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LIFE STAGES AND POPULATION OF *PROECHINOPHTHIRUS ZUMPTI* (ANOPLURA: ECHINOPHTHIRIIDAE), FROM THE CAPE FUR SEAL (*ARCTOCEPHALUS PUSILLUS*)[1]

By **Ke Chung Kim**[2]

Abstract. The egg and nymphs of *Proechinophthirus zumpti* are described for the first time and the adults are redescribed. Preliminary data on infestation, population and topographic distribution of *P. zumpti* based on 10 pelt samples of *Arctocephalus pusillus* are presented, and a phylogenetic inference is made for *Proechinophthirus* by comparing *P. fluctus* and *P. zumpti*.

Proechinophthirus Ewing exclusively infests fur seals (Arctocephalinae, Otariidae) and contains 2 known species: *P. fluctus* (Ferris) on *Callorhinus ursinus* (L.) (Northern Fur Seal) and *P. zumpti* Werneck on *Arctocephalus pusillus* (Schrever) (Cape Fur Seal) (Kim et al. 1975). *Proechinophthirus zumpti* was described on the basis of several specimens collected from "Cape Sea Lion" in 1955 (Werneck 1955). No additional collection has been made since the type specimens were collected in 1953.

Dr P. D. Shaughnessy, Director of Sea Fisheries, South Africa Department of Industries, made available 10 salted pelt samples of *Arctocephalus pusillus* for this study, collected through the efforts of Mr C. A. Repenning, U.S. Geological Survey, Menlo Park, California.

Morphological and chaetotactic terminologies devised by Kim & Ludwig (1978) and terminology of simple symmetrical plane shapes of the Systematics Association Committee on Descriptive Biological Terminology (1962) are used in this paper.

This paper presents the first description of the egg and nymphs and data on the population density and structure of *Proechinophthirus zumpti*. The adults are redescribed. A phylogenetic inference is made for *Proechinophthirus* and related echinophthiriids.

MATERIALS AND METHODS

Of the 10 pelt samples of *A. pusillus* for this study which were collected in South Africa, only 3 samples represented complete pelts and 1 sample was only the posterior ½ of the pelt. Other pelt samples were small pieces. The pelt sample data used for population analysis are as follows.

1 ♀ yearling (approximately 10 months old), found dead, 10.X.1974, Seal I, False Bay, posterior ½ of pelt (sample no. 74-149). 1 ♂ yearling (approximately 10 months old), 10.X.1978, Seal I, False Bay, whole pelt (sample no. 74-167). 2 yearlings (7–10 months old), sex unknown (presumably ♂), VII-IX.1974, Kleinsee; taken in annual government harvest (sample no. 1974-A & 1974-B). Two small pieces of pelts from 2 adult ♀: 25.IX.1974, Elephant Rock, found dead (sample no. AP 101 and 102); 1 pelt sample from 1 black pup (less than 1 month old), Koeberg Beach, 15 mi [24 km] N of Cape Town, 2.XII.1975 (sample no. 1975-A); 3 yearlings (10 months old), Seal I, False Bay, 8.X.1975, sex unknown (sample no. 1975-B, C, D).

The modified Cook's technique was used to extract the total louse population from the pelt (Kim 1972). From all samples, this process yielded 455 specimens of all stages including a number of eggs.

Proechinophthirus zumpti Werneck FIG. 1–6

Proechinophthirus zumpti Werneck, 1955, Rev. Bras. Biol. **15:** 419–21.

Description. ♂ (FIG. 1, 2). Total body length 1.94 mm ($\bar{x}$) (n = 10) (range 1.83–2.04 mm); slender, delicate species. *Head* longer than wide, with anterior margin rounded and strongly sclerotized; forehead with long lateral barlike apodemes; postantennal angle strongly developed with 2 strong lateral setae (SMHS); dorsally with setae of various lengths scattered, forehead with 9 setae and hindhead with about 18 medium to long setae; centrally with a pair of heavily sclerotized narrowly obovate pegs; posterior lateral angle with spiniform projection; occiput heavily sclerotized and slightly constricted at posterior end; occipital apophyses slightly elongated; ventrally at the posterior end of each lateral bar with 2 strong narrowly obovate pegs, forehead with 8 long setae on each side and centrally with 2 rows of 4 setae between obovate pegs and hindhead with 3 to 4 long setae on each side. *Antenna* 4-segmented; basal segment enlarged with a large spiniform peg on each of dorsal and ventral sides; segment 2 shortest; terminal segment with 4 sensoria and about 5 peg organs at apex. *Thorax* wider than head, with strong phragmata and a distinct notal pit; protho-

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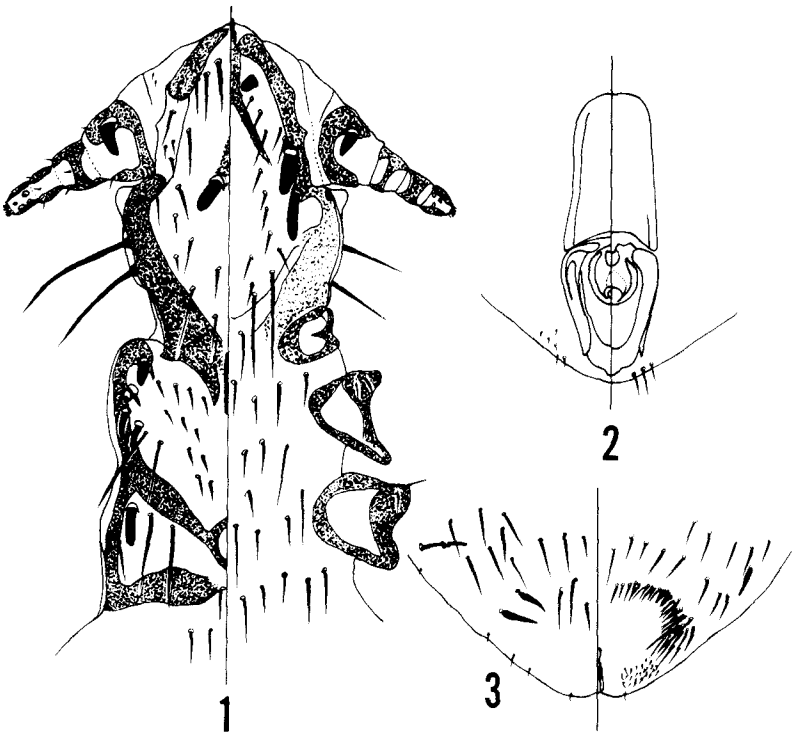

FIG. 1–3. *Proechinophthirus zumpti* Werneck, adult. 1, head, thorax and coxal plates, ♀; 2, ♂ genitalia; 3, ♀ terminalia.

racic phragma short and converging; mesothoracic phragma continuous across the notum, enclosing the notal pit; metathoracic phragma not continuous; dorsal prothoracic setae (DPtS) usually spiniform pegs but occasionally regular slender setae; mesonotum with 2 strong spiniform pegs and metanotum with a spiniform peg on each side; in addition to these pegs, anteriorly with 7 long setae on each side and posteriorly with 2 very long setae; 2 long setae placed next to the dorsal mesothoracic setae (DMsS); ventrally more than 20 long setae scattered on each side; mesothoracic spiracle located in front of 2 mesothoracic setae; sternum membranous without distinct sternal plate. *Legs*. Forelegs small, weak with unmodified tibia and tarsus and with acuminate claw; mid- and hindlegs similar in shape and size, very large and strong, each with tibia-tarsus complex and a large, blunt claw. *Abdomen* elongated without tergal, sternal and paratergal plates; 6 distinct spiracles, each with specialized closing apparatus; setae forming central and lateral fields, large number of setae scattered on each segment or rows without distinct segmental demarcation; anal segment with 3 moderate-sized setae on each side; posterior abdomen with occasional arrow-shaped setae. *Genitalia*. Basal apodeme broad and long; parameres slender and shorter than pseudopenis with pointed apex; pseudopenis V-shaped with apical arm short and blunt; endomere sclerotized, anteriorly open, posteriorly connected; aedeagus sclerotized, connected to posterior arms of endomere.

♀ (FIG. 1, 3). Total body length 2.37 mm ($\bar{x}$) (n = 10) (range = 2.22–2.57 mm). Head, thorax, legs, and abdomen as in ♂ unless mentioned otherwise. *Genitalia* (FIG. 3). Vulva fringed with dense setae and with a crowded cluster of long setae on each side of the anal segment.

EGG (FIG. 4). Length 1.26 mm ($\bar{x}$) (n = 7); narrowly oval, attached to the hair longitudinally; operculum indistinct.

NYMPH I (FIG. 5). Total body length 0.92 mm ($\bar{x}$) (n = 2). *Head* longer than wide; anterior margin with 6 or 7 blunt spines or pegs; postantennal angle not highly developed; forehead with 7 or more setae on each side; hindhead with 6 to 7 setae set diagonally, starting from base of antennae to center of head; dorsal principal head seta (DPHS) long; 3 dorsal marginal head setae (DMHS) present; moderately sized setae located towards occiput; ventrally with 1 ventral preantennal head seta (V PaHS). *Antenna* 4-segmented; basal segment enlarged, with 1 peg on each of the dorsal and ventral sides; terminal segments with 1 distinct sensillum and several peg organs at apex. *Thorax* slightly wider than head; prothoracic phragmata indistinct; mesothoracic phragmata extended centrally but not connected; metathoracic phragmata incomplete; notal pit indistinct; mesothoracic spiracle distinct, with 1 mesothoracic seta (DMsS); dorsal prothoracic setae (DPtS) spiniform; dorsal metathoracic setae (DMtS) spiniform; 3 or 4 additional setae on mesonotum and 2 setae on metanotum on each side. *Legs* as in adult. *Abdomen* elongated; 6 spiracles distinct; dorsally with 2 rows of 10 dorsal central abdominal setae (DCAS), 7 dorsal lateral abdominal setae (DLAS), and 2 minute setae on 8th and 1 minute seta on anal segment on each side; ventrally with 2 to 8 rows of 9 ventral central abdominal setae (VCAS), 5 ventral lateral abdominal setae (VLAS) and 1 minute seta on anal segment on each side.

NYMPH II. Total body length 1.39 mm ($\bar{x}$) (n = 2); similar to nymph III.

NYMPH III (FIG. 6). Total body length 1.87 mm ($\bar{x}$) (n = 2). Similar to nymph I, unless mentioned otherwise. *Head* with anterior margin strongly sclerotized; spines and pegs larger and setae longer; dorsally with 17 setae on each side; ventrally 2 large pegs at the base of antenna in addition to VPHS. Hind-

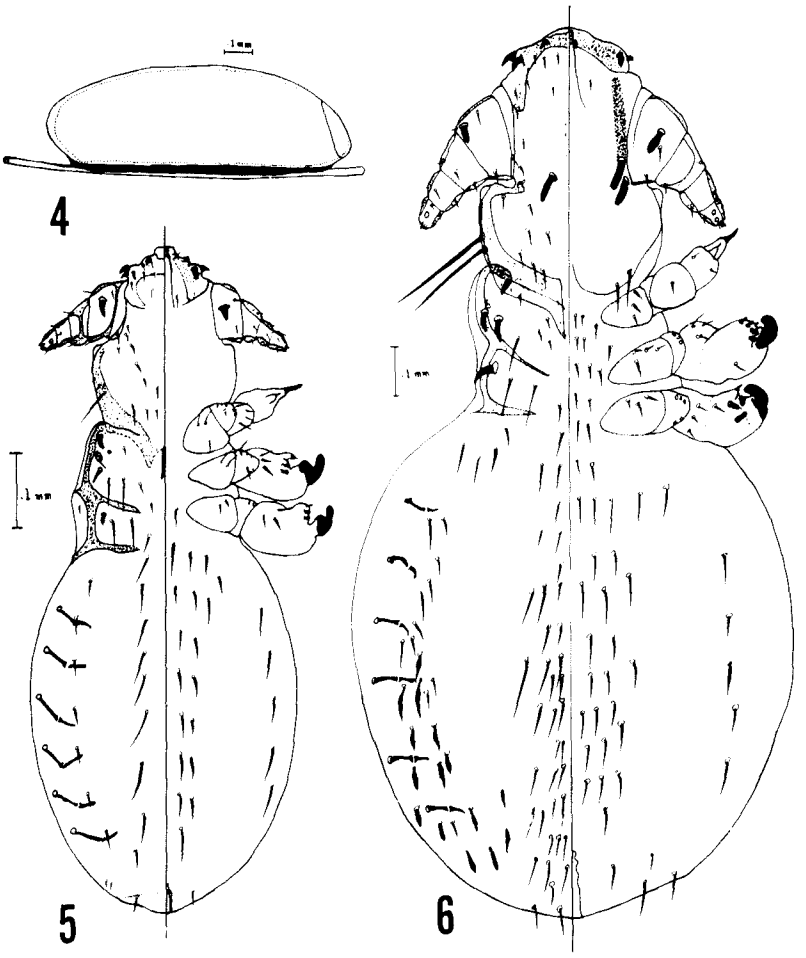

FIG. 4–6. *Proechinophthirus zumpti* Werneck. 4, egg; 5, nymph I; 6, nymph III.

head with 2 or 3 long setae on each side; mesonotum with 2 mesothoracic pegs; ventrally 3 or 4 rows of 4–6 setae. *Abdomen* with 2–4 rows of DLAS and 2–6 rows of DCAS; ventrally 10 rows of 4–10 VCAS.

Type data. Holotype ♂ (#2753) and 3 paratypes [1♀ (#2754), 2 N (#2755)], collected by Dr Zumpt from "Cape Sea Lion" 3835, Mossel Bay, Cape Province, South Africa, XII.1953. There are 2 more ♂ on 1 slide, in poor condition, from the type lot (J. A. Ledger, 26.I.1979, pers. commun.). They are deposited in the collection of The South African Institute for Medical Research, P.O. Box 1038, Hospital Street, Johannesburg, South Africa.

Specimens examined. Ex *Arctocephalus pusillus*, SOUTH AFRICA: Cape Province, Seal I, False Bay, 14♂,18♀, 5 eggs, 40 N I, 6 N II, 4 N III, VII-X.1974; 6♂,5♀,5 N I, Kleinsee, VII-IX.1974; 2♂,5♀,2 N III, Koeberg Beach, 15 mi [24 km] N of Cape Town, 2.XII.1975.

INFESTATION, POPULATION AND TOPOGRAPHIC DISTRIBUTION

The population data presented here are at best preliminary, since they are based on inadequate samples. Approximately 70% of the Cape Fur Seals studied were infested with *Proechinophthirus zumpti*. This infestation rate will certainly increase when larger pelt samples are studied, as seen in Northern Fur Seals. In an earlier study (Kim 1972), approximately 89% of Northern Fur Seals (*Callorhinus ursinus*) were infested with lice. Of the infested Northern Fur Seals, about 51% harbored *Proechinophthirus fluctus* and 96% were infested with *Antarctophthirus callorhini* (Osborn) (Kim 1972). No *Antarctophthirus* was found on Cape Fur Seals.

The population density and structure of *P. zumpti* are presented in TABLE 1. The mean population density was 108.5 lice per host, which is

TABLE 1. Population density and structure of *Proechinophthirus zumpti* Werneck on the Cape Fur Seal (*Arctocephalus pusillus pusillus*). Pelt samples were taken from yearlings (7–10 months old).

PELT SAMPLE NO.	NO. OF ADULTS ♂	♀	Total	NO. OF Nymph III	Nymph II	Nymph I	TOTALS
74-149*	5	1	6	0	0	69	75
74-167	24	47	71	13	47	203	334
1974-A	1	3	4	2	0	3	9
1974-B	6	5	11	0	0	5	16
Totals	36	56	92	15	47	280	434
Mean ($\bar{x}$)	9.0	14.0	23.0	3.8	11.7	70.0	108.5
Population structure (%)	8.3	12.9	21.2	3.5	10.8	64.5	—

* Posterior ½ of pelt; absolute population density is expected to be much larger than the number indicated.

similar to 107.6 lice per infested host of *P. fluctus* on Northern Fur Seals. The Cape Fur Seal was infested with all nymphal instars; 65% of the total louse population represented 1st-instar nymphs.

P. zumpti was most commonly found on the belly and tail area of the host body (TABLE 2). Fifty percent of the total louse population was found on the belly and 26% on the tail area. This pattern of distribution is again similar to that found in *P. fluctus* on Northern Fur Seals (Kim 1972, 1975).

PHYLOGENETIC NOTES

Proechinophthirus is exclusively parasitic on fur seals (Arctocephalinae, Otariidae) and only 2 species are known: *P. fluctus* from the Northern Fur Seal (*Callorhinus ursinus*) and *P. zumpti* from the Cape Fur Seal (*Arctocephalus pusillus pusillus*). Of the 7 species of *Arctocephalus*, the Cape Fur Seal is the only species from which sucking lice are known. I expect to find additional species of *Proechinophthirus* from other fur seals (Kim et al. 1975).

P. zumpti adults retain a number of morphological characters found in the 3rd-instar nymph: a pair of dorsal central pegs, 2 pairs of ventral lateral pegs and 2 lateral marginal head setae, while the adults of *P. fluctus* possess none of these 3rd-instar nymphal characters (Kim 1971). This phenomenon may indicate neotonous evolution in *P. zumpti*, as seen in *Sathrax durus* Johnson (Polyplacidae). This further suggests that *P. fluctus* has been separated for a long time from the ancestral stock of *Proechinophthirus* and acquired its own adult characters not found in *P. zumpti*. This inference further supports the contention that the 2 fur seals, *Callorhinus* and *Arctocephalus*, have evolved along separate lineages for a long time, lineages that have been distinct for a much longer period of time than have those leading to the various living sea lions (Kim et al. 1975, Moorejohn 1975, Repenning 1975, Repenning & Telford 1977). The 3rd-instar nymph of *P. fluctus* is very similar to that of *P. zumpti*. The close similarity of the 3rd-instar nymphs of *Proechinophthirus* supports the monophyly of fur seals (Repenning & Telford 1977).

Antarctophthirus callorhini is found on Northern Fur Seals along with *P. fluctus* and has a definite microhabitat preference (Kim 1972, 1975). No *Antarctophthirus* species was found in my samples of *Arctocephalus pusillus*, although it was expected. It is premature to make any definite statement at this time as to whether *Arctocephalus* does harbor *Antarctophthirus* and, if not, of what significance the absence of *Antarctophthirus* on *Arctocephalus* may be. However, the answer to the question is of considerable significance in the interpretation of the evolution of the fur seals.

TABLE 2. Topographic distribution of *Proechinophthirus zumpti* Werneck on the Cape Fur Seal (*Arctocephalus pusillus pusillus*).

PELT SAMPLE NO.	NO. OF LICE Head	Belly	Back	Tail	TOTAL
74-149*	—	—	3	72	75
74-167	33	229	34	38	334
1974-A	8	0	0	1	9
1974-B	0	6	9	1	16
Totals	41	235	46	112	434
% distributed	9	54	11	26	—

* Anterior ½ of pelt missing.

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have been possible. I am also indebted to Mrs Verda Haas for her excellent assistance in extracting lice from pelts and preparing specimens for study.

LITERATURE CITED

Kim, K. C. 1971. The sucking lice (Anoplura: Echinophthiriidae) of the northern fur seal; descriptions and morphological adaptation. *Ann. Entomol. Soc. Am.* **64:** 280–92.

1972. Louse populations of the northern fur seal (*Callorhinus ursinus*). *Am. J. Vet. Res.* **33:** 2027–36.

1975. Ecology and morphological adaptation of the sucking lice (Anoplura, Echinophthiriidae) on the northern fur seal. *Rapp. P.-V. Reun. Cons. Int. Explor. Mer* **169:** 504–15.

Kim, K. C. & H. W. Ludwig. 1978. The family classification of the Anoplura. *Syst. Entomol.* **3:** 249–84.

Kim, K. C., C. A. Repenning & G. V. Moorejohn. 1975. Specific antiquity of the sucking lice and evolution of otariid seals. *Rapp. P.-V. Reun. Cons. Int. Explor. Mer* **169:** 544–49.

Moorejohn, G. V. 1975. A phylogeny of the otariid seals based upon the morphology of the baculum. *Rapp. P.-V. Reun. Cons. Int. Explor. Mer* **169:** 49–56.

Repenning, C. A. 1975. Otariid evolution. *Rapp. P.-V. Reun. Cons. Int. Explor. Mer* **169:** 27–33.

Repenning, C. A. & R. H. Telford. 1977. Otarioid seals of the Neogene. *U.S. Geol. Surv. Prof. Pap.* **992:** 1–93, pl. 1–24.

Systematics Association Committee for Descriptive Biological Terminology. 1962. Terminology of simple symmetrical plane shapes. Chart Ia. *Taxon* **11:** 145–56, 245–47.

Werneck, F. L. 1955. Novo Anopluro de Leao Marinho. *Rev. Bras. Biol.* **15:** 419–21.