

## Taxonomy of the arboreal polychaete *Lycastopsis catarractarum* Feuerborn (Namanereidinae: Nereididae), with a discussion of the feeding biology of the species

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*Lycastopsis catarractarum* Feuerborn, 1931 is redescribed and a neotype designated. A full synonymy is given and all known records of the species are examined. Gut contents are analysed for two populations (Papua New Guinea and Fiji) and the feeding biology and ecology are discussed.

KEYWORDS: polychaetes, Nereididae, Namanereidinae, taxonomy, feeding.

### Introduction

Recent discoveries of *Lycastopsis catarractarum* Feuerborn, 1931 in a freshwater-filled tree hole near Madang, Papua New Guinea (by RLK) and in the moist leaf axils of *Panaanus* trees near Suva, Fiji (by PAR) have considerably extended the known distribution of this species. The species was first collected in Indonesia by the Sunda Expedition of 1928-29 and subsequently described by Feuerborn (1931 a, b). Feuerborn (1931 a) records the species from South Sumatra, near Tjurup (3°31'S 102°32'E) and near Lake Ranau (4°9'S 103°9'E) and from East Java at Bedali, now Malang (7°59'S 112°45'E) and from Bali (no localities given). The only other correctly identified record of this species in the taxonomic literature was by Berkeley and Berkeley (1963 and repeated in 1964) from Luzon Island, Philippines.

The habitat of *L. catarractarum* in arboreal-water appears to be unique in the subfamily and the polychaetes in general. The Namanereidinae Hartman, 1959 have been recorded from a variety of coastal and inland environments, ranging from ocean beaches (supralittoral) and estuaries (mangroves) to freshwater streams up to hundreds of kilometres from the coast. Indo-Pacific namanereid occurring in the upper reaches of streams and rivers include *Namalycastis hawaiiensis* (Johnson, 1903), *N. longicirris* (Takahasi, 1933), *N. ranauensis* (Feuerborn, 1931), *N. tiriteae* Winterbourn, 1969 and *N. vuwaensis* Ryan, 1980. *Lycastopsis beroni* (Hartmann-Schröder and Marinov, 1977) inhabits the subterranean waters of caves (Hartmann-Schröder, 1986). Such habitats are rare for polychaetes, the vast majority of which are marine or estuarine. The Nereididae and the Namanereidinae in particular, have been the most frequent polychaete groups to have colonised freshwater environments (Wesenberg-Lund, 1958).

Little is known of the feeding habits of nereidid polychaetes. Of the 439 species in the family recognised by Fauchald (1977) only about eight species have been studied

from this point of view (Fauchald and Jumars, 1979). The diet and feeding biology of namanereids are not known, but they may be omnivorous. The namanereids are equipped with a muscular pharynx, without paragnaths or papillae (at least in adults), and a pair of opposing jaws.

The 'potential diet' (after Fauchald and Jumars, 1979) of *L. catarractarum* are food items the species is capable of using in its diet both enzymatically and behaviourally. Potential food items are estimated from the fauna cohabiting the arboreal-water habitats. Also we estimate the 'realized' diet (after Fauchald and Jumars, 1979) of *L. catarractarum* based on gut content examination.

In the systematics section, a neotype of *L. catarractarum* is designated and described, and the variation in other material is indicated in brackets. A redescription of the species was considered necessary as the original type material is considered lost and the species has been confused in the past with *L. amboinensis* Pflugfelder, 1933 (see Augener, 1933; Lieber, 1931). The species description has been formatted using the automated description printing program of the DELTA system (Dallwitz, 1980; Dallwitz and Paine, 1986) and is directly comparable with descriptions in a taxonomic revision of the Namanereidinae in preparation by CJG.

### Abbreviations

- AM Australian Museum, Sydney.  
 BMNH British Museum of Natural History, London.  
 HZM Zoologisches Institut und Zoologisches Museum der Universität  
 Hamburg, Hamburg.  
 USNM National Museum of Natural History, Smithsonian Institution,  
 Washington D.C.

### Systematics

#### *Lycastopsis* Augener

*Lycastopsis* Augener, 1922: 42. Fauchald, 1977: 89.

Eversible pharynx without papillae or paragnaths. Prostomium with paired antennae. Tentacular cirri, 3 pairs. Parapodia with reduced notopodia, without ligules. Notosetae absent. Neurosetae are sesquigomph spinigers and heterogomph falcigers. Dorsal cirri reduced; cirrophores absent. Modified after Fauchald (1977).

#### *Lycastopsis catarractarum* Feuerborn

(Figs 1 a-e, 2 a-e, 3 a-f)

*Lycastopsis catarractarum* Feuerborn, 1931 a: 651-658, figs 11-13; 1931 b: 240-241. Berkeley and Berkeley, 1963: 907-908, fig. 1; 1964: 147-148.

#### Material examined

NEOTYPE: Java, Bedali, now Malang (7.59°S, 112.45°E), coll. Feuerborn, Nov. 1928, det. Augener (HZM F-19668). NON-TYPE: Java, as for neotype 7(HZM V11933); Philippines, Luzon Island, Luna (16.52°N, 120.4°E) 13(USNM 35670); Papua New Guinea, west of Kowe near Madang (5.14°S, 145.45°E) 1(AM W202966); Fiji, Wailoku, Savuro Creek near Suva (18.08°S, 178.25°E) 30(AM W202965). 22 specimens measured.

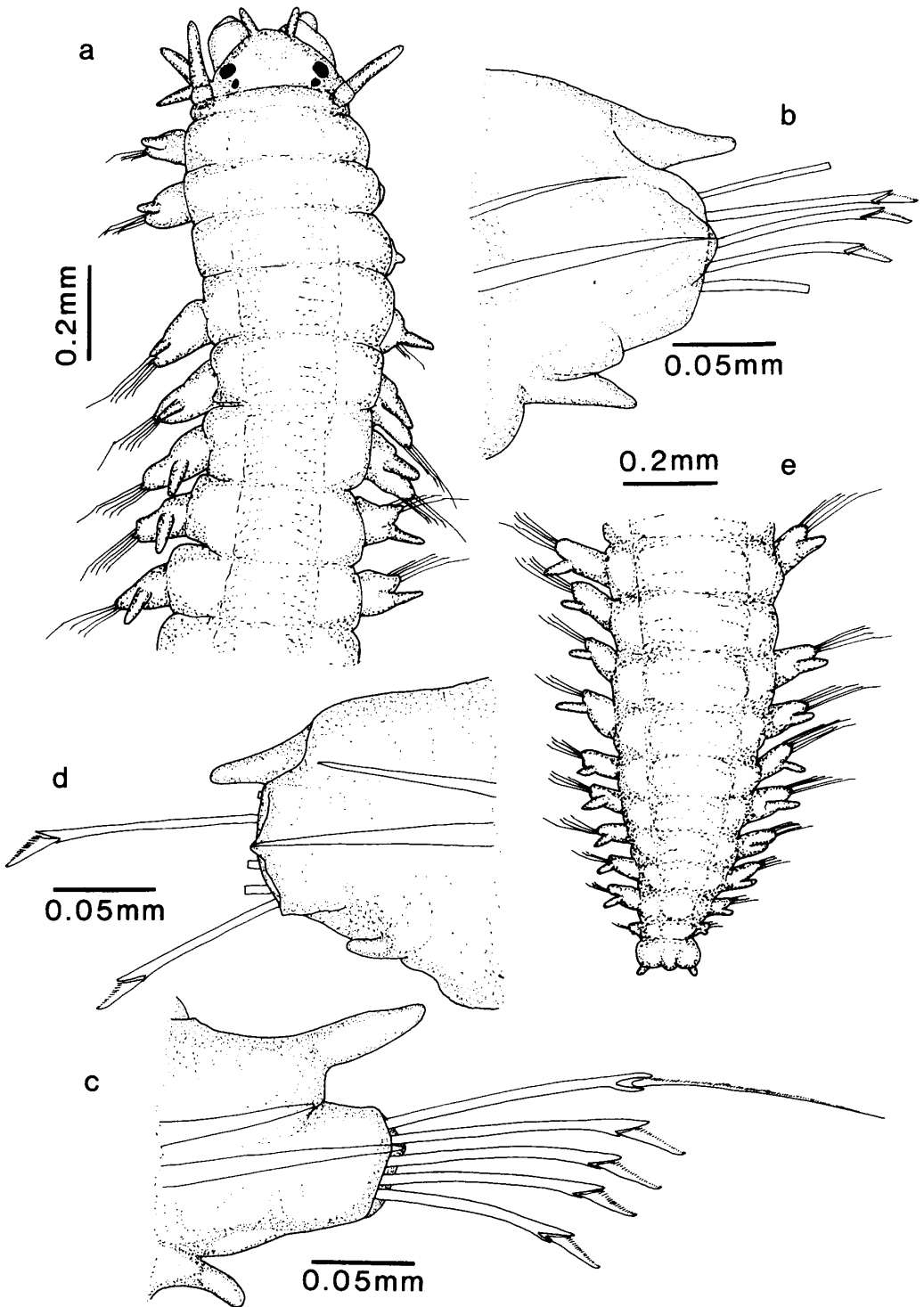


FIG. 1. *Lycastopsis cararractarum* Feuerborn. NEOTYPE: (a) anterior end, dorsal view, L.S., parapodium 3 missing; (b) parapodium 3, L.S., anterior view; (c) parapodium 31, R.S., posterior view; (d) parapodium 50, R.S., anterior view; (e) posterior end, dorsal view.

*Other material examined*

Solomons, Guadalcanal Island, Mt. Austen 1(BMNH ZB 1970.328). Not measured.

*Description*

Neotype moderately-well preserved, 2 R.S. tentacular cirri and anal cirri missing, segmentally complete; mature oocytes in coelom. Other material in variable condition (Papua New Guinea material poorly preserved); segmentally complete, or segmentally incomplete (rarely). Size 60 setigers (38–79); 7.9 mm long (4.9–12.5); 0.65 mm wide at setiger 10 (0.70–1.0).

*Body.* Body uniform in width to midbody, tapering in far posterior region. Dorsum moderately convex. Venter moderately convex, or flat. Colour in alcohol yellow-brown, or white, or yellow-white (very rarely). Epidermal pigment absent. Living colour pale pink throughout.

*Prostomium.* Prostomium anteriorly entire, or shallowly incised (rarely); with no dorsal groove or hollow, or with a shallow dorsal hollow. Prostomium shape hexagonal to half-circular, or roughly trapezoidal; laterally entire; 2.0 times wider than long (1.8–2.5) (Fig. 1 a, 3 a). Antennae conical, smooth; extending beyond tip of palpophore, or extending short of tip of palpophore (very rarely); aligned over inner edge of palps (Fig. 1 a, 3 a, b, c). Eyes 2 pairs (rarely one pair, perhaps pigment in posterior pair faded); black, or red (Papua New Guinea material and one specimen from Philippines); arranged obliquely, or arranged longitudinally (rarely); posterior pair markedly smaller; lenses indistinct (Fig. 1 a).

*Peristomium.* Tentacular cirri with cirrophores indistinct; cirrostyles smooth. Anterodorsal tentacular cirri 1.2 times length anteroventral (1.0–1.5) (Fig. 3 a, b). Anterodorsal tentacular cirri 1.0 times length posterodorsal (0.8–1.4) (Fig. 3 a, b). Posterodorsal tentacular cirri extending posteriorly to setiger 2 (1–2). Jaws with a single robust terminal tooth, 4 subterminal teeth (3–7), 5 teeth ensheathed proximally (3–7), brown, moderately sclerotised, or weakly sclerotised (rarely) (Fig. 2 a).

*Parapodia.* Parapodia of setiger 10 with length 0.31 times body width (0.30–0.56). Acicular neuropodial ligule conical-subconical (very small). Dorsal cirri 1.1 times length of podium at setiger 3 (0.4–2.4) (Fig. 1 b), 1.0 times length of podium in midbody (0.4–1.8) (Fig. 1 c), 1.5 times length of podium posteriorly (0.6–1.4); 2.1 times longer than wide posteriorly (1.1–2.8) (Fig. 1 d). Anterior dorsal cirri weakly vascularised. Posterior dorsal cirri weakly vascularised. Ventral cirri 0.53 length of podium at setiger 3 (0.21–0.44) (Fig. 1 b), 0.35 length of podium posteriorly (0.14–0.33) (Fig. 1 d).

*Setal numbers.* Supraneuroacicular setae in postacicular fascicle are sesquigomph spinigers; 1 in podium 3 (0–1), 1 in podium 10 (rarely 0 or 2), 1 in podium 30, 1 in podium 60. Supraneuroacicular setae in preacicular fascicle are heterogomph falcigers throughout; 1 in podium 3, 1 in podium 10 (1–2), 2 in podium 30 (1–2), 1 in podium 60 (1–2). Subneuroacicular setae in postacicular fascicle are absent. Subneuroacicular setae in preacicular fascicle are heterogomph falcigers throughout; 3 in podium 3 (2–4), 3 in podium 10 (rarely 1 or 4), 3 in podium 30 (rarely 2 or 4), 3 in podium 60 (rarely 2).

*Setal morphometrics.* Supraneuroacicular sesquigomph spinigers in setiger 10 with boss 1.5 times length of collar (1.4–1.7, rarely to 1.9) (Fig. 2 b). Heterogomph setae with boss not prolonged; articulation deeply incised basally (Fig. 3 e, f). Supraneuroacicular falcigers in setiger 10 with blades 4.8 times longer than width of the shaft head (4.2–6.2), finely serrated, 18 teeth (15–25), 0.58 times total blade length (0.50–0.64), teeth increasing in length greatly proximally (Fig. 2 c). Subneuroacicular falcigers in setiger 10 with blades finely serrated; 4.0 times longer than width of shaft head for the dorsal-

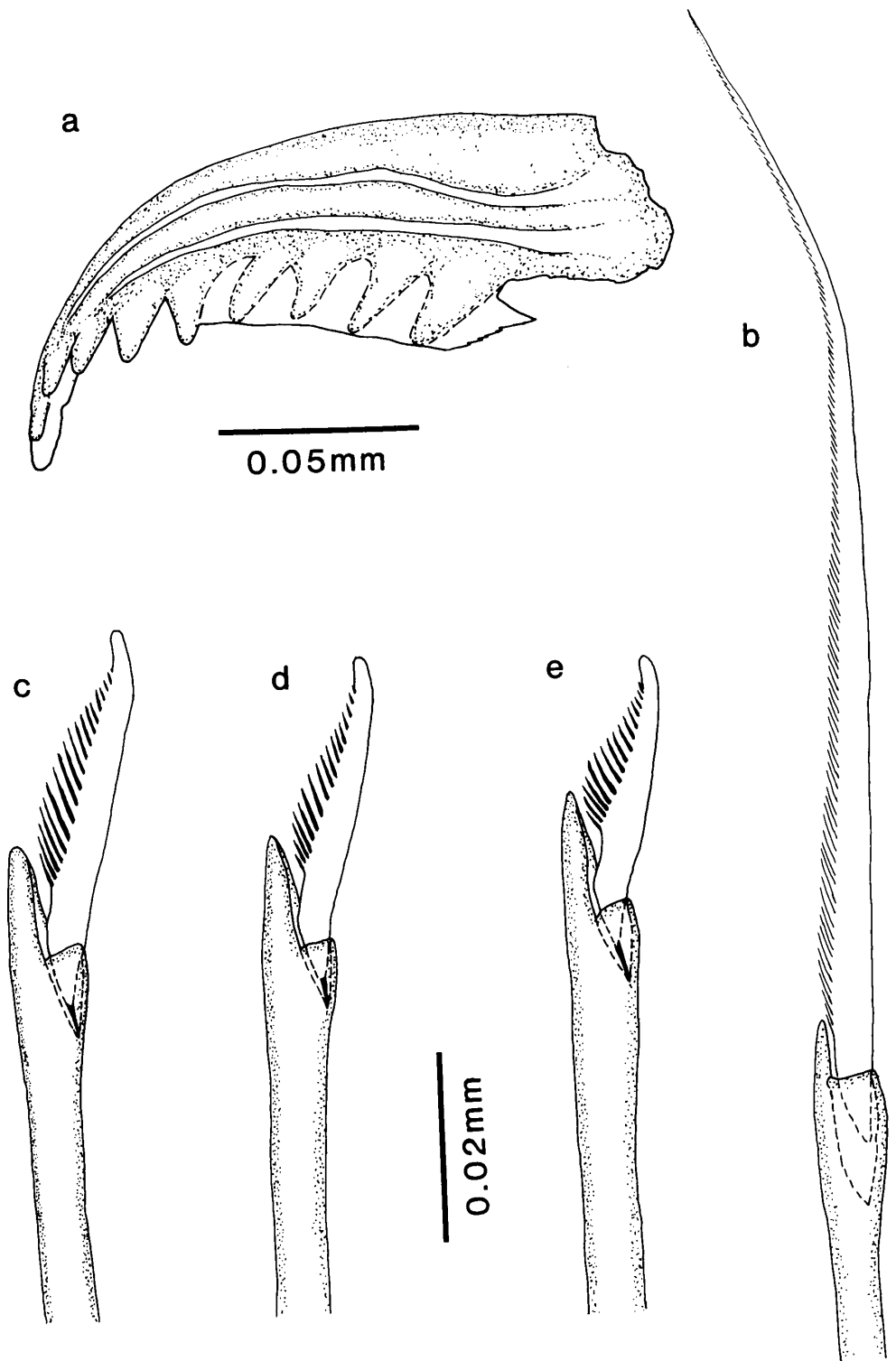


FIG. 2. *Lycastopsis catarractarum* Feuerborn. NEOTYPE: (a) jaw, R.S. dorsal view; (b) supraneuroacicular sesquigomph spiniger, parapodium 10; (c) supraneuroacicular falciger, parapodium 10; (d) dorsal-most subneuroacicular falciger, parapodium 10; (e) ventral-most subneuroacicular falciger, parapodium 10.

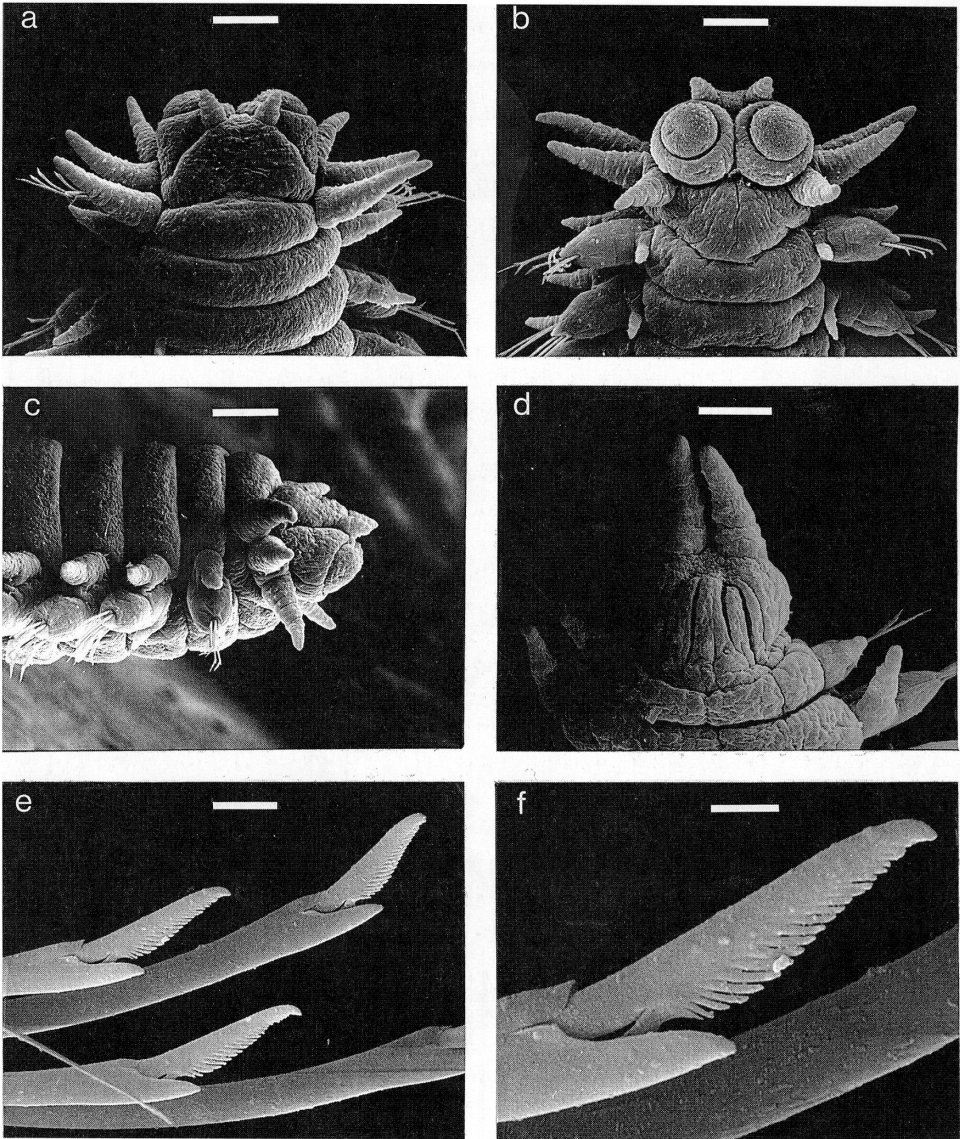


FIG. 3. *Lycastopsis catarractarum* Feuerborn. Fiji. SEM micrographs at 20 kV. (a) anterior end, dorsal view, scale 100  $\mu\text{m}$ ; (b) anterior end, ventral view, scale 100  $\mu\text{m}$ ; (c) anterior end, lateral view, scale 100  $\mu\text{m}$ ; (d) posterior end, dorsal view, scale 50  $\mu\text{m}$ ; (e) subneuroacicular falcigers, scale 10  $\mu\text{m}$ ; (f) subneuroacicular falciger, scale 4  $\mu\text{m}$ .

most (4.1–5.5), 16 teeth (13–22) (Fig. 2 d); 4.0 times longer than width of shaft head for the ventral-most (3.1–4.8), 16 teeth (13–20) (Fig. 2 e). Subneuroacicular falcigers in midposterior region with blades finely serrated. Setae pale. Acicula in midbody brown (light to dark).

*Pygidium*. Pygidium button-shaped, or funnel-shaped (very rarely); terminally with 2 large lateral lobes and a smaller pointed dorsal lobe (Fig. 1 e), appearing incised under SEM magnification (Fig. 3 d). Anus terminal. Anal cirri arising laterally, or ventrolaterally (rarely), conical, smooth, 0.3–1.0 times width pygidium.

*Sex*. Monoecious (according to Feuerborn, 1931 a), or parthenogenetic (see Remarks). Mature oocytes 330  $\mu\text{m}$  (260–320, range of means for 5 specimens), ellipsoid, straw-coloured, with external membrane. Epitokal setae in sexually mature specimens absent.

#### Remarks

The type material of *Lycastopsis catarractarum* Feuerborn, 1931 cannot be located, despite the efforts of colleagues in searching various Natural History Museums in Germany. There is no indication in Feuerborn (1931 a, b) where type material was deposited. Feuerborn spent some time in the Westfälisches Museum für Naturkunde, Münster, as well as the Westfälisches Wilhelms Universität, Münster. However the type material is not present in either of these institutions (P. Scharnofske, pers. comm., 1985).

A neotype is designated therefore from among eight specimens collected by Feuerborn in November 1928 from Bedali (now Malang), east Java (7.59°S, 112.45°E), one of the localities given by Feuerborn (1931 a). It seems likely that this material, like that in the type description, was collected on the Sunda Expedition of 1928–29 (Hartmann–Schroder, pers. comm., 1987), and is the only material of *L. catarractarum* from Indonesia known to exist. The material was determined, however, by Augener rather than Feuerborn, although a description of this species was never published by Augener. Incidentally, Augener (1933, p. 194) in a description of another namanereid, incorrectly referred to *Lycastopsis amboinensis* Pflugfelder, 1933 as *L. catarractarum*. This material will be reexamined and described in the revision of the Nananereidinae currently in progress (Glasby, in prep.). Also Lieber (1931) confuses the two species (according to Pflugfelder, 1933).

The specimen selected as neotype (HZM P-19668) agrees well with the descriptions of Feuerborn (1931 a, b) especially in regard to the highly diagnostic characters of the number and shape of the teeth of the falciger blades (cf. Feuerborn, 1931 a, fig. 12 a). Feuerborn (1931 a) states that *L. catarractarum* is an hermaphrodite, as both male and female gametes were detected in each segment (although mature sperm were not seen). However, male gametes were not detected in the present material, which included 27% of sexually mature specimens having very large oocytes (260–320  $\mu\text{m}$ ). We suggest therefore that *L. catarractarum* is parthenogenetic, or facultatively so. Parthenogenesis may be an adaptation for life in freshwater, especially in temporary freshwater reservoirs which are subject to environmental stress.

The 'proboscis' of *L. catarractarum* is described by Berkeley and Berkeley (1963) as papillated and resembling an 'elongated pine cone'. Their illustration of the everted 'proboscis' is repeated in Wolf (1976, p. 26, fig. 14 f). Unfortunately, the specimens having fully everted proboscides are no longer present in the material examined by Berkeley and Berkeley (USNM 35670), and the remaining specimens are too small and poorly preserved to dissect. However, our observations of other specimens of

*L. catarractarum*, with the proboscides dissected, indicates that papillae of any sort are absent. The 'pine cone' papillae observed by Berkeley and Berkeley are more likely to represent the lining of the oesophagus which has everted beyond the proboscis and paired jaws. This does not occur commonly in preserved nereidids but may conceivably occur in an animal that died as a result of dehydration, as did the specimens of Berkeley and Berkeley.

The other material examined, one specimen from Gaudalcanal Island, Solomons, is mentioned by Gibbs (1971) following his description of *Cryptonereis malaitae*, although it is not confidently identified. On reexamination, this specimen was found to have a small pair of prostomial antennae, characteristic of *Lycastopsis* rather than *Cryptonereis*. The form of the setae of the specimen matches that of *L. catarractarum*. The specimen was found at an altitude of about 350 m in moist leaf litter.

#### *Habitat*

Feuerborn's material (1931 a, b) was collected at the leaf bases and in the fouling cover of the lower parts of the stems of *Colocasia indica* and the wild banana (*Musa* sp., Musaceae), commonly found along freshwater jungle creeks, and often very abundant near waterfalls, up to 450–500 km from the coast. Berkeley and Berkeley's material (1963) was collected from wet, rotting banana leaves lying in heavy shade in a cocoa plantation about 40 km from the coast and 45 m above sea level.

One of us (RLK) found the species in a water-filled tree hole of some buttress roots, 26 cm above the ground in lowland rainforest. PAR discovered a few specimens in the accumulated detritus contained in the leaf axils of *Pandanus vitiensis* beside a freshwater stream in lowland rainforest. Subsequently, PAR and CJG returned to the same area and found the species to be far more numerous at the base of the lowest (often dead) leaves, which contained no detritus. Here they were found on the surface and in the interstices of the leaves where a thin film of water existed. They appeared almost transparent and moved quite rapidly in and out of the leaf fibres. Thus they may be easily overlooked in an investigation of the pandanan leaf axil fauna (see Stone, 1982, p. 421) and may only venture into the detrital filled axils when there is sufficient moisture available (on the occasion of PAR and CJG collecting, the detritus was relatively dry).

#### *Distribution*

NEOTYPE: Java, Bedali (now Malang). Additional occurrences in Indonesia, Philippines, Papua-New Guinea, Solomons and Fiji.

New records for Papua New Guinea, Fiji and Solomons.

#### *Feeding*

The realised diet of *L. catarractarum* was determined for two specimens from Papua New Guinea and for twenty specimens from Fiji. Specimens chosen for gut content analysis in the Fiji sample were those having some dark material in the gut as seen through the body wall. Roughly half the intestinal tract of each specimen was removed by dissection and mounted whole on a slide. The gut, made translucent by mounting in polyvinyl lactophenol, was then examined and contents identified.

Gut contents were identified by various specialists (see Acknowledgements), and are listed in Table 1. The gut contents, which estimate the realised diet of *L. catarractarum*, include fungal hyphae and oligochaetes (for Papua New Guinea) and

Table 1. Flora and fauna associated with *L. catarractarum* in the Fiji and Papua New Guinea habitats, with an estimation of potential and realised food items.

	Faunal component	Floral/detrital component
PNG treehole	culicids† chironomids† ceratopogonids† psychodids† tipulids† oligochaetes‡	fungal hyphae‡ protozoans† bacteria†
Fiji <i>Pandanus</i> leaf axil	<i>L. catarractarum</i> ‡ diplopods chilopods nematodes† formicids nemerteans araneids oligochaetes† schizomids dipteran larvae† acaridids	fungal hyphae‡ fungal spores‡ fern spores‡ protozoans† bacteria†

† Potential food items, based on nereidid functional morphology and feeding habits.

‡ Realised food items, based on gut content analysis.

fungal hyphae, fungal spores, fern spores and other *L. catarractarum* (for Fiji). Some unidentifiable animal remains and small spines were also found in the guts of some Fijian specimens. Gut content analysis of this kind probably underestimates the range of the actual diet.

Potential food items are also indicated in Table 1. These items, not included in the realised diet include, for Papua New Guinea, dipteran larvae (culicids, chironomids, ceratopogonids and psychodids) and tipulid larvae (see Kitching, in press) and for Fiji, dipteran larvae, nematodes and oligochaetes. For both areas, bacteria and protozoans are potential food items, and may in fact have been present in the gut but not recognised. The apparent non-utilisation of these items by *L. catarractarum* may reflect the small sample size, but a relatively limited diet is characteristic for the Nereididae in general (Goerke, 1971).

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