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Endoparasites of three species of house geckoes in Lampung, Indonesia

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Abstract

Thirty-four house geckoes (21 *Cosymbotus platyurus*, four *Gehyra mutilata* and nine *Hemidactylus frenatus*) in December, 1997 (rainy season) and 26 geckos (16 *C. platyurus*, six *G. mutilata* and four *H. frenatus*) in July, 2000 (dry season) were captured in Lampung, Indonesia. Some species of geckoes have been inadvertently introduced to many tropical regions from their native region, but the three species of geckoes in this study are native to Indonesia. Six species of endoparasites were recovered: *Oochoristica javanensis* (Cestoda) from the small intestine, *Paradistomum geckonum* (Digenea) from the small intestine and gallbladder, *Postorchigenes ovatus* (Digenea) from the small intestine, *Spauligodon hemidactylus* (Nematoda) from the large intestine, and *Raillietiella gehyra* and *R. frenatus* (Pentastomida) from the lungs. The prevalence and mean intensity of infection in each species of geckoes are also presented. The prevalence of *S. hemidactylus* from *C. platyurus* and *H. frenatus* in the rainy season was significantly higher than in the dry season. The low prevalence of *S. hemidactylus* in *G. mutilata* in the present study corresponded to a previous report from a non-native area. According to the original description, the male of *S. hemidactylus* lacked a spicule, but in the present study, one male was found with a spicule. The present study suggests male dimorphism occurs in *Spauligodon*. The number of endoparasite species and snout vent length of geckoes were positively correlated. Geckoes with high worm burdens may be more easily captured by predators.

Introduction

Cosymbotus platyurus, *Gehyra mutilata* and *Hemidactylus frenatus* (Gekkonidae: Sauria) are nocturnal and insectivorous common house geckoes in Indonesia. *Cosymbotus platyurus* and *G. mutilata* are distributed mainly in oriental regions (Welch *et al*., 1990), whereas *H. frenatus* has been widely disseminated to other zoogeographic areas after World War II (Case *et al*., 1994). *Gehyra mutilata* was also inadvertently introduced to several locations in the Pacific Basin (Fisher, 1997). However, all three species of geckoes in the present study are native to Indonesia (Welch *et al*., 1990). These species have approximately the same body size and reproduce throughout the year in Java, Indonesia (Church, 1962). The purpose of the present study is to report on the endoparasites of house geckoes in their native region during different seasons.

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Materials and methods

Thirty-four geckoes (21 *C. platyurus*, four *G. mutilata* and nine *H. frenatus*) in December 1997 (rainy season) and 26 geckos (16 *C. platyurus,* six *G. mutilata* and four *H. frenatus*) in July 2000 (dry season) were captured on the walls of buildings in Lampung, at the southern tip of Sumatra Island, Indonesia (5°40′S, 105°22′E). Geckoes were killed and fixed in 70% ethanol and the snout vent length (SVL) measured. Parasites were recovered from the viscera under a stereo microscope. Nematodes and pentastomids were washed with water and cleared in lactophenol for identification. Trematodes and cestodes were stained with Schneider's aceto-carmine. Drawings were made with a camera lucida and measurements were made using an Olympus video micrometer (Model VM-30). Specimens of each species were deposited in the Laboratory of Parasitology, Department of Disease Control, Graduate School of Veterinary Medicine, Hokkaido University, Japan.

Results and Discussion

Six species of parasites were recovered (Helm. Coll. No. 2984–2989): *Oochoristica javanensis* (Cestoda), *Paradistomum geckonum* and *Postorchigenes ovatus* (Digenea), *Spauligodon hemidactylus* (Nematoda) and *Raillietiella gehyra* and *R. frenatus* (Pentastomida). Twenty-nine of 34 geckoes (85%) in December, 1997 and 17 of 26 geckoes (65%) in July 2000 were infected with one or more species of these endoparasites. According to Ota (1994), the species composition of arthropods found in the stomach of *H. frenatus* varied with seasonality and Zamprogno & Teixeira (1998) also reported that prey selection changed with the season. Since arthropods serve as intermediate hosts for some of the parasites found, differences in prevalence values in the present study might be correlated with seasonal food changes.

The prevalence and mean intensity of each parasite species are presented in table 1. *Oochoristica javanensis* was first described by Kennedy *et al.* (1982) from *C. platyurus*, *G. mutilata* and *H. frenatus*. In the present study, *O. javanensis* was only recovered from *C. platyurus* and *G. mutilata* in 1997. Although the intermediate host of *O. javanensis* is unknown, cysticercoids in other species of *Oochoristica* have been found in coleopterans and lepidopterans (Rendtorff, 1948; Widmer & Olsen, 1967). House geckoes may be infected with *O. javanensis* by consuming these insects.

In the present study, two species of trematodes were found. Previously, *Mesocoelium sociale* has been recovered from *C. platyurus* and *H. frenatus* in west Java, Indonesia and its prevalence was lower than *Paradistomum geckonum* and *Postorchigenes ovatus* (Kennedy *et al.*, 1987a). *Mesocoelium sociale* could not be found in the present study, presumably due to a combination of a low prevalence and a small host sample size. Although the life cycle of *P. ovatus* is unknown, the first intermediate host of *P. geckonum* and *M. sociale* is the pulmonate snail, *Lamellaxis gracilis*, and second intermediate hosts are presumed to be arthropods (Kennedy *et al.*, 1987b). Madhavi *et al.* (1998) reported that population size of *Paradistomum orientalis* in the garden lizard, *Calotes versicolor,* showed an annual variation closely correlated with rainfall. The present data reveal that the prevalence of trematodes in house geckoes in the rainy season of 1997 tends to be higher than that in the dry season of 2000 (Fisher's exact test, $P = 0.0462$). The prevalence of *Paradistomum geckonum* and *Postorchigenes ovatus* may be also related to the seasonal ecology of the snail intermediate host.

Spauligodon hemidactylus has previously been found in *H. frenatus* (Bursey & Goldberg, 1996) and *G. mutilata* (Goldberg *et al.*, 1998) and the present results showed that *Cosymbotus platyurus* also harboured this species. The prevalence of *S. hemidactylus* was lowest in *G. mutilata*, as also reported by Goldberg *et al.* (1998) in introduced populations in Guam and Rota, Micronesia. Thus, the susceptibility of *G. mutilata* to *S. hemidactylus* appears not to vary between regions. The prevalence of this nematode in *C. platyurus* and *H. frenatus* during the rainy season was significantly higher than in the dry season (Fisher's exact test, $P = 0.0017$). Bursey & Goldberg (1992) reported seasonal changes in the prevalence of *S. giganticus* in Yarrow's spiny lizard, *Sceloporus jarrovii jarrovii* in Arizona.

Males of *Spauligodon hemidactylus* lack a spicule (Bursey & Goldberg, 1996) and the males in our collection correspond with this description, except for one male with a spicule from *C. platyurus* (fig. 1). The characteristics of an adult female recovered from the same gecko could not be distinguished from the original description of *S. hemidactylus* by Bursey & Goldberg (1996). Measurements (in μm) of this male specimen are as follows: total body length 1384 and 144 maximum width; nerve ring not clear and excretory pore opens 345 from cephalic extremity; oesophagus 200 in length including bulb; bulb 46 long and 65 wide; tail 427 without spine; three pairs of genital papillae respectively situated in preanal, adanal and postanal position; spicule 52 long, ventral proximal part brownish colour and distal end sharp; gubernaculum absent. Unfortunately, this specimen was broken during the course of measuring and the caudal alae, used as key characteristic to distinguish between *Skrjabinodon* and *Spauligodon* (Petter & Quentin, 1976), could not be observed in detail. Male dimorphism has been reported by some authors. Hasegawa (1985) described two types of males in *Skrjabinodon* sp. from *H. frenatus*: type I with a spicule and type II without a spicule. Ainsworth (1990) also reported male dimorphism in *Skrjabinodon trimorphi* and *Skrjabinodon poicilandri*. The present study suggests that male dimorphism also occurs in *Spauligodon*.

Raillietiella gehyra has been reported from *G. mutilata* in Java, Indonesia and Malaysia (Ali *et al.*, 1981). *Raillietiella frenatus* was found from *C. platyurus* and *G. mutilata* in Indonesia (Ali & Riley, 1983) and *H. frenatus* occurred in South East Asia such as Malaysia, Philippines, Taiwan and Vietnam (Ali *et al.*, 1981). In the present study, both species of *Raillietiella* were recovered from *C. platyurus*, *G. mutilata* and *H. frenatus*. The life cycle of these species is well known, with *Raillietiella gehyra* and *R. frenatus* developing to infective third stage larvae in cockroaches and such larvae are infective to geckoes (Ali & Riley, 1983).

As mentioned above, these three species of house geckoes have approximately the same body size and reproduce throughout the year in Indonesia (Church, 1962) and we compared the combined data of the rainy season in 1997 with the dry season in 2000. The number of parasites species recovered and the SVL of hosts were positively correlated (fig. 2, $P = 0.0003$, $r = 0.454$). Kennedy *et al.* (1987b) showed experimentally that *Paradistomum geckonum* could infect juvenile *C. platyurus*, *G. mutilata* and *H. frenatus*. Bursey & Goldberg (1992) reported that the infection of Yarrow's spiny lizard with *Spauligodon giganticus* may occur shortly after hatching of

Table 1. Endoparasites of *Cosymbotus platyurus*, *Gehyra mutilata* and *Hemidactylus frenatus* in Lampung, Indonesia.

	Cosymbotus platyurus (n = 21)		*Gehyra mutilata* (n = 4)		*Hemidactylus frenatus* (n = 9)		
Rainy season (December, 1997)	Prevalence (%)	Mean intensity ±S.D. (range)	Prevalence (%)	Mean intensity ±S.D. (range)	Prevalence (%)	Mean intensity ±S.D. (range)	Location
Cestoda							
Oochoristica javanensis	5	1	25	3	–	–	Small intestine
Trematoda							
Paradistomum geckonum	19	3.5±2.65 (1–7)	25	3	11	3	Small intestine, gallbladder
Postorchigenes ovatus	–	–	–	–	11	19	Small intestine
Nematoda							
Spauligodon hemidactylus	86	4.3±2.28 (1–8)	–	–	89	3.0±3.00 (1–7)	Large intestine
Pentastoma							
Raillietiella gehyra	5	1	25	3	–	–	Lung
R. frenatus	10	3.0±2.83 (1–5)	–	–	33	2.7±0.58 (2–3)	Lung

	Cosymbotus platyurus (n = 16)		*Gehyra mutilata* (n = 6)		*Hemidactylus frenatus* (n = 4)		
Dry season (July, 2000)	Prevalence (%)	Mean intensity ±S.D. (range)	Prevalence (%)	Mean intensity ±S.D. (range)	Prevalence (%)	Mean intensity ±S.D. (range)	Location
Cestoda							
Oochoristica javanensis	–	–	–	–	–	–	–
Trematoda							
Paradistomum geckonum	38	3.3±2.42 (1–8)	17	2	25	3	Small intestine, gallbladder
Postorchigenes ovatus	6	1	33	4±1.41 (3–5)	–	–	Small intestine
Nematoda							
Spauligodon hemidactylus	50	1.5±0.76 (1–3)	17	1	25	4	Large intestine
Pentastoma							
Raillietiella gehyra	6	1	–	–	25	10	Lung
R. frenatus	13	1±0	33	7±7.07 (2–12)	25	1	Lung

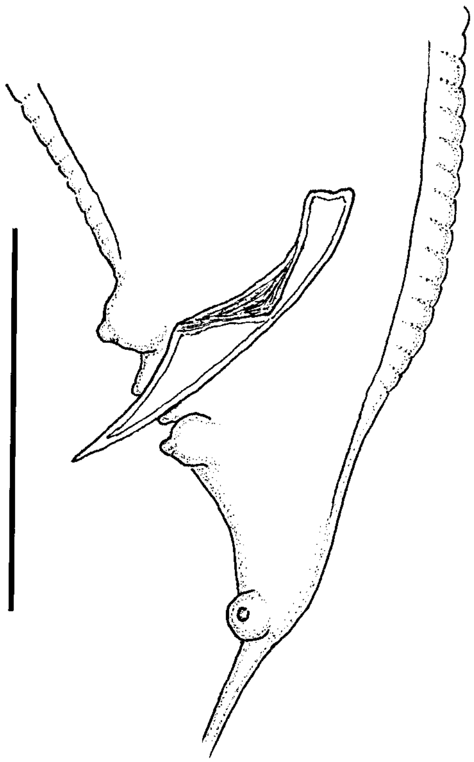

Fig. 1. Posterior end of male *Spauligodon hemidactylus* with a spicule (lateral view). Scale bar = 50 μm.

the lizards. The recovery rate of *Raillietiella hemidactylus* from juveniles of the same house geckoes in the present study was similar to that of adults in an experimental infection (Lavoipierre & Rajamanickam, 1973). Although details of the biological characteristics and the behaviour of the house geckoes are unknown, differences in the relationship between prevalence values and body size might be dependent on feeding habits. Zamprogno & Teixeira (1998) found that juvenile geckoes consumed mainly Homoptera, whereas adult geckoes selected a variety of species of arthropods. Hence, differences in food selection are likely to influence the prevalence of endoparasites in juvenile hosts. In addition, house geckoes are preyed upon by several predators and cannibalism is also known (Church, 1962; Zamprogno & Teixeira, 1998). According to Riley (1992), pathological changes were not observed in the lungs of geckoes infected with pentastomids despite the fact that adult females of *Raillietiella* can develop to 8–10 mm in length. In the present study, a maximum of 12 *R. frenatus* were recovered from one gecko and this could be harmful to the host. Geckoes with high worm burdens may be more easily captured by predators, especially juvenile geckoes. This may be one reason why there is a positive correlation between the number of parasite species recovered and the SVL of hosts.

The present results are based on limited data and further investigations on the ecology and epidemiology of the parasites of house geckoes including climatic data, are required. House geckoes and their parasites are also likely to be suitable models for studies on competition by introduced host species.

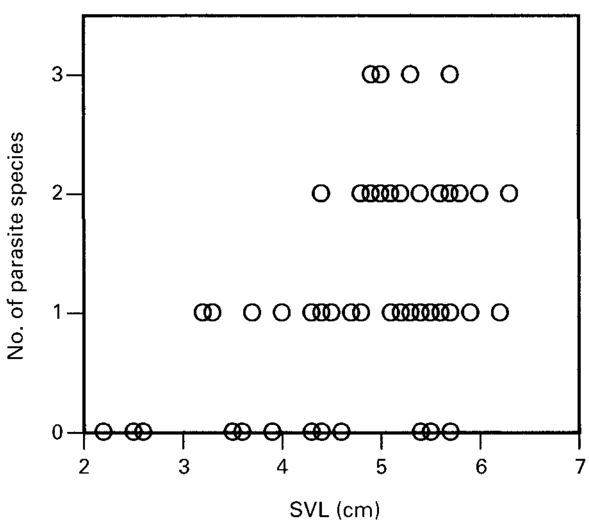

Fig. 2. Correlation of the number of parasite species recovered from three species of house geckoes and host snout vent length (SVL).

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References

Ainsworth, R. (1990) Male dimorphism in two new species of nematode (Pharyngodonidae: Oxyurida) from New Zealand lizards. *Journal of Parasitology* **76**, 812–822.

Ali, J.H. & Riley, J. (1983) Experimental life-cycle studies of *Raillietiella gehyrae* Bovien, 1927 and *Raillietiella frenatus* Ali, Riley and Self, 1981: pentastomid parasites of geckos utilizing insects as intermediate hosts. *Parasitology* **86**, 147–160.

Ali, J.H., Riley, J. & Self, J.T. (1981) A revision of the taxonomy of the blunt-hooked *Raillietiella*, pentastomid parasites of African, South-East-Asian and Indonesian lizards, with a description of a new species. *Systematic Parasitology* **3**, 193–207.

Bursey, C.R. & Goldberg, S.R. (1992) Monthly prevalences of *Spauligodon giganticus* (Nematoda Pharyngodonidae) in naturally infected Yarrow's spiny lizard *Sceloporus jarrovii jarrovii* (Iguanidae). *American Midland Naturalist* **127**, 204–207.

Bursey, C.R. & Goldberg, S.R. (1996) *Spauligodon hemidactylus* n. sp. (Nematoda: Pharyngodonidae) from *Hemidactylus frenatus* (Reptilia: Gekkonidae) from Oceania. *Journal of Parasitology* **82**, 299–301.

Case, T.J., Bolger, D.T. & Petren, K. (1994) Invasions and competitive displacement among house geckos in the tropical Pacific. *Ecology* **75**, 464–477.

Church, G. (1962) The reproductive cycles of the Javanese house geckos, *Cosymbotus platyurus, Hemidactylus frenatus*, and *Peropus mutilatus*. *Copeia* **2**, 262–269.

Fisher, R.N. (1997) Dispersal and evolution of the Pacific basin gekkonid lizards *Gehyra oceanica* and *Gehyra mutilata*. *Evolution* **51**, 906–921.

Goldberg, S.R., Bursey, C.R. & Cheam, H. (1998) Gastrointestinal helminths of four gekkonid lizards, *Gehyra mutilata, Gehyra oceanica, Hemidactylus frenatus* and *Lepidodactylus lugubris* from the Mariana Islands, Micronesia. *Journal of Parasitology* **84**, 1295–1298.

Hasegawa, H. (1985) Helminth parasites of reptiles from Okinawa, Japan. *Biology Magazine Okinawa* **23**, 1–11.

Kennedy, M.J., Killick, L.M. & Beverley-Burton, M. (1982) *Oochoristica javanensis* n. sp. (Eucestoda: Linstowiidae) from *Gehyra mutilata* and other geckonid lizards (Lacertila: Geckonidae) from Java, Indonesia. *Canadian Journal of Zoology* **60**, 2459–2463.

Kennedy, M.J., Killick, L.M. & Beverley-Burton, M. (1987a) The prevalence of *Paradistomum geckonum, Mesocoelium sociale*, and *Postorchigenes ovatus* (Digenea) in lizards (Suria) from Indonesia. *Canadian Journal of Zoology* **65**, 1292–1294.

Kennedy, M.J., Killick, L.M. & Beverley-Burton, M. (1987b) Life cycle studies on two Digenea, *Paradistomum geckonum* (Diclocoeliidae) and *Mesocoelium sociale* (Mesocoeliidae), in geckonid lizards from Indonesia. *Canadian Journal of Zoology* **65**, 2491–2497.

Lavoipierre, M.M.J. & Rajamanickam, C. (1973) Experimental studies on the life cycle of a lizard pentastomid. *Journal of Medical Entomology* **10**, 301–302.

Madhavi, R., Nirmala, E. & Subbalakshmi, C. (1998) A population study of the dicrocoeliid trematode *Paradistomum orientalis* in the garden lizard *Calotes versicolor*. *Journal of Zoology* **244**, 489–496.

Ota, H. (1994) Female reproductive cycles in the northernmost populations of the two gekkonid lizards, *Hemidactylus frenatus* and *Lepidodactylus lugubris*. *Ecological Research* **9**, 121–130.

Petter, A.J. & Quentin, J.C. (1976) Key to the genera of Oxyuroidea. *in* Anderson, R.C., Chabaud, A.G. & Willmott, S. (*Eds*) *CIH keys to the nematode parasites of vertebrates*. 30 pp. Farnham Royal, Bucks, Commonwealth Agricultural Bureaux.

Rendtorff, R.C. (1948) Investigations on the life cycle of *Oochoristica* and the status of linstowiine cestodes. *Journal of Parasitology* **34**, 243–252.

Riley, J. (1992) Pentastomids and the immune response. *Parasitology Today* **8**, 133–137.

Welch, K.R.G., Cooke, P.S. & Wright, A.S. (1990) *Lizards of the orient: a checklist*. 162 pp. Malabar, Florida, Krieger Publishing Company.

Widmer, E.A. & Olsen, O.W. (1967) The life history of *Oochoristica osheroffi* Meggitt, 1934 (Cyclophyllidea: Anoplocephalidae). *Journal of Parasitology* **53**, 343–349.

Zamprogno, C. & Teixeira, R.L. (1998) Food habits of the tropical house gecko *Hemidactylus mabouia* (Reptilia, Gekkonidae) from a sandy coastal Plain of Espirito Santo, eastern Brazil. *Revista Brasileira de Biologia* **58**, 143–150.

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