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A NEW SPECIES OF *NAMANEREIS* (POLYCHAETA: NEREIDIDAE: NAMANEREIDINAE) IN GROUNDWATER OF THE SULTANATE OF OMAN, ARABIAN PENINSULA

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ABSTRACT

A new species of namanereid polychaete, *Namanereis araps* n. sp., is described from groundwater of the Sultanate of Oman. It occurs in fresh groundwater of natural springs, man-made water channels (falaj) and dry stream beds (wadis) in recently uplifted limestone areas of the south-eastern Arabian peninsula. This is the first species of *Namanereis* recorded from the coast of the northern Indian Ocean. *Namanereis araps* n. sp. most closely resembles the Caribbean species *Namanereis hummelincki* (Augener, 1933).

INTRODUCTION

A 1996 survey of the biota of groundwater of the Sultanate of Oman, south-eastern Arabian peninsula, undertaken jointly by the University of Amsterdam and the Ministry of Water Resources (Sultanate of Oman) yielded a new species of polychaete worm belonging to the genus *Namanereis* (Nereididae: Namanereidinae). While the vast majority of polychaetes are marine, members of the Namanereidinae are remarkable for their ability to tolerate terrestrial freshwater and low salinity waters including rivers, subterranean streams, anchialine 'lava' ponds and plant-container habitats (Glasby, in

press a). The new species was collected from fresh groundwater on the Indian Ocean fringe of the Arabian desert. The area has numerous caves, springs and subterranean water reserves, which together with their biota, were left stranded as a result of a marine regression beginning some 25 My ago and continuing to the present (Stock et al., 1997).

Members of the genus *Namanereis* sensu Hartman, 1959, which are also referred to in the literature under *Lycastopsis*, are small namanereids having either three or four pairs of tentacular cirri defined by the autapomorphic absence (i.e. loss) of both cirrophores at the base of the dorsal cirri and notosetae, and the presence of a tripar-

tite pygidium (Glasby, in press a). The genus is represented mainly in tropical, subtropical and temperate coasts around the world. The only previous record of a *Namanereis* species from this part of the world is that of *N. quadraticeps* (Blanchard in Gay, 1849) from St. Paul, southern Indian Ocean (Ehlers, 1913), a unique member of the genus in having four rather than three pairs of tentacular cirri and a circum-subantarctic distribution. *Namanereis amboinensis* (Pflugfelder, 1933) is widespread in the Indo-Pacific but has not been recorded west of Maluku, Indonesia (Glasby, in press a). The new species described here brings the number of species in the genus to sixteen.

MATERIALS AND METHODS

Specimens described in this paper were collected by the biological groundwater survey of the Sultanate of Oman, March-April, 1996. Stock et al. (1997) provide station details and additional data on the physico-chemical properties, water quality and community structure of the groundwater. Stations where the polychaete was found were:

Station 96-26: Falaj Al-Dahgale, Sfalat Samail (ca. 23°18'32"N 57°59'38"E), man-made water channel originating from spring, fine and coarse gravel, sample taken with Bou-Rouch biophreatical pump at 60 cm below sediment surface, coll. Stock, 26.3.1996

Station 96-52: Halban area, Wadi Taww (ca. 23°34'N 57°01'E), alt. ca. 90 m, depth of wadi 0.10 m, gravel and loam, sample taken with Bou-Rouch biophreatical pump at 60 cm below sediment surface, coll. J. Stock, 28.3.1996.

Station 96-116: Nakhal, 'hot' spring (37.5°C) next to closed well (ca. 23°22'34"N 57°49'44"E), handnet, coll. 9.4.96.

Station 96-118: Wadi Nakhl, just past cataract in middle of stream bed (23°22'33"N 57°49'42"E), gravel, sample with Bou-Rouch biophreatical pump at taken 50 cm below sediment surface, coll. 9.4.96.

Station 96-119: as for 96-118 but sample taken 60 cm below sediment surface.

The type material of the new species is deposited in the Zoölogisch Museum Amsterdam (ZMA)

and the Omani Natural History Museum (ONHM). Terminology follows that used in Glasby (in press, a).

TAXONOMY

Family Nereididae

Subfamily Namanereidinae

Genus *Namanereis* Chamberlin, 1919

***Namanereis araps* n.sp.**

(Figs 1a-f)

Material: HOLOTYPE: Sultanate of Oman, Wadi Nakhal, Station 96-118 (ZMA.V.Pol. 4110). PARATYPES: locality as for holotype, Station 96-118, 1 incomplete specimen plus 10 fragments (ZMA.V.Pol. 4111); Nakhal, Station 96-116, 3 specimens (1 complete), plus 3 fragments (ZMA.V.Pol. 4112); Wadi Nakhal, Station 96-119, 1 incomplete specimen and three posterior ends (ONHM). NON-TYPES: Sultanate of Oman, Spring of Falaj Al-Dahgale, Station 96-26, 1 incomplete specimen (ZMA.V.Pol. 4113); near Wadi Taww, Station 96-52, 1 specimen, complete, 20 setigers (ZMA.V.Pol. 4114).

Diagnosis: Antennae cirriform, jointed. Eyes absent. Tentacular cirri, 3 pairs. Jaws with bifid terminal teeth. Notosetae absent. Supra-neuroacicular falcigers with blades 4.3-5.6 times longer than width of shaft head, finely serrated, 15-22 teeth, teeth increasing in length greatly proximally.

Description: Holotype about 8 mm long, posteriorly incomplete, 40 setigers; 1.5 mm wide at setiger 10 (excluding setae); no gametes in coelom. At setiger 10 length of parapodia about $\frac{1}{2}$ body width.

Body: uniform in width over first 40 setigers. Dorsum moderately convex, venter less so giving the body slightly flattened appearance in cross-section. Colour in alcohol yellow-white. Epidermal pigment absent.

Prostomium: with slight cleft anteriorly leading to shallow depression on mid-prostomium; prostomial shape approximately trapezoidal; about 2 times wider than long. Antennae cirri-

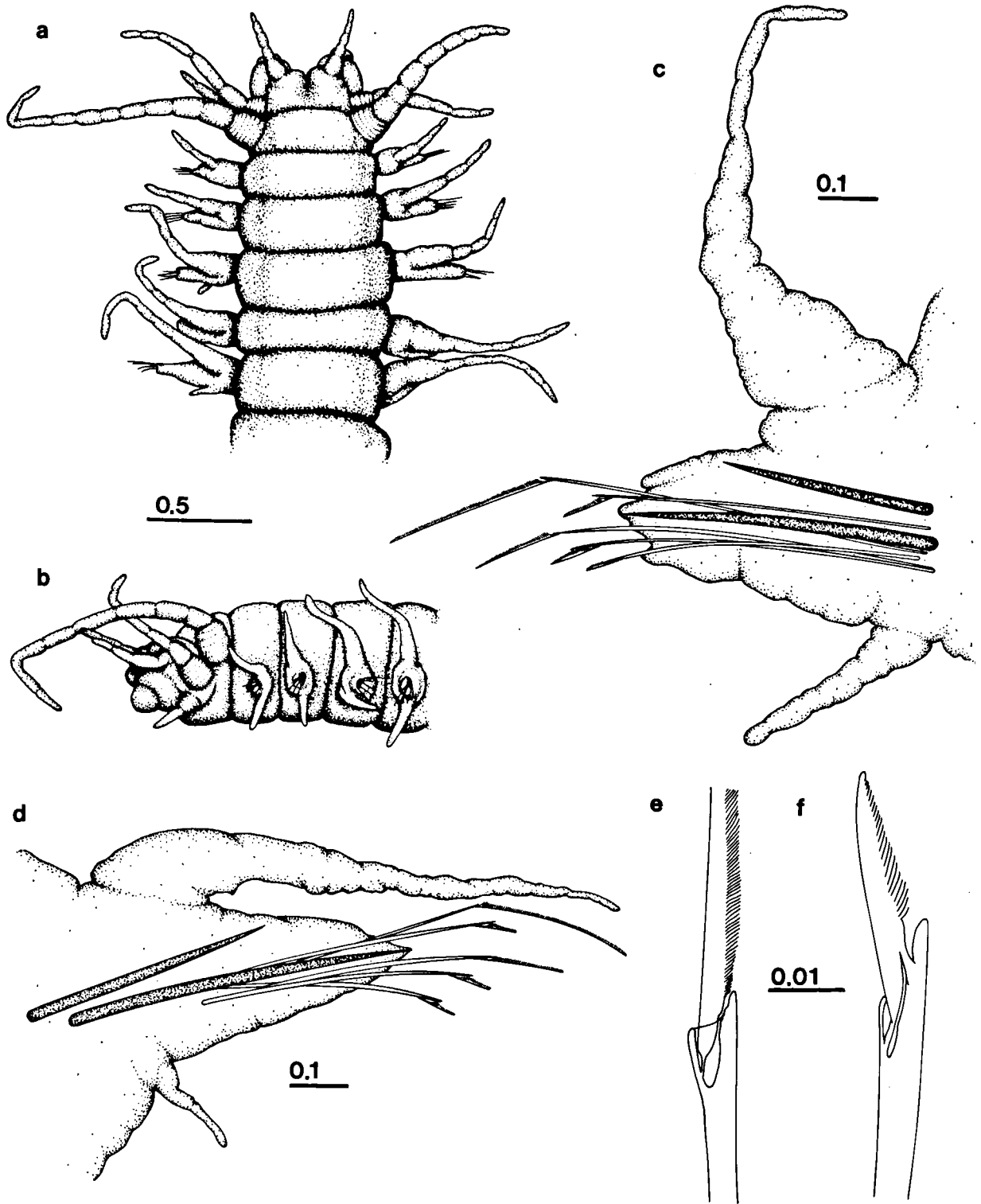


Figure 1. *Namanereis araps* n. sp. a. HOLOTYPE, dorsal view of anterior end, b. HOLOTYPE, lateral view of anterior end, c. HOLOTYPE, parapodium 3, left side, posterior view; d. PARATYPE (ZMA V.Pol.4-111) posterior parapodium; e. PARATYPE (ONH., Stn 96-119) supra-neuroacicular sesquigomph spinigers from parapodium 10; f. PARATYPE (ONHM, Stn 96-119) supra-neuroacicular falciger from parapodium 10. Scales indicated on figure are mm.

form, jointed, extending well beyond tip of palpostyle (slightly longer than length of prostomium), aligned over inner edge to mid-palps. Eyes absent (Figs 1a,b).

Peristomium: tentacular cirri, 3 pairs; cirrophores of anteroventral pair indistinct, those of anterodorsal and posterodorsal pairs cylindrical and faintly annulated; cirrostyles jointed. Anterodorsal tentacular cirri 1.8 times length anteroventral and 0.5 times length posterodorsal. Posterodorsal tentacular cirri extending posteriorly to setiger 5 (Figs 1 a, b). Jaws brown, with bifid terminal teeth, no subterminal teeth or teeth ensheathed proximally.

Parapodia: acicular neuropodial ligule conical-subconical (Figs 1 c, d). Dorsal cirri 2.5 times length of parapodium of setiger 3 (Fig. 1 c), 2.5-3.0 times length of parapodium of mid-body (Fig. 1 d). Ventral cirri 0.5-0.6 length of parapodia in anterior and mid-body setigers.

Setae: supra-neuroacicular setae: 1 sesquigomph spiniger in post-acicular fascicle of each parapodium and 1 heterogomph falciger in pre-acicular fascicle of each parapodium. Sub-neuroacicular setae include heterogomph falcigers (2 per parapodium) and one heterogomph pseudospiniger (or spiniger). Pseudospinigers begin on setiger 1 at which point blade length is only slightly longer than that of normal falciger, and continue to last setiger; from anterior to mid-body the blade of pseudospiniger distally tapered, only slightly less than that of corresponding sesquigomph spiniger.

Supra-neuroacicular sesquigomph spinigers with boss 1.4-1.7 times length of collar (Fig. 1 e). Heterogomph setae with boss not prolonged. Supra-neuroacicular falciger with blades 4.3-5.6 times longer than width of shaft head, finely serrated, 15-22 teeth, 0.56-0.64 times total blade length, teeth increasing in length greatly proximally (Fig. 1 f). Sub-neuroacicular falcigers with blades finely serrated; dorsal-most 11.1-17.5 times longer than width of shaft head, ∞ teeth (Figs 1 c, d); ventral-most 4.0 times longer than width of shaft head, 17-20 teeth. Setae pale yellow externally with brown cortex visible in transmitted light. Acicula black.

Pygidium: missing (but see below).

Variation (among paratypes): Only complete

paratype with 36 setigers, 4.5 mm long, 0.5 mm. Anterodorsal tentacular cirri 1.5-2.0 times length anteroventral, anterodorsal tentacular cirri 0.4-0.7 times length posterodorsal. Posterodorsal tentacular cirri extending posteriorly to setiger 4-7. Dorsal cirri 1.5-2.0 times length of parapodium of setiger 3, 1.7-2.5 times length of parapodium of mid-body, 1.5-3.0 times length of parapodium of posterior setiger. Relative size of dorsal cirrus increasing with body size. Very rarely 2 rather than 1 supra-neuroacicular heterogomph falcigers in pre-acicular fascicle. Pygidium weakly tripartite, with 2 large lateral lobes and smaller pointed dorsal lobe. Anus terminal. Anal cirri arising laterally, faintly articulated, 2.0-2.5 times width pygidium.

Variation (non-types): Specimens from station 96-26 posteriorly incomplete; those from station 96-52 complete, 20 setigers, 2.2 mm long, 0.3 mm wide. Both specimens with body yellower than types. Falciger blades with a greater number of teeth (up to 38 for the supra-neuroacicular falcigers and up to 30 for the ventral-most sub-neuroacicular falcigers) and teeth only increasing slightly in length proximally. Dorsal-most sub-neuroacicular setae elongate with a distinct terminal hook (i.e. typical pseudospiniger), rather than distally tapered (i.e. spinigerous).

Type locality: Sultanate of Oman, south-eastern Arabian peninsula.

Etymology: The species name is after the Greek, *araps*, masculine, meaning a native of Arabia.

TAXONOMIC REMARKS

The specimens from the Spring of Falaj Al-Dahgale (Station 96-26) and the Wadi Taww, Halban (Station 96-52) vary slightly in body colour and in the form of the falcigers compared to the type material. The variation most likely reflects some slight genetic drift between the two populations, but at least morphologically it is insufficient to warrant recognition of separate species. The type material was collected at stations 96-116, 96-118, 96-119, interconnected sites derived from the same spring at Nakhil. In other respects though, the specimens from the

two different areas are essentially the same.

Namanereis araps n. sp. most closely resembles *Namanereis hummelincki* (Augener, 1933), a species originally described from Bonaire (Caribbean), but generally widespread in the Caribbean (Glasby, in press a) and extending to the Canary Islands according to Hartmann-Schröder (1988), although this needs to be confirmed. The new species has jointed antennae whereas those of *N. hummelincki* are generally smooth; larger and faintly annulated cirrophores of the tentacular cirri, which are absent or at least poorly developed in *N. hummelincki*; dorsal cirri that are slightly longer relative to the length of the anterior and mid-body parapodia (2.5-3.0 compared to 1.0-2.2 in *N. hummelincki*); and anal cirri that are slightly longer relative to the width of the pygidium (2.0-2.5 compared to 0.5-1.5 in *N. hummelincki*). The colour of the setae and acicula also differ between the two species, although this may not be a reliable character: setae in the new species are pale yellow externally with a brown cortex visible in transmitted light, and acicula are black whereas in *N. hummelincki* setae are pale and acicula brown.

In the structure of the hard parts (jaws and setae) and in the distribution of the setae the new species is indistinguishable from the syntypes of *N. hummelincki* (Zoologisches Institut und Zoologisches Museum, Universität Hamburg V11930 a, b) and other material from the type locality, Bonaire. The jaws of both species are terminally bifid and lack subterminal teeth (see Glasby, in press a: fig. 35b). Also both species have two subacicular heterogomph setae with normal length blades in the ventral position and a single heterogomph seta with very elongate blade (pseudospiniger) in the dorsal position. As noted by Glasby (in press a) however, other Caribbean populations of *N. hummelincki* have subacicular heterogomph setae whose blade length decreases gradually from pseudospiniger-length (almost as long as a true spinger), through an elongate falciger blade to a normal falciger blade. Interestingly, this same situation is found in the two non-type specimens from Oman; the possibility that these different morphotypes represent new species and that some sort of parallel evolution is operating can only be determined with detailed morphometric or genetic studies.

ECOLOGY AND EVOLUTION

Although not common, the new species was well distributed among the various types of ground-water habitats in the Sultanate of Oman, including natural springs (Station 96-116), underground man-made water channels (falaj; station 96-26) and groundwater in the coarse sediments of otherwise dry stream beds (wadis; Station 96-52, Station 96-118, Station 96-119). Interestingly, the new species was not found in cave waters, either fresh or brackish, a habitat exploited by other species of *Namanereis* (Glasby, in press a). *Namanereis araps* n. sp. was found only at stations having clean, fresh groundwater, classified by Stock et al. (1997) as Quality Class 2 (in a scale from 1-10, 1 being best), and which showed high to moderately-high diversity of other stygobiont organisms such as oligochaetes and crustaceans (Thermosbaenacea, Isopoda and Amphipoda).

Stygobiontic species are thought to have evolved from marine ancestors isolated by uplift of coastal areas and/or fall in sea level (ie. marine regression) and subsequent radiation firstly into brackish near coastal groundwater and then into fresh groundwater. The process is explained by the Regression model of Stock (1980). Under this model one might invoke a widely distributed ("Tethyan") ancestor giving rise to several species, including *N. araps* n. sp. and the presumably closely-related Caribbean species [*N. hummelincki*, *N. cavernicola*, (Solís-Weiss & Espinasa, 1991), and two new species described by Glasby, in press a] in separate, closely-spaced speciation events associated with widespread marine regression. Evidence for this hypothesis is seen in the position of the four Caribbean species in a crown clade in the preferred cladogram of Glasby (in press, a, b). However, the hypothesis must remain speculative until cladistic relationships of *N. araps* is determined. Deeper speciation events among the Namanereidinae (pre-Miocene) are thought to be explainable largely by vicariance associated with movement of land-masses (Glasby, in press, b).

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