ACANTHOCEPHALUS REUNIONENSIS N. SP. (ACANTHOCEPHALA: ECHINORHYNCHIDAE), A PARASITE OF *ANGUILLA* SPECIES (ANGUILLIDAE) FROM REUNION ISLAND

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Summary:

In a survey of 118 eels *Anguilla bicolor, A. marmorata* and *A. mossambica,* (Anguillidae) indigenous to Reunion Island in the Mascarene island group, western Indian Ocean, a new species of acanthocephalan, *Acanthocephalus reunionensis* n. sp., was found. With a proboscis hook formula of 19 rows of 4-5 hooks, and elongated cement glands arranged in three pairs, this species differs from all other species in the genus. This is the first record of the genus *Acanthocephalus* occurring in eels from the African Region.

KEY WORDS : Reunion Island, Mascarene Islands, eel, Anguillidae, *Anguilla,* Acanthocephala, *Acanthocephalus reunionensis* n. sp.

Résumé : *ACANTHOCEPHALUS REUNIONENSIS* N. SP. (ACANTHOCEPHALA: ECHINORHYNCHIDAE) PARASITE D'*ANGUILLA* SP. (ANGUILLIDAE) DANS L'ÎLE DE LA RÉUNION

Dans une étude portant sur 118 anguilles – Anguilla bicolor, A. marmorata *et* A. mossambica *(Anguillidae) – indigènes de l'Île de la Réunion, Archipel des Mascareignes à l'ouest de l'Océan Indien, une nouvelle espèce d'acanthocephale,* Acanthocephalus reunionensis *n. sp., avec un proboscis comportant 19 rangées de 4-5 crochets, a été trouvée. Cette espèce diffère des autres espèces du genre par trois paires de glandes allongées. Il s'agit de la première observation du genre* Acanthocephalus *chez des anguilles dans cette région de l'Afrique.*

MOTS CLÉS : *Île de la Réunion, Mascareignes, anguille, Anguillidae,* Anguilla, *Acanthocephala,* Acanthocephalus reunionensis *n. sp.*

INTRODUCTION

The genus *Acanthocephalus* Koelreuther, 1771 (Echinorhynchida: Echinorhynichidae) is a cosmopolitan genus occurring in freshwater fish, including five species from eels (Anguillidae), amphibians and reptiles (Golvan, 1969; McAlpine, 1996; Crusz & Ching, 1975; Kennedy, 1982; Bursey & Goldberg, 2003. The type species *Acanthocephalus anguillae* (Müller, 1780) *A. clavula* (Dujardin, 1845) and *A. lucii* Müller, 1776 are found in Europe, *A. dirus* Van Cleave, 1931 in North America and *A. gotoi* Van Cleave, 1925 in Japan (Golvan, 1969).

In a survey of fresh water fishes from the French island of Reunion, one of the Mascarene Islands, in the western Indian Ocean, a new species of *Acanthocephalus* from the autochthonous eels *Anguilla bicolor* McClelland, 1884, *Anguilla marmorata* Quoy & Gaimard, 1824 and *Anguilla mossambica* (Peters, 1852) was found, and is described below.

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MATERIALS AND METHODS

A total of 118 eels, comprising 23 *A. bicolor,* 15 *A. mossambica* and 80 *A. marmorata* were collected from rivers in Reunion Island, including 22 eels from Grande Rivière St-Jean (20° 930' S, 55° 640' E), 13 from Rivière St-Jean (20° 942' S, 55° 645' E) and five from Roche Bras-Panon (21° 006' S, 55° 653' E) (Table I) and examined for helminths.

All acanthocephalans so found were relaxed overnight in tap water, fixed in AFA and stored in 70 % ethanol. Prior to microscopic examination the worms were cleared in beechwood creosote and studied as temporary wet mounts. All figures were prepared with the aid of a drawing tube and all measurements are given in micrometres unless otherwise stated. The specimens collected for this study are registered in the collection of the Muséum National d'Histoire Naturelle, Paris (MNHN) or the South Australian Museum, Adelaide (SAM).

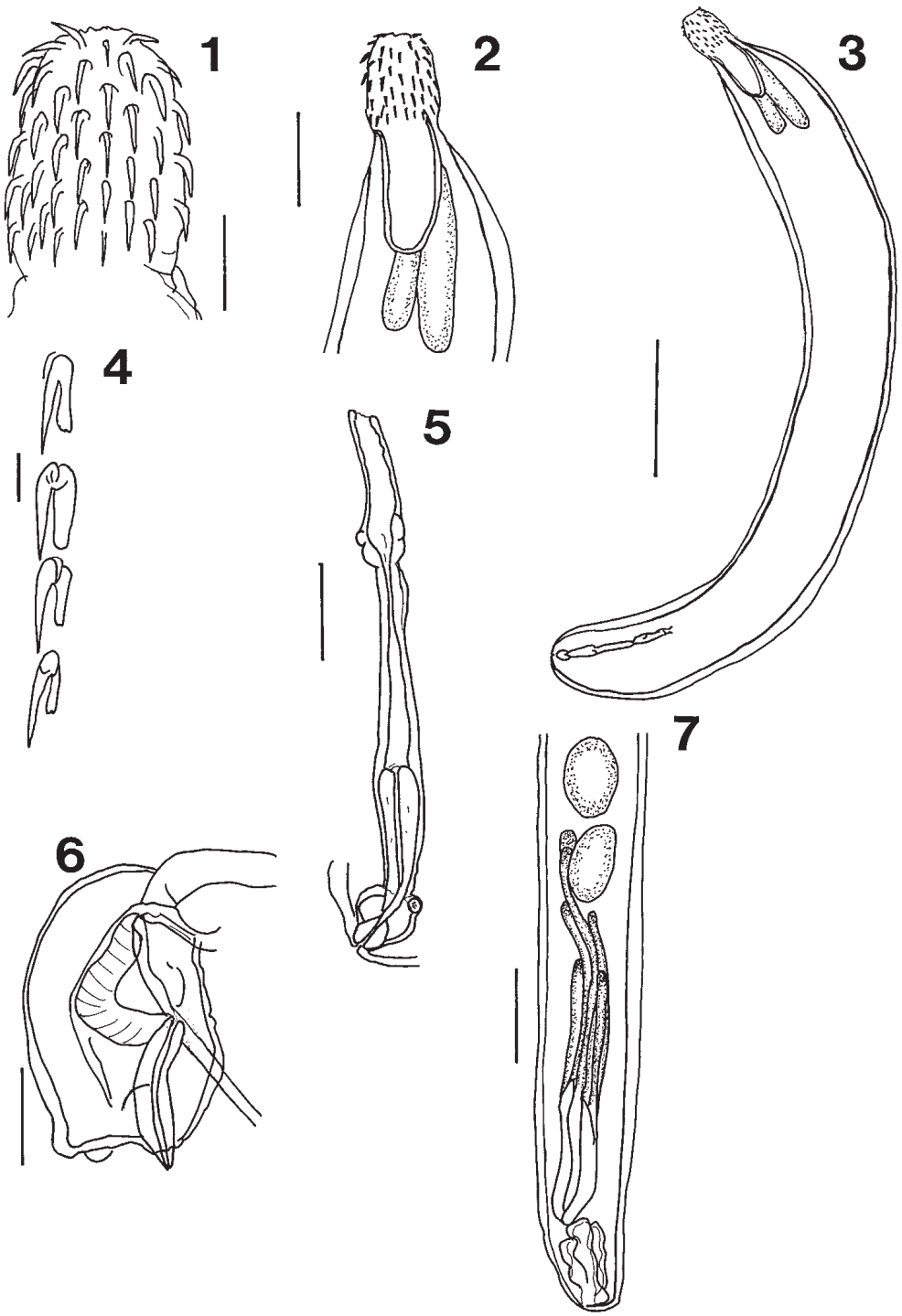
DESCRIPTION

ACANTHOCEPHALUS REUNIONENSIS N. SP. (Figs 1-7)

Type material: holotype male SAM AHC33910; allotype female SAM AHC33911, other paratypes one male, one female MNHN 307HG.

	Locality								
	Grande Rivière St Jean			Rivière St Jean			River Roches Bras-Panon		
Host taxon	No	Prevalence	Intensity	No	Prevalence	Intensity	No	Prevalence	Intensity
A. bicolor	9	33	1-4	5	0	0	0	0	0
A. marmorata	10	0	0	2	0	0	1	100	1
A. mossambica	3	0	0	6	16.6	6	4	50	1-2

Table I. – Number (No), prevalence (%), and intensity of infections with *Acanthocephalus reunionensis* in three species of *Anguilla* collected from three rivers in the Reunion Islands.



Figs 1-7. – *Acanthocephalus reunionensis* n. sp. 1-5 female, 1, proboscis; 2, anterior extremity; 3, proboscis and trunk; 4, hooks; 5, genital apparatus; 6-7 male, 6, bursa; 7, posterior end.
Scales 1, 5, 6, 200 µm; 2, 500 µm; 3, 1,000 µm; 4, 50 µm; 7, 750 µm.

Type host: *Anguilla bicolor* McClelland, 1884 (Anguillidae).
Type locality: Grande Rivière St-Jean, Reunion Island, September 2005.
Site in host: intestine.
Other material examined: from the Grande Rivière St-Jean, one male, two females from *Anguilla bicolor* SAM AHC33912; from the Rivière St Jean, two males, one female from *Anguilla mossambica* SAM AHC33913; from the river Roche Bras-Panon, two males, two females from *Anguilla mossambica* MNHN308HG; one female from *Anguilla marmorata* SAM AHC33914.
Prevalence: seven of 118 hosts; three of 23 *A. bicolor,* one of 80 *A. mamorata* and three of 15 *A. mosambica* (Table I).

Trunk cylindrical, smooth, same width throughout. Proboscis cylindrical, armed with 19 longitudinal rows, 4-5 (usually 4) hooks. Proboscis receptacle cylindrical, double walled, cerebral ganglion at base. Lemnisci elongate, digitiform, same length or slightly longer than proboscis receptacle.
Male (n = 4): trunk 5.6-8.0 (6.65) mm long, 0.85-1.275 (1.025) mm wide. Proboscis 400-505 (435) long, 300-335 (335) wide. Proboscis hooks, thorn length I 82.5-89; II 95-105.6; III 79-95.5; IV 69-95.5; roots simple, length I 70.5-80; II 90-90.5; III 50.5-60.5; IV 40-50. Neck 134-175 (148) long, 375-470 (406) wide; proboscis receptacle 405-1,070 (720) long, 265-370 (295) wide; lemnisci 770-1,105 (885). Testes ovoid, tandem, in posterior half of body; anterior testis 535-657 (610) long, 335-450 (395) wide; posterior testis 470-665 (590) long, 340-450 (395) wide. Cement glands 6, filiform, arranged in three pairs 1,050-2,100 long.
Female (n = 6): trunk 6.5-10 (8.2) mm long, 0.87-1.275 (1.03) mm wide. Proboscis 470-540 (505) long, 300-400 (355) wide; proboscis hooks, thorn length I 82-105.6; II 115.5-128.7; III 105.6-122.1; IV 99-122.1; V 79.2. Neck 135-270 (185) long, 380-435 (405) wide; proboscis receptacle 645-905 (750) long, 120-400 (280) wide; lemnisci 670-1,275 (995) long. Uterine bell to vagina 1,005-1,530 (1,195); genital pore sub-terminal. No eggs seen.

DISCUSSION

The new species, *Acanthocephalus reunionensis*, with a cylindrical proboscis with many hooks, double walled proboscis receptacle, six cement glands, parasitic in freshwater fishes, keys down to the family Echinorhynchidae and having a cylindrical trunk without spines, to the subfamily Echinorhynchinae (see Amin, 1987).
Having only hooks, no spines, on the proboscis, hooks larger mid proboscis than anteriorly or posteriorly, lemnisci sacciform and testes in the posterior half of the trunk, the new species falls within the genus *Acanthocephalus* as defined by Golvan (1969). Golvan's generic diagnosis, however, lists the cement glands as short and pyriform, clustered together irregularly or more or less in three pairs. Although in three pairs, the six cement glands of *A. reunionensis* n. sp. are long and filiform rather than short or pyriform. When the descriptions of a series of *Acanthocephalus* species are examined, however, it can be seen that the cement glands of the congeners vary from a short, round cluster, as in *A. echigoensis* Fujita, 1920 and *A. falcatus* Frölich, 1789, through more elongated, pyriform cement glands as in *A. ula* Lent & Portes-Santos, 1989, *A. fluviatilis* Paperna, 1964 and *A. lucidus* Van Cleave, 1925, to filiform as in *A. bufonis* (Shipley, 1903) (see Golvan, 1969; Kennedy, 1982; Lent & Portes-Santos, 1989). In this context the cement glands of *A. reunionensis* represent a continuation of the trend towards elongation. *Acanthocephalus reunionensis* n. sp. differs from all its congeners, except *A. bufonis,* therefore, in having filiform cement glands arranged in three pairs. There are also similarities in proboscis hook formulae, *A. reunionensis* having 19 rows of 4-5 hooks and *A. bufonis* 12-15 rows of 4-6 hooks (Kennedy, 1982) or 15-19 rows of 4-6 hooks (Van Cleave, 1937). *Acanthocephalus reunionensis* differs, however, in usually having four hooks and no more than five per row, the number of hooks per row being reported as a more consistent character for *Acanthocephalus* species than the number of rows of hooks in the proboscis (Kennedy, 1982). *Acanthocephalus reunionensis* further differs from *A. bufonis* in having a larger proboscis (males 400-505 compared with 310-440). *Acanthocephalus reunionensis* occurs in eels from the Reunion Islands, while *A. bufonis* occurs in frogs, toads and lizards from China and Indonesia (Kennedy, 1982). *Acanthocephalus reunionensis* is also similar to *A. ula*, which has a cluster of elongated cement glands and a proboscis armature of 16-20 rows of 7-8 hooks (Lent & Portes-Santos, 1989), but differs in having an armature of only five hooks per row, cement glands arranged in pairs, larger testes (anterior testis 535-565 by 335-450 compared with 270-440 by 270-300) and a longer female reproductive system (1,005-1,530 compared with 570-720). Further *A. ula* occurs in frogs from Venezula (Lent & Portes-Santos, 1989).
The proboscis armature of *A. reunionensis* is similar to that of *A. madagascariensis* Golvan, 1965 with 18-20 rows of 5-6 hooks but differs in having no more than five hooks, usually four. *Acanthocephalus reunionensis* further differs from *A. madagascariensis* in body shape, the female trunk is anteriorly dilated in *A. madagascariensis* and a longer female reproductive system, 1,005-1,530, despite the immaturity, compared with 1,000 for *A. madagascariensis*, and *A. madagascariensis* occurs in frogs from Madagascar.
The proboscis armatures of *Acanthocephalus* species known to occur eels, namely *A. anguillae*, with 10 rows

of 5-7 hooks (Golvan, 1969); *A. clavula* with 16-18 rows of 13-14 hooks (Grabda-Kazubsa & Chubb, 1968; Outeiral, 2002; Byrne *et al.*, 2004); *A. dirus* with 11-16 rows of 7-10, 11-13 hooks (Amin, 1984, 1985); *A. gotoi* with 15-18 rows of 11-15 hooks (Golvan, 1969); *A. lucii* with 12-16 rows of 7-9 hooks (Golvan, 1969); are not congruent with that of *A. reunionensis* which has 19 rows of 4-5 hooks. *Acanthocephalus reunionensis* is the first species to be recorded from eels in the African Region. All the females of *A. reunionensis* collected for this study were immature, no eggs being present. This is indicative of either infections in which the worms had not been established long enough to reach maturity or, as is most likely in this case, infections of worms unable to reach maturity because they were established in unsuitable hosts. Acanthocephala from fish hosts are occasionally reported as accidental infections in amphibia and vice versa (Flyunt & Lisitsyna, 1995; McAlpine, 1996) and this probably happened with *A. reunionensis*. On Reunion Island itself there is a dearth of possible alternative suitable indigenous hosts, as there are no fresh water fishes that include crustaceans in their diet and no amphibians (Institute for Environmental & Legal Studies, 1998). The cichlid fish *Oreochromus nilotica nilotica* (Linnaeus, 1758), which includes crustaceans in its diet, was introduced to Reunion in 1957 (Welcomme, 1988) but the cichlids examined in this study were not infected. The presence of exotic frogs and tadpoles was noted during this study but they were not collected. The species of *Acanthocephalus* morphologically closest to *A. reunionensis*, namely *A. bufonis*, and that biogeographically closest, namely *A. madagascariensis*, both occur in amphibian hosts, *Racophorus* sp., from Madagascar (Golvan, 1969) and *Bufo* and *Rana* spp. from Indonesia. This could be indicative of introduced amphibian hosts being more suitable for *A. reunionensis* than eels. Potential amphibian hosts from Reunion Island as well as fishes and amphibians from other islands in the Mascarenes need to be examined before the hosts of *A. reunionensis* can be determined as required, suitable or unsuitable, respectively.

ACKNOWLEDGEMENTS

Thanks are due to ARDA for their help with sampling eels and providing facilities for dissections. Financial support for the field work was provided by the CNRS-SDV for P. Sasal and by Karlsruher Universitätsgesellschaft for H. Taraschewski.

REFERENCES

AMIN O.A. Variability and redescription of *Acanthocephalus dirus* (Van Cleave, 1931) (Acanthocephala: Echinorhynchidae) from freshwater fishes in North America. *Proceedings of the Helminthological Society of Washington*, 1984, *51*, 225-237.

AMIN O.A. Hosts and geographic distribution of *Acanthocephalus* (Acanthocephala: Echinorhynchidae) from North American freshwater fishes, with a discussion of species relationships. *Proceedings of the Helminthological Society of Washington*, 1985, *52*, 210-220.

AMIN O.A. Key to the families and subfamilies of Acanthocephala with the erection of a new class (Polyacanthocephala) and a new order (Polyacanthorhynchida). *Journal of Parasitology*, 1987, *73*, 1216-1219.

BURSEY C.R. & GOLDBERG S.R. *Acanthocephalus saurius* n. sp. (Acanthocephala: Echinorhynchidae) and other Helminths from the lizard *Norops limifrons* (Sauria: Polychrotidae) from Costa Rica. *Journal of Parasitology,* 2003*, 89,* 573-576.

BYRNE C.J., HOLLAND C.V., WALSH E., MULLIGAN C., KENNEDY C.R. & POOLE W.R. Utilization of brown trout *Salmo trutta* by *Acanthocephalus clavula* in an Irish lake: is this evidence of a host shift? *Journal of Helminthology*, 2004, *78*, 201-206.

CRUSZ H. & CHING C.C. Parasites of the relict fauna of Ceylon VI. More new helminths from amphibians and reptiles with a new host record and redescription of *Acanthocephalus serendibensis* Crusz & Mills, 1970. *Annales de Parasitologie Humaine et Comparée,* 1975, *50,* 531-538.

FLYUNT R.B. & LISITSYNA O.I. *Acanthocephalaus falcatus* (Acanthocephala, Echinorhynchidae), a parasite of amphibians found in trout. *Vestnik Zoologii,* 1995, *1*, 67-70.

GOLVAN Y.J. Systématique des acanthocéphales (Acanthocephala Rudolphi, 1801) L'ordre des Palaeacanthocephala Meyer, 1931, I – La superfamille des Echinorhynchidea (Cobbold, 1876) Golvan et Houin 1963. *Mémoires du Muséum National d'Histoire Naturelle nouvelle série, ser. A. Zoologie*, 1969, *57*, 1-373.

GRABDA-KAZUBSKA B. & CHUBB J.C. *Acanthocephalus* the correct generic name for *Echinorhynchus clavula* Dujardin, 1845 (Acanthocephala). *Acta Parasitologica Polonica*, 1968, *15*, 305-312.

INSTITUTE FOR ENVIRONMENTAL & LEGAL STUDIES. Mauritius and its Environment, The environment, Fauna, 1998, Viewed 24 May 2006, http://www.intnet.mu/iels/env_mts.htm

KENNEDY M.J. A redescription of *Acanthocephalus bufonis* (Shipley, 1903) Southwell and Macfie, 1925 (Acanthocephala: Echinorhynchidae) from the black spotted toad, *Bufo melanostictus* from Bogor, Indonesia. *Canadian Journal of Zoology*, 1982, *60*, 356-360.

LENT H. & PORTES-SANTOS C. *Acanthocephalus ula* n. sp. (Acanthocephala, Echinorhynchidae) and *Schulzia usu* n. sp. (Nematoda, Moleneidae) described from *Atelopus oxyrhynchus* (Amphibia) from Venezuela. *Revista Brasileira de Biologia*, 1989, *49*, 1085-1091.

MCALPINE D.F. Acanthocephala parasitic in North American amphibians: a review with new records. *Alytes (Paris),* 1996, *14*, 115-121.

OUTEIRAL S. Non digenean parasites of eels from estuaries in North-west Spain. *Helminthologia*, 2002, *39*, 19-97.

VAN CLEAVE H.J. Acanthocephala from China 11. Two new species of the genus *Acanthocephalus from A*mphibia. *Parasitology 1937, 29*, 395-398

WELCOMME R.L. International introductions of inland aquatic species. Fisheries Technical Paper 294, FAO, 1988, 1-318.

Reçu le 4 juillet 2006
Accepté le 22 mars 2007