizard, *G. stehlini*, are analysed in order to: (i) characterize the patterns of helminth community richness and diversity; (ii) characterize the helminths as either specialists or generalists; and (iii) compare the helminth fauna of *G. stehlini* with other insular hosts.

Materials and methods

Gran Canaria is a volcanic island (1560 km^2; 1948 m maximum elevation) with a central position in the Canarian Archipelago. The landscape in Gran Canaria is of volcanic origin. The island is microclimatically and ecologically heterogeneous, with large differences between the north and the south, which has a warmer climate (Fernández-Palacios & Martín, 2001). In all, 33 lizards were caught during July 1994 in the locality of Aldea Blanca, located in the south-east of the island.

All lizards captured were killed with an overdose of chloroform. The body cavity, digestive tract, heart, lungs and liver were removed, opened, and placed in Ringer's solution for examination. Helminths were removed, washed in distilled water, fixed and mounted according to standard techniques. Parasites were identified, when

possible, to species level and the number and location of individual parasites of each species were recorded.

The use of descriptive ecological terms follows Bush *et al.* (1997). Brillouin's index was used for calculating diversity according to Magurran (1988).

Results

A total of 13 helminth species were recovered (11 Nematoda, and two Cestoda). Only the two cestode species were found in the intestine. *Skrjabinelazia* sp. was found in the stomach, and the remaining nematode species (all belonging to the family Pharyngodonidae), were found in the caecum. The total number of parasite species and the infection parameters are shown in table 1. The overall prevalence of helminth infection in *G. stehlini* was 100%.

Intestinal infracommunities of *G. stehlini* comprised mainly pharyngodonid nematodes. Prevalences of the nematode species were less than 30% for four (*Tachygonetria macrolaimus*, *Parapharyngodon micipsae*, *P. echinatus* and *P. bulbosus*) of the 11 nematode species. Five nematode species, namely *Thelandros filiformis*, *Alaeuris numidica canariensis*, *Tachygonetria dentata*, *T. conica* and *Spauligodon atlanticus*, infected more than 50% of the host population. Both cestode species (*Oochoristica agamae* and *Nematotaenia tarentolae*) each infected 3% of the host population. Table 2 shows the diversity parameters for the helminth infracommunities of *G. stehlini*.

Discussion

The most common nematodes in the infracommunities of *G. stehlini* are members of the Pharyngodonidae, of which *Thelandros filiformis*, *Spauligodon atlanticus* and *Alaeuris numidica canariensis* are endemic species or subspecies on the Canary Islands, and are known to be *Gallotia* specialists, since they parasitize only hosts of this genus (Edwards & Bush, 1989, but also see Roca & Hornero, 1994). The remaining helminths parasitizing the Gran Canaria giant lizard are generalist species, because they have been also found in other saurian hosts (Roca *et al.*, 1999; Martin & Roca, 2004).

The high prevalences and mean intensities of infection (table 1) indicate that many members of the helminth infracommunities occurred frequently, a view supported by high values of species richness and diversity. This disagrees with the typical pattern of helminth infections in many reptiles, i.e. few species occurring frequently, few species occurring with moderate prevalence, and many species being rare (Aho, 1990; Roca & Hornero, 1994). In fact, *G. stehlini* has diversity patterns of intestinal helminth infracommunities (table 2) that are dissimilar to those of other insular saurians living in the Canary Islands (table 3) and in other islands of the Mediterranean (table 4). Such high diversity values found in *G. stehlini* contrast with values observed in most reptiles (Aho, 1990) and suggest that the helminth infracommunities of the Gran Canaria giant lizard appear to be closer to the interactive end of the continuum isolationist–interactive

Table 1. Infection parameters of the helminths parasitizing *Gallotia stehlini* from Gran Canaria.

Helminth species	Site of infection	Prevalence (%)	Intensity of infection		Mean abundance
			Range	$\bar{X}$	
Cestoda					
Oochoristica agamae	Intestine	3.0	0	0	0
Nematotaenia tarentolae	Intestine	3.0	0	0	0
Nematoda					
Thelandros filiformis	Caecum	97.0	(2–1263)	277.9 ± 282.3	192.4 ± 280.0
Alaeuris numidica canariensis	Caecum	87.9	(2–896)	159.7 ± 227.4	140.3 ± 219.2
Tachygonetria dentata	Caecum	60.6	(5–664)	88.7 ± 150.0	53.7 ± 123.6
Tachygonetria macrolaimus	Caecum	12.1	(2–18)	7.0 ± 7.6	0.8 ± 3.3
Tachygonetria conica	Caecum	75.8	(3–805)	69.8 ± 157.7	52.9 ± 139.9
Tachygonetria numidica	Caecum	30.3	(8–86)	28.7 ± 24.1	8.7 ± 18.5
Parapharyngodon micipsae	Caecum	15.2	(1–20)	8.8 ± 7.8	1.3 ± 4.2
Parapharyngodon echinatus	Caecum	9.1	(5–47)	28.7 ± 21.5	2.6 ± 9.9
Parapharyngodon bulbosus	Caecum	9.1	(6–19)	14.7 ± 7.5	1.3 ± 4.7
Spauligodon atlanticus	Caecum	51.5	(3–65)	22.6 ± 17.3	11.7 ± 16.8
Skrjabinelazia sp.	Stomach	42.4	(1–51)	10.3 ± 14.3	4.7 ± 10.5

Table 2. Overall diversity parameters of helminth infracommunities in the Gran Canaria giant lizard *Gallotia stehlini*.

Host	*n*	Species richness*	Helminth abundance*	Brillouin's index*	Proportion of sample with 0 or 1 helminth species
G. stehlini	33	4.9 ± 1.6 (2–7)	468.2 ± 644.6 (31–2734)	1.2 ± 0.4 (0.2–1.7)	0

*Values are given as the mean ± SD, with the range in parentheses.

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Table 3. Comparison of the prevalence and Brillouin's index of helminths in different species and subspecies of Canarian lizards.

Hosts	Locality	Prevalence (%)	Brillouin's index
Gallotia stehlini	Gran Canaria	100	1.2 ± 0.4 (0.2–1.7)
G. galloti galloti	Tenerife	77.8	0.2 (0–0.9)
G. caesaris caesaris	El Hierro	85.2	0.2 ± 0.3 (0–1.1)
G. caesaris gomerae	La Gomera	81.0	0.3 ± 0.4 (0–1.0)

Source of data: Martin & Roca (2004); Roca *et al*. (unpublished data).

helminth communities (Holmes & Price, 1986), in comparison with other reptile (Roca & Hornero, 1994), fish or bird hosts (Kennedy *et al*., 1986). In fact, these values are close to those found in mammals (Kennedy *et al*., 1986). The generation of a diverse helminth community in the case of *G. stehlini* seems to be related to: (i) a wide-ranging diet (unpublished observations); and (ii) exposure to direct life-cycle helminths (Kennedy *et al*., 1986; Roca & Hornero, 1994).

Martin & Roca (2004) noted that Canary lacertid lizards showed higher prevalences of helminths than other insular lizards (Roca, 1995) (tables 3 and 4), and explained this in two ways. Firstly, the high prevalence of helminths is a feature of oceanic islands (e.g. Canary Islands) rather than continental or 'land bridge' islands, (e.g. Balearic and other Mediterranean islands; see Roca, 1995), and, secondly, the tendency towards hervibory in saurians (higher in canarian lizards; see Roca, 1999), will increase their prevalence of infection, mainly by pharyngodonid nematodes, as noted by Dearing (1993) and Roca (1999). Both explanations can apply in the case of *G. stehlini*. The size of lizards (related to the tendency to herbivorism) might also contribute to the composition and structure of helminth communities. Thus, only the Gran Canaria giant lizard shows more helminth abundance and species richness than smaller lizards living in other Canarian islands, such as Tenerife (*G. galloti*), La Gomera or El Hierro (*G. caesaris*) (Roca *et al*., unpublished data).

One other saurian host, *Tarentola boettgeri boettgeri* (Gekkonidae), is also endemic to Gran Canaria Island (López-Jurado, 1991). Infracommunities and component communities of a population of 46 individuals from the same locality where *G. stehlini* were caught (Aldea Blanca) were studied by Roca (1999) and Roca *et al*. (1999). Communities from both hosts differ considerably in the following features:

1. Four cestode species were found, as larval forms, in the body cavity of *T. b. boettgeri*, whereas no larval forms were found in *G. stehlini*. It suggests that such cestodes use *T. b. boettgeri* as an intermediate host in their life cycles, and thus predators of these gekkonids must be definitive hosts for them. Birds of prey and feral cats have been cited as predators for *Tarentola* spp. in the Canary Islands (Roca *et al*., 1999). On the other hand, the absence of helminth larval forms in *G. stehlini* suggests that this large lizard is not a usual prey for predators on Gran Canaria Island.
2. Ten Pharyngodonidae nematodes were found in *G. stehlini*, most of them being typical of herbivorous reptiles, such as tortoises or iguanid lizards (Petter & Quentin, 1976; Roca, 1999), whereas only three were found in *T. b. boettgeri*, and these are only found in carnivorous reptiles. This suggests that both saurian hosts have different food strategies, *G. stehlini* having a marked tendency towards herbivory (Roca, 1999; Martin *et al*., unpublished observations).
3. Species richness and abundance values are higher in *G. stehlini* than in *T. b. boettgeri*. Thus, Brillouin's diversity index is 0.08; range 0–0.7, for *T. b. boettgeri* (Roca, 1999), a very low value that seems to indicate depauperate, isolationist helminth communities for this host, in contrast with the helminth communities of *G. stehlini*.

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Table 4. Comparison of the prevalence and Brillouin's index of helminths in different species of Mediterranean insular lizards.

Hosts	Locality	Prevalence (%)	Brillouin's index
Podarcis pityusensis	Ibiza – Formentera (Spain)	79.4	0.2 ± 0.3 (0–1.2)
P. lilfordi	Mallorca – Menorca islets (Spain)	72.2	0.1 ± 0.2 (0–0.8)
P. muralis	Rioux archipelago (France)	65.8	0.1 ± 0.2 (0–0.9)
P. sicula	Corsica (France)	62.3	0.1 ± 0.2 (0–0.8)
P. milensis	Milos (Greece)	71.4	0.1 ± 0.2 (0–0.8)
P. erhardii	Lesvos (Greece)	73.1	0.1 ± 0.2 (0–0.6)

Source of data: Roca (1995).

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