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D.J. Marshall · N.J.M. Gremmen · L. Coetzee
B.M. OConnor · P.J.A. Pugh · P.D. Theron
E.A. Ueckermann

New records of Acari from the sub-Antarctic Prince Edward Islands

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Abstract Sixty species of Acari are recorded from the sub-Antarctic Marion and Prince Edward Islands (the Prince Edward archipelago). Twenty of the 45 species collected on recent expeditions are new and currently undescribed. Other new taxa include a family of Mesostigmata, four new genera, and the first sub-Antarctic records of Cillibidae (Mesostigmata) and *Eryngiopus* (Prostigmata). Fifteen of the 31 species previously reported from the islands are confirmed, although eight of the previous accounts remain doubtful. The fauna, which shows a distinction between the shoreline and terrestrial components, comprises endemic, South Indian Ocean Province and sub-Antarctic mite species.

Introduction

Marion Island (46°54′S, 37°45′E) and nearby Prince Edward Island (46°60′S, 46°97′E) are sub-Antarctic members of the South Indian Ocean Province (sensu Lewis-Smith 1984). Marion Island is a major study centre for the physiology, ecology and biogeography of marine birds and mammals, as well as terrestrial sub-Antarctic plants and invertebrates (e.g. Gremmen 1981; Crafford et al. 1986; Smith 1987; Lutjeharms 1995). The invertebrate fauna includes well-documented macroarthropods, that is insects (Crafford et al. 1986; Chown and Scholtz 1989; Chown 1989, 1990, 1993, 1994; Chown et al. 1997), although mesoarthropods, mites (Acari) and springtails (Collembola) have attracted relatively little attention.

Studies on the Prince Edward Islands acarofauna have concentrated on the taxonomy and physiology of the Cryptostigmata (Oribatida; e.g. van Pletzen and Kok 1971; Engelbrecht 1974, 1975; Marshall and Chown 1995; Marshall 1996). There have been no broad-scale field studies of this group. As a consequence the reported acarine diversity of 20 Cryptostigmata, five Prostigmata (Actinedida), two Astigmata (Acaridida) and no free-living Mesostigmata (Gamasida), is very poor compared with other sub-Antarctic islands (Block 1992; Pugh 1993; Starý and Block 1995; Starý et al. 1997; Starý and Block 1998). The current study reports on the Acari collected by recent expeditions to Marion and Prince Edward Islands and comments on the acarofauna of the islands in light of the new findings.

D.J. Marshall (✉)
Department of Zoology, University of Durban-Westville,
Private Bag X54001, Durban 4000, South Africa
e-mail: marshall@pixie.udw.ac.za, Fax: +27-31-2044790

N.J.M. Gremmen
Bureau Data-Analyse Ecologie, Dwarsdrift 24,
7981 AP Diever, The Netherlands

L. Coetzee
National Museum, Bloemfontein, South Africa

B.M. OConnor
Museum of Zoology, University of Michigan,
Ann Arbor, MI USA

P.J.A. Pugh
British Antarctic Survey, High Cross, Cambridge CB3 0ET, UK

P.D. Theron
Zoology Department, Potchefstroom University,
Potchefstroom, South Africa

E.A. Ueckermann
Biosystematics Division, Plant Protection Research Institute,
Pretoria, South Africa

Materials and methods

Free-living Acari were collected from Marion and Prince Edward Islands during April/May of 1996 and 1997. Collections were made from a diverse range of localities and habitat types. These included vegetated (mire and non-mire) and non-vegetated (fellfield) habitats over a large altitudinal range, as well as the littoral and supralittoral zones. Strictly controlled access to Prince Edward Island limited sampling there to a single-day visit.

The few Acari observed in the field, especially those in epilithic habitats, were collected with an aspirator. The majority of samples, comprising vegetation and soil cores, were hand sorted or heat extracted, for 5 days, via Tullgren or high-gradient funnels into

70% ethanol (e.g. MacFadyen 1961). Hypersaline flotation (Pugh and Bartsch 1993) was used to extract mites from intertidal algae and the surface of stones. The latter were scrubbed into a bucket of seawater and any suspended material retained by a 60 μm nylon mesh was extracted using hypersaline.

All Acari were stored in 70% aqueous ethanol with 5% v/v glycerol, macerated in 70% lactic acid and mounted for identification in either lactic acid, Hoyer's medium or glycerine jelly (e.g. Krantz 1978). Specimens are currently in the institute collections of the authors and collaborators as follows: Mesostigmata (E.A. Ueckermann), non-marine Prostigmata (P.D. Theron), Oribatida (L. Coetzee), Astigmata (B.M. OConnor) and halacarid and hyadesiid mites, I. Bartsch and P.J.A. Pugh.

Results and discussion

Acarine taxa (Tables 1, 2)

The revised faunal list for the Prince Edward Islands comprises 60 free-living acarine species and subspecies, including eight Mesostigmata, 20 Prostigmata, 23 Cryptostigmata and nine Astigmata. Fifteen of the 31 previously reported species are confirmed, although eight remain unsubstantiated (cf. van Pletzen and Kok 1971; Bartsch 1979; Pugh 1993). A further 30 species are reported as new to the Prince Edward Islands but are not described here. New taxa include one family (Mesostigmata), four genera (Mesostigmata and Prostigmata) and 20 species. The latter include the first sub-Antarctic records of Cillibidae (Mesostigmata) and *Eryngiopus* (Prostigmata).

The new genus of the family Cillibidae is closely related to the genus *Cilliba* Von Heyden, known only from the Mediterranean region, and *Australocilliba* Athias-Binche and Bloszyk, from Australia. It differs from both of these genera in the shape of the peritremes, the anterior extension of the genital shield, possession of a claw on the tarsus of leg I, the absence of a metapodal line, submarginal setae on the opisthogaster, the length of the corniculi, and the shape of the h1 setae. The family Rhodacaridae is represented here by five new species, of which three appear to be closely related to the species of *Athiasella* Lee, previously only known from New Zealand and Australia. The new family of Mesostigmata is currently being investigated.

Of the nine new species of Prostigmata, four are from the family Nanorchestidae. *Nanorchestes* species 1 is clearly distinguishable from the others on account of its large size and the characteristics of the prodorsal area. Species 2 resembles *N. capensis* and *N. globosus* (both described from the southern African subcontinent) and *N. bellus*, but warrants separation on the basis of the leg chaetotaxy and structural differences in the prodosal area and cheliceral setae. Whereas species 3 shows similarities to *N. antarcticus*, it differs in the detail of the gnathosoma and prodorsal area. *Nanorchestes* species 4 has an integumental fold in the sensory area separating it from both *N. antarcticus* and species 3, and differs from the latter in setal lengths.

The new genus of Halacaridae collected from the supply reservoir (van den Boogaard river) represents the

Table 1 Distributions of Mesostigmata and Prostigmata recorded from the Prince Edward Islands. All new taxa are in *bold*. Sub-antarctic distributions are taken from Bartsch (1979), Pugh (1993) and Starý and Block (1998). (*Mar* Maritime Antarctic – South Shetland, South Orkney and South Sandwich Islands, South Georgia, Bouvetøya, *SIP* South Indian Ocean Province Islands – Prince Edward Islands, Isles Crozet and Kerguelen, Heard Island, *SPP* South Pacific Ocean Province Islands – Macquarie, Campbell Islands, *new* new to the Prince Edward Islands, + confirmed prior record, ? doubtful record)

Family	Species	Record	Distribution		
Mesostigmata					
Rhodacaridae	**gen. nov. 1 sp. nov. 1**				
	gen. nov. 1 sp. nov. 2				
	gen. nov. 1 sp. nov. 3				
	gen. nov. 1 sp. nov. 4				
	gen. nov. 1 sp. nov. 5				
Digamasellidae	***Dendrolaelaps* sp. nov.**				
Cillibidae	**gen. nov. sp. nov.**				
Fam. nov.	**gen. nov. sp. nov.**				
Prostigmata					
Nanorchestidae	***Nanorchestes* sp. nov. 1**				
	***Nanorchestes* sp. nov. 2**				
	***Nanorchestes* sp. nov. 3**				
	***Nanorchestes* sp. nov. 4**				
Eupodidae	*Eupodes minutus* (Strandtmann)	+	Mar	SIP	SPP
Rhagidiidae	*Rhagidia* sp.	New			
Halacaridae	**gen. nov. sp. nov.**				
	Werthella tera Bartsch			SIP	
	Halacarellus parilis Bartsch			SIP	
	H. novus (Lohmann)	New	Mar	SIP	SPP
	H. robustus Lohmann			SIP	
	Lohmannella gaussi Lohmann		Mar	SIP	
	Isobactrus magnus (Lohmann)	New		SIP	
	Rhombognathus auster Bartsch	New	Mar		
Ereynetidae	*Ereynetes macquariensis* Fain	+	Mar	SIP	SPP
Tydeidae	***Tydeus (Pertydeus)* sp. nov.**				
Bdellidae	***Bdellodes* sp. nov.**				
Scutacaridae	*Disparipes antarcticus* Richters			SIP	
Stigmaeidae	***Eryngiopus* sp. nov.**				
Erythraeidae	***Balaustium* sp. nov.**				

Table 2 Distribution of Cryptostigmata and Astigmata recorded from the Prince Edward Islands

Family	Species	Record		Distribution	
Cryptostigmata					
Brachychthonidae	*Liochthonius australis* Covarrubias	New	Mar	SIP	
	L. fimbriatissimus (Hammer)	?			
Hermanniellidae	*Hermanniella* sp.	?			
Gymnodamaeidae	*Allodamaeus* sp.	?			
Peloppiidae	*Macquarioppia striata* (Wallwork)	+		SIP	SPP
Oppiidae	*Austroppia crozetensis* (Richters)	+	Mar	SIP	SPP
Ameronothridae	*Alaskozetes antarcticus intermedius* (Michael)	+	Mar	SIP	SPP
	A. bouvetøyaensis van Pletzen & Kok	?	Mar	SIP	
	Halozetes belgicae (Michael)	+	Mar	SIP	SPP
	H. crozetensis (Richters)	?		SIP	SPP
	H. edwardensis van Pletzen & Kok	?			
	H. fulvus Englebrecht	+		SIP	
	H. marinus (Lohmann)	?	Mar	SIP	SPP
	H. marinus devilliersi Englebrecht	+		SIP	
	H. marionensis Englebrecht	+		SIP	
	Podacarus auberti Grandjean	+	Mar	SIP	SPP
Oribatulidae	*Dometorina marionensis* van Plezten & Kok	+		SIP	
	Zygoribatula subantarctica van Plezten & Kok				
Protoribatidae	*Totobates marionensis* van Pletzen & Kok	+		SIP	
Ceratozetidae	*Antarctozetes crozetensis* (Richters)			SIP	
	Ceratozetes gausii (Richters)	?			
	Magellozetes antarcticus (Michael)	New	Mar	SIP	
Parakalummidae	*Porokalumma rotunda* (Wallwork)	+		SIP	SPP
Astigmata					
Acaridae	*Schwiebea talpa subantarctica* Fain	+		SIP	
Algophagidae	***Algophagus* sp. nov. 1**				
	***Algophagus* sp. nov. 2**				
Hyadesiidae	*Hyadesia halophila* Fain	New	Mar	SIP	
	H. kerguelenensis Lohmann	New		SIP	
	H. subantarctica Fain	New	Mar	SIP	
Winterschmidtiidae	*Neocalvolia travei* Fain	+		SIP	
	***Neocalvolia* sp. nov.**				
Histiostomatidae	*Austranoetus kerguelenensis* Fain	New		SIP	

first sub-Antarctic freshwater halacarid mite (I. Bartsch personal communication; cf. Pugh and Dartnall 1994). All four previously reported Halacaridae from the islands were collected offshore (Bartsch 1979), while all three new records, of *Halacarellus novus* (Lohmann), *Isobactrus magnus* (Lohmann) and *Rhombognathus auster* Bartsch, are intertidal.

The cryptostigmatid fauna contains numerous discrepancies between the current and earlier records (cf. van Pletzen and Kok 1971; Pugh 1993). Five taxa reported by van Pletzen and Kok (1971) remain unconfirmed. These are *Hermanniella* sp. (Hermanniellidae), *Allodameus* sp. (Gymnodameidae) *Halozetes crozetensis* (Richters) and *H. edwardensis* van Pletzen and Kok (Ameronothridae) and *Antarctozetes crozetensis* (Richters) (Mycobatidae). Diagnoses of *Hermanniella* and *Allodameus* are based on single badly preserved specimens that have not subsequently been recorded from the sub-Antarctic. *H. crozetensis* is probably referable to *H. fulvus* (Engelbrecht 1975), the only abundant terrestrial *Halozetes* species (Tables 3, 5), while *H. edwardensis* is probably *H. marinus devilliersi* (Engelbrecht 1974). *Antarctozetes* is a synonym of *Africoribates* (Balogh and Balogh 1992), which may be confused with *Ceratozetes gausii* (Richters) (Ceratozetidae) (Wallwork 1972). Furthermore, Pugh (1993) wrongly placed *C. gausii* in the Prince Edward Islands instead of the Îles Crozet, although a related species, *Magellozetes antarcticus* (Michael), is a new record for Prince Edward Island.

Further uncorroborated records are as follows. *Liochthonius fimbriatissimus* (sensu Travé 1976a in Pugh 1993) was probably incorrectly identified by van Pletzen and Kok (1971) and is probably *L. australis*, a species recorded during the present study and which occurs on other sub-Antarctic islands. In contrast *L. fimbriatissimus* is only known from New Zealand and South America (Hammer 1958; Luxton 1985). *H. marinus* (sensu Travé 1976a, in Pugh 1993) could, like *H. edwardensis*, refer to *H. marinus devilliersi*. *A. antarcticus* (Travé 1976a, in Pugh 1993), is unsubstantiated, although this could, like *A. bouvetøyaensis* (sensu van Pletzen and Kok 1971; Engelbrecht 1975), be referable to *A. antarcticus intermedius* (sensu Sømme 1986).

The Astigmata include three new records of *Hyadesia*, and new species of *Algophagus* and *Neocalvolia* (Table 2). Both *Algophagus* spp. have the small dorsal sclerites of *A. semicollaris* Fain which are not present in either *A.a.antarcticus* Hughes or *A.a. laticollaris* Fain. Unlike *A. semicollaris*, both have a well-developed axillary organ extending between the bases of legs I and II. They differ between themselves in body size, the devel-

opment of spines on legs and axillary organ morphology. The new *Neocalvolia* sp. is similar to *N. kerguelenensis* Fain, from which it differs in the structure of the male genitalia and the relative positions of solenidia 1–2 on tarsus I.

Ecology (Tables 3–5)

There are distinct terrestrial and shoreline faunas for Marion Island (Tables 3, 4). The terrestrial species have general habitat requirements, a feature typical of sub-Antarctic island acarofaunas (e.g. Travé 1976b; Pugh and Bartsch 1993; Pugh and MacAlister 1994; Pugh 1995). However, the shoreline species, particularly littoral species and excluding the predacious Mesostigmata and Prostigmata interlopers, such as *Balaustium*, *Bdellodes* and Rhodacaridae spp., are more specific with regard to habitat requirements (Tables 3, 4). Some terrestrial species occur in edaphic, epilithic and vegetative habitats, whereas the shoreline species are often restricted to a particular littoral zone, lichen or alga (Tables 3, 4). For example, for *Halozetes*, the terrestrial *H. fulvus* is found in 20 habitat/sites on the islands, whereas its marine counterparts, *H. belgicae*, *H. marionensis* and *H. marinus devilliersi*, show restrictive distributions (Tables 3–5). These differences in niche specificity may be explained by historical climatic events. The ice-capping of Marion Island that occurred during glaciation must have obliterated most of the terrestrial fauna (Chown 1989, 1990) while having a lesser effect on the shoreline fauna. Recolonization of the terrestrial environment under low interspecific competition would have facilitated niche expansion.

Biogeography

Tables 1 and 2 would suggest that all Mesostigmata, 58% of Prostigmata, 13% of Cryptostigmata and 33% of Astigmata are endemic. Endemism of these taxa may relate to differences in their dispersal capacities in the sub-Antarctic which, in turn, may be associated with diet, energetics and life histories. The least endemic Cryptostigmata have low-energy diets (fungivorous, algivorous and/or detritivorous) and low metabolic rates. A number of the Mesostigmata, Prostigmata and Astigmata taxa are predacious or parasitic (more correctly invertebrate haematophages), or have phoretic life stages. The phoretic representatives of these groups are more likely the products of human-mediated introduction (Pugh 1997). These would include the new Cillibidae, a member of the phoretic Uropodina and *Dendrolaelaps* sp. (Digamasellidae). *Balaustium* sp. (Erythraeidae) is a probable insect parasite (as juveniles), while most Winterschmidtiidae (though not yet confirmed for *Neocalvolia*) and possibly *Austranoetus kerguelenensis* Fain (Histiostomatidae) are phoretic.

A number of species, particularly of the Cryptostigmata and Astigmata, occur on other Southern Ocean islands (Tables 1, 2; cf. Pugh 1993; Starý and Block 1995; Starý et al. 1997). Of these mite groups, the nu-

Table 3 Terrestrial Acari of Marion Island: sampling sites and substrata. [*A–D* Azorella Kop (400 m): *A Poa cookii* tussock, *B Azorella* plant, *C* Black lava rocks, *D Ditrichum* (moss) cushion; *E–F* Kattedraal Krans (800 m): *E* rocks/lichen, *F Ditrichum* (moss) cushion; *G–H* Stony Ridge: *G Ditrichum* (moss) cushion, *H Lycopodium*; *I–J* Skua Ridge (100 m): *I* soil, *Acaena* drainage line, *J* soil, *Agrotis stolonifera*; *K* Trypot: soil and plant, *Poa cookii*; *L* Archway Bay: soil and plant, *Cotula*; *M–N* Log Beach: *M Schistidium* (moss) cushion, *N Stereocaulon* (lichen); *O* Junior's Kop: *Ditricum* (moss) cushion; *P* Van den Boogaard River Dam: vegetation at dam edge]

Order/species	Site/substrata															
Mesostigmata																
Rhodacaridae sp. nov. 2								H								
sp. nov. 5	A											L				
Dendrolaelaps sp. nov.	A	B							I	J						
Cillibidae sp. nov.	A			D	E	F		H	I	J					O	
Prostigmata																
Nanorchestes sp. nov. 1						F	G									
sp. nov. 2							G									
sp. nov. 3						F	G								O	
sp. nov. 4							G								O	
Eupodes minutus							G				K					
Rhagidia sp.					E											
Halacaridae sp. nov.																P
Ereynetes macquariensis						F					K					
Tydeus (*Pertydeus*) sp. nov.	A	B		D		F			I	J	K	L			O	
Bdellodes sp. nov.					E		G									
Balaustium sp. nov.			C													
Cryptostigmata																
Liochthonius australis						F			I	J	K	L				
Macquarioppia striata	A						G		I	J						
Austroppia crozetensis		B					G	H	I	J	K		M			
Halozetes fulvus	A			D		F	G	H	I	J	K	L	M	N		P
Podacarus auberti	A									J	K	L				
Dometorina marionensis	A	B		D	E		G	H	I	J			M	N		P
Astigmata																
Schwiebea talpa subantarctica									I	J	K					
Algophagus sp. nov. 1																P
Neocalvolia travei											K	L				

Table 4 Littoral and supralittoral Acari of Marion Island: sampling sites and substrata. (*A–F* Macaroni Bay: *A Mastodia*, supralittoral lichen, *B Caloplaca*, supralittoral lichen, *C Verrucaria*, upper-shore lichen, *D Porphyra*, mid-shore alga, *E* red alga from low-shore, *F* pool in supralittoral zone; *G–H* Transvaal Cove: *G Porphyra*, mid-shore alga, *H* red alga from low shore; *I–J* Ship's Cove: *I* beach debris near penguin nest, *J Mastodia*, supralittoral lichen)

Order/species	Site/substrata
Mesostigmata	
Rhodacaridae sp. nov. 1	G H
sp. nov. 3	G
sp. nov. 4	G
sp. nov. 5	A B H I J
Prostigmata	
Halacarellus novus	E H
Isobactrus magnus	C
Rhombognathus auster	E G H
Bdellodes sp. nov.	B
Eryngiopus sp. nov.	B
Balaustium sp. nov.	B
Cryptostigmata	
Alaskozetes antarcticus	A
Halozetes belgicae	A
H. marinus devilliersi	D G H
H. marionensis	C
Podacarus auberti	A I J
Totobates marionensis	J
Porokalumma rotunda	B
Astigmata	
Algophagus sp. nov. 2	A F
Hyadesia halophila	A B
H. kerguelenensis	C G
H. subantarctica	E
Austranoetus kerguelenensis	I J

Table 5 Terrestrial Acari of Prince Edward Island: sampling sites and substrata. (*A–F* Cave Bay: *A Prasiola* mat on old *Poa* stool, *B Caloplaca* on black larval rocks, *C Azorella* and *Sagina*, *D Acaena* drainage line, *E* open *Blechnum*/bryophyte vegetation, *F* dry mire vegetation; *G–I* Golden Gate: *G* lichens of sheltered vertical face, *H* lichens and rocks, *I Blechnum*/*Plagichila* mire; *J* Kraterkoppie: *J* upland fjeldmark on scoriae)

Order/species	Site/substrata
Mesostigmata	
Dendrolaelaps sp. nov	C
Cillibidae sp. nov.	D
Fam. nov. sp. nov.	D E F J
Prostigmata	
Tydeus (*Pertydeus*) sp. nov.	B E F
Bdellodes sp. nov.	D F
Eryngiopus sp. nov.	B
Balaustium sp. nov.	B
Cryptostigmata	
Macquarioppia striata	F G H I J
Austroppia crozetensis	C E F G I
Halozetes fulvus	A C E F G H I J
Podacarus auberti	F H
Dometorina marionensis	E F G I J
Totobates marionensis	G
Magellozetes antarcticus	G H
Astigmata	
Schwiebea talpa subantarctica	C E
Algophagus sp. (unidentified)	A C
Neocalvolia sp. nov.	F G

merous species shared with Îles Crozet (11), Îles Kerguelen (14) and Heard Island (5) in particular, support the proposal of a South Indian Ocean Province (sensu Lewis-Smith 1984). The 15 species which also occur on the Maritime Antarctic Islands (including 7 on South Georgia), and the 11 on the South Pacific Islands (including 7 on Macquarie) corroborate a sub-Antarctic element of the Prince Edward Islands acarofauna (sensu e.g. Gressitt 1967).

The Prince Edward Islands are geologically young at *ca* 2 million years old, and so were most likely colonised, during the Holocene, by trans-oceanic waifs (sensu Peake 1981; Kuschel 1991). Most of these waifs originated on other sub-Antarctic islands and the numbers of common species suggest that the Mesozoic continental/oceanic microplates of the Îles Crozet and Kerguelen, both of which contained Pleistocene glacial refugia (Chown 1994), are the most likely sources of the current Prince Edward Islands acarofauna.

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