Helminths parasitising endemic geckoes from Canary Islands

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Helminths parasitising endemic geckoes from Canary Islands.– Parasitological studies on geckoes in Europe are scarce but there are even fewer in the Canary Islands. A complete survey of the helminth communities of *Tarentola boettgeri boettgeri*, *T. b. hierrensis*, *T. gomerensis*, *T. delalandii* and *T. angustimentalis* (Sauria, Lacertidae) in the Canary Islands, Spain, was recently carried out. Larval cestodes constitute a significant part of the helminth community parasitising geckoes. Helminth fauna on insular geckoes is similar but not identical to continental fauna. The low values in richness, abundance and diversity indices of species suggest that infracommunities of Canary geckoes are depauperate and isolationist.

Key words: Parasites, Endemic geckoes, Canary Islands, Spain.

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Introduction

The study of insular reptile parasite faunas in the Palaearctic region has recently increased (Roca, 1995; Roca & Hornero, 1991, 1992, 1994). These studies deal with lizard hosts (family Lacertidae) in the Mediterranean area. However, the parasites of gekkonid lizards have not been studied as much in Palaearctic areas (Roca, 1993).

Geckoes in the Canary Islands are endemic (López-Jurado, 1991). Of the four species living in the archipelago, the wrinkled "perinquén" *Tarentola angustimentalis* (Steindachner, 1891) originated from an African stock of Moorish gecko *T. mauritanica* (Linnaeus, 1768) (Barbadillo, 1987), whereas the colonizer nucleus of the other three species, Boettger "perinquén" *T. boettgeri* (Steindachner, 1891), Gomera "perinquén" *T. gomerensis* (Joger et Bischoff, 1983) and common "perinquén" *T. delalandii* (Duméril et Bibron, 1836) came from other archipelagos such as Madeira or Savages islands (Joger, 1984).

Helminthological research on Canarian geckoes is scarce and incomplete. Spaul (1926) described *S. tarentolae* from *T. delalandii* (see also Skrjabin et al., 1960); and recently, Roca et al. (1987) studied the plathyelminths parasitising *T. delalandii* and *T. boettgeri* from the point of view of fauna.

In this study we present the results of the helminthological analysis of specimens belonging to the species *T. delalandii*, *T. gomerensis* and *T. angustimentalis*, and the subspecies *T. boettgeri boettgeri* and *T. boettgeri hierrensis*, including data on the structure of their infracommunities.

Material and methods

The Canary Islands are located southwest of the Iberian peninsula (fig. 1) in the Atlantic Ocean at 27° 37'-29° 24' N and 13° 37'-8° 10' W. All the islands and islets are of volcanic origin. The "malpaises" type landscape, typical alluvial soils with large lava cones, predominates. Geckoes were caught in these habitats and in anthropic areas. In all, 46 specimens of *T. boettgeri boettgeri* (from Gran Canaria Island), 12 specimens of *T. boettgeri hierrensis* (from El Hierro Island), 16 specimens of *T. gomerensis* (from La Gomera Island), 14 specimens of *T. delalandii* (from Tenerife Island), and 47 specimens of *T. angustimentalis* (19 from Fuerteventura Island and 28 from Lanzarote Island) were analysed. Specimens were caught in IX 94, III 96 and IV 96 and gave an overdose of chloroform. The digestive tract, heart, lungs, and liver were removed, then were opened, and subsequently placed in Ringer's solution for examination. Helminths were removed, washed in distilled water, and fixed and mounted according to routine techniques. Parasites were identified to species and the number and site of individuals of each species were recorded. Margolis et al. (1982) and Bush et al. (1997) were followed in the use of descriptive ecological terms. Brillouin's index of diversity and evenness (Pielou, 1977; Magurran, 1988) was calculated for each helminth infracommunity irrespective of the site of infection, using DIVERS software (Krebs, 1989).

Results

Ten helminth species (five Cestoda, four Nematoda, and one Acanthocephala) were found. Table 1 shows the total number of parasite species and the infection parameters for each host. For descriptions of species see Roca (1993), Roca et al. (1985, 1987, 1990), and Sharpilo (1973).

Cestoda

Nematotaenia tarentolae López-Neyra, 1944 was found only in *T. angustimentalis* from Fuerteventura with a prevalence of 10.5%. Larval forms of cestodes were widespread among geckoes and islands, but only *T. boettgeri boettgeri* harboured all the species found. The most common species were *Diplopylidium nölleri* (Skrjabin, 1924) (larvae) and *Dipylidium* sp. (larvae) with maximum prevalences 21.7% (*T. boettgeri boettgeri*) and 15.8% (*T. angustimentalis* from Fuerteventura), respectively.

Nematoda and Acanthocephala

Parapharyngodon micipsae (Seurat, 1917) was the only helminth found in all the species and subspecies of hosts examined, with a range of prevalence between 39.1%

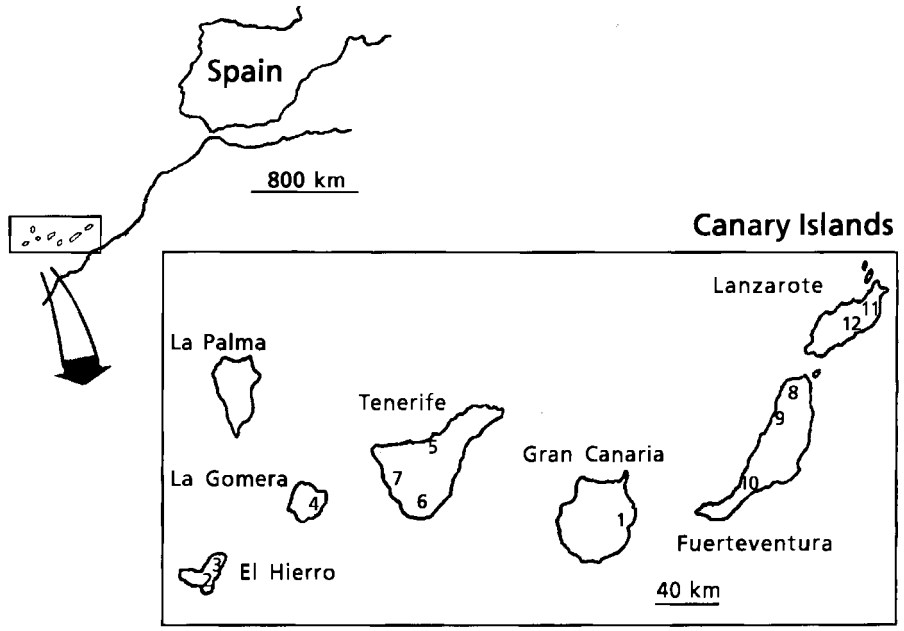

Fig. 1. Location of the Canary Islands, and sampled localities: 1. Aldea Blanca; 2. La Dehesa; 3. Guinea; 4. San Sebastián de la Gomera; 5. Puerto de la Cruz; 6. El Gincho; 7. Escalona; 8. Corralejo; 9. Lajares; 10. La Pared; 11. Orzola; 12. Nazaret.
Situación de las Islas Canarias y localidades muestreadas. (Para las abreviaturas ver arriba.)

(*T. boettgeri boettgeri*) and 81.3% (*T. gomerensis*). *Parapharyngodon echinatus* (Rudolphi, 1819) was recovered from *T. boettgeri boettgeri*, *T. gomerensis* and *T. delalandii*, whereas *S. hoffmanni* Li, 1934 was found in *T. angustimentalis* from both Fuerteventura and Lanzarote Islands. Subadults of *Spauligodon* sp. were present in *T. boettgeri boettgeri* and *T. b. hierrensis* with maximum prevalence of 66.7% (*T. boettgeri hierrensis*). The acanthocephalan *Centrorhynchus* sp. (larvae) was observed in the body cavity of *T. gomerensis* only.

Helminth community diversity

Although 10 helminth species were recovered, the average number per gecko was 1.43, and the maximum number found in any individual gecko was four in the case of *T. boettgeri boettgeri* and *T. delalandii*, and two in *T. boettgeri hierrensis*, *T. gomerensis* and *T. angustimentalis* (table 2). The total number of helminth species in the populations of the examined hosts exceeded the average number per gecko, but the maximum number of species per individual gecko was only slightly exceeded, except in the case of *T. b. hierrensis*. The proportion of sample with 0 or 1 species was never under 0.57.

Table 2 shows diversity parameters for the helminth infracommunities from all hosts. Helminth richness and Brillouin's index are highest in *T. delalandii*, whereas the highest abundance was found in *T. b. hierrensis*. Nevertheless, for all hosts the low values of this index emphasise the low diversity of their helminth infracommunities.

Table 1. Infection parameters of the helminths from the different hosts: I. Intensity of infection; Loc. Localities; P. Prevalence (number of hosts parasitised divided by the number of hosts sampled, values in parentheses are percentages); A. Mean abundance; Tbb. *Tarentola boettgeri boettgeri*; Tbh. *T. b. hierrensis*; Td. *T. delalandii*; Tg. *T. gomerensis*; Ta. *T. angustimentalis*. GC. Gran Canaria; T. Tenerife; LG. La Gomera; EH. El Hierro; L. Lanzarote; F. Fuerteventura. BC. Body cavity; In. Intestine; C. Cloaca.

Parámetros de infección de los helmintos de los diferentes hospedadores. (Para las abreviaturas ver arriba.)

Helminth species	Host	Loc.	Site	P	I		A
					Range	x	
Cestoda							
D. acanthotetra	Tbb	GC	BC	1(2.2)	-	-	-
	Td	T		2(14.3)	9-27	18	2.6
D. nölleri	Tbb	GC	BC	10(21.7)	2-158	37.5	8.2
	Tg	LG		1(6.3)	-	-	-
	Td	T		2(14.3)	6-17	11.5	1.6
Dipylidium sp.	Tbb	GC	BC	3(6.5)	3-6	4.3	0.3
	Ta	F		3(15.8)	4-20	10	1.6
		L		4(14.3)	2-23	11.5	1.6
Monopylidium sp.	Tbb	GC	BC	3(6.5)	1-2	1.3	0.1
	Td	T		1(7.1)	-	-	-
N. tarentolae	Ta	F	In	2(10.5)	1-5	3	0.3
Nematoda							
P. micipsae	Tbb	GC	In,C	18(39.1)	1-33	8.9	3.5
	Tbh	EH		3(25)	4-7	5.7	1.4
	Tg	LG		13(81.3)	1-10	4	3.3
	Td	T		9(64.3)	2-19	10	6.4
	Ta	F		12(63.2)	1-28	4.9	3.1
		L		16(57.1)	1-19	5.6	3.2
P. echinatus	Tbb	GC	In,C	1(2.2)	-	-	-
	Td	T		6(42.9)	1-6	3.2	1.4
Spauligodon sp.	Tbb	GC	C	1(2.2)	-	-	-
	Tbh	EH		8(66.7)	5-127	61.3	40.8
S. hoffmanni	Ta	F	C	1(5.3)	-	-	-
		L		1(3.6)	-	-	-
Acanthocephala							
Centrorhynchus sp.	Tg	LG	BC	1(6.3)	-	-	-

Table 2. Overall diversity parameters of the helminth infracommunities from all hosts: Ns. Number of helminth species/host; Nh. Number of helminths/host; B. Brillouin's index; P. Proportion of sample with 0 or 1 species. (Ns, Nh and B are given as the mean±SD with the range in parentheses.)

Parámetros de diversidad de las infracomunidades helmintianas de todos los hospedadores: Ns. número de especies de helmintos/hospedador; Nh. número de helmintos/hospedador; B. Índice de Brillouin; P. Proporción de muestra con 0 o 1 especies. (Ns, Nh y B son la media±DS con el rango entre paréntesis.)

Hosts	n	Ns	Nh	B	P
T. boettgeri boettgeri	46	0.80±1.05 (0-4)	12.67±28.43 (0-174)	0.08±0.194 (0-0.708)	0.83
T. boettgeri hierrensis	12	0.92±0.51 (0-2)	42.25±45.58 (0-127)	0.157 (0-0.157)	0.92
T. gomerensis	16	1.06±0.68 (0-2)	7.44±12.55 (0-50)	0.114±0.224 (0-0.594)	0.75
T. delalandii	14	1.43±1.34 (0-4)	12.57±16.12 (0-60)	0.265±0.393 (0-1.156)	0.57
T. angustimentalis	47	0.83±0.70 (0-2)	4.96±7.73 (0-32)	0.077±0.176 (0-0.581)	0.83

Discussion

Although Roca et al. (1987) indicated that the scarce presence of *N. tarentolae* in the Canary Islands was an artifact of the low number of geckoes sampled, our results based on a larger sample size show that this cestode species is not widely distributed in the archipelago. *N. tarentolae* therefore appears to be a palaearctic species living mainly in Europe and northern Africa (Dollfus, 1957; Sharpilo, 1973; Roca et al., 1985), whereas in Canary Islands it could be considered an accidental species.

Concerning the cestode larval forms, our results agree qualitatively with those of Roca et al. (1987), having found the same species with the only exception of *Mesocestoides* sp. Prevalences are quite different. *D. nölleri* (larvae) had a maximum prevalence of 21.7% (*T. boettgeri boettgeri*), whereas Roca et al. (1987) found 63% for the same host; for *D. acanthotetra* (larvae) these values were 14.3% (*T. delalandii*) and 27% (*T. boettgeri*); for *Dipylidium* sp. (larvae) prevalences were respectively 15.8% (*T. angustimentalis*) and 82% (*T. boettgeri*); finally, 7.1% (*T. delalandii*) and 65% (*T. delalandii*) are, respectively, the maximum prevalences for *Monopylidium* sp. (larvae). Except for domestic cats, there are no other mammalian carnivores which could prey on geckoes in the Canary Islands. It is probable that nocturnal birds of prey, such as *Tyto alba* and *Asio otus* are definitive hosts for these cestodes. The remains of geckoes have been found in the regurgitated pellets of these birds (Báez, pers. com. in Roca et al., 1987).

The common nematodes in the infracommunities of Canary geckoes are members of the Pharyngodonidae. Three species, *P. micipsae*, *P. echinatus* and *Spauligodon* sp. are host generalists (*sensu* Edwards & Bush, 1989) as they have been recorded in more than one host. *Skrjabinelazia hoffmanni* (Seuratidae) is also a generalist as it has been recovered from *T. angustimentalis* and *Gallotia caesaris* (unpublished data).

All helminth faunas from insular populations of geckoes are very similar but differ considerably from other insular and continental populations. In *Tarentola mauritanica*

Table 3. Frequency distribution of the number of parasite species of the helminth community from the different hosts: P. Prevalence. (For abbreviations see table 1.)
Distribución de frecuencias del número de especies parásitas en los diferentes hospedadores: P. Prevalencia. (Para las abreviaturas ver tabla 1.)

	Host (locality)					
	Tbb	Tbh	Tg	Td	Ta(L)	Ta(F)
Nucleus species (P>30%)	1	1	1	2	1	1
Secondary species (10%≤P≤30%)	1	1	1	2	1	2
Satelite species (P<10%)	5	0	2	1	1	1

from Balearic Islands (W Mediterranean) Roca (1993) and Martin (1996) found the same two species of *Parapharyngodon*, one species of *Spauligodon*, and two of the four larval forms found in Canary geckoes. In addition, two digeneans (*Paradistomum mutabile* and *Paradistomum* sp.) and two nematode larval forms (*Acuaria* sp. and Spirurida gen. sp.), were recorded in the Balearic Islands. On the other hand, *Skrjabinelazia hoffmanni* and *Centrorhynchus* sp. (larvae) were not found in Balearic geckoes. The presence of fewer helminth species than in continental hosts, might be one of the effects of insularity on the helminth fauna of small mammals, as noted by Mas-Coma & Feliu (1984). Geckoes fit into this pattern, with continental hosts harbouring more helminth species than those from insular ecosystems. In *T. mauritanica* from the Iberian peninsula, Roca et al. (1985) recorded two digenean species and eight nematode species not found in Canary geckoes.

The pattern of helminth infection of most reptiles is usually such that few species occur frequently, few species occur with moderate prevalence, and many species are rare (Roca & Hornero, 1994). Helminth communities of Canary geckoes fit into this pattern (table 3), but the nematodes *Parapahryngodon micipsae* and *Spauligodon* sp. have, in some cases, a higher prevalence than is usual in other lizards.

All the hosts show low values of helminth richness, abundance and Brillouin's diversity index with the exception being the abundance of *Spauligodon* sp in *T. b. hierrensis*. These values suggest that helminth infracommunities of *Tarentola* spp. from Canary Islands are depauperate isolationist communities (Holmes & Price, 1986; Kennedy et al., 1986; Goater et al., 1987). Geckoes exhibit many of the characteristics responsible for the existence of this kind of community, being ectothermic, with a simple alimentary canal and diet, low vagility, generalist feeding and a small number of helminth species with a direct life cycle (Kennedy et al., 1986; Pence, 1990). The depauperate character of these helminth infracommunities agrees with those observed by Roca et al. (1987) for *T. boettgeri* and *T. delalandii*, as well as with those observed in other gecko species, *Tarentola mauritanica* and *Hemidactylus turcicus* from the Balearic Islands (Roca, 1993). These patterns seem widespread amongst saurian reptiles (Aho, 1990).

Resumen

Helmintos parásitos de gecónidos endémicos de las Islas Canarias

Los estudios parasitológicos de gecónidos en Europa son escasos, y más aun en las Islas Canarias. Se ha llevado a cabo un exhaustivo estudio de las comunidades helmintianas de *Tarentola boettgeri boettgeri*, *T. b. hierrensis*, *T. gomerensis*, *T. delalandii* y *T. angustimentalis* (Sauria, Lacertidae) de las Islas Canarias, España (tablas 1-3). Las larvas de cestodo constituyen una parte importan-

te de las comunidades parásitas de los gecos. Las faunas helmintianas de los gecos canarios son similares, pero no idénticas, a las de los gecos continentales. Los bajos valores de riqueza y abundancia de especies y de diversidad, sugieren que las infracomunidades de los gecos canarios estan empobrecidas i aisladas.

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