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DESCRIPTIONS OF THE PARALARVAE OF TWO LOLIGINID SQUIDS IN SOUTHERN AFRICAN WATERS

M. VECCHIONE† and M. R. LIPÍŃSKI*

Morphological differences between paralarvae of two loliginid squid species common in southern African waters (*Loligo vulgaris reynaudii* and *Lolliguncula mercatoris*) are described. The differences are: *Loligo* — “cheek patches” consisting of four dark chromatophores, nine large dark dorsal chromatophores on the mantle, tentacular clubs broad and much wider than tentacle stalks, proximal row of three club suckers with others tetraserial, suckers large enough to appear crowded on the club surface; *Lolliguncula* — “cheek patches” with three dark chromatophores, two pairs of large, dark dorsal chromatophores on the mantle, tentacular clubs narrow, proximal club suckers arranged in three pairs, suckers small, not particularly crowded. Relationships with other myopsids are briefly discussed.

Morfologiese verskille tussen die paralarwes van twee spesies pylinkvisse behorende tot die Loliginidae in Suider-Afrikaanse waters (*Loligo vulgaris reynaudii* en *Lolliguncula mercatoris*) word beskryf. Die verskille is: *Loligo* — “wangkollie” bestaande uit vier donker chromatofore, nege groot, donker dorsale chromatofore op die mantel, die knuppelgedeeltes van die tentakels breed en baie wyer as die steelgedeeltes, proksimale ry van drie knuppelsuiers en die ander in vier rye, suiers groot genoeg om op die knuppeloppervlak dig gepak te lyk; *Lolliguncula* — “wangkollie” met drie donker chromatofore, twee paar groot, donker dorsale chromatofore op die mantel, tentakelknuppels smal, proksimale knuppelsuiers in drie pare gerangskik, suiers klein, nie juis dig bymekaar nie. Verwantskappe met ander miopsides word kortweg bespreek.

Cephalopod paralarvae of southern Africa have not been investigated in any detail up to now. The region is interesting and distinct zoogeographically and it contains a fair number of endemic species (Roeleveld 1972, 1975). Knowledge of the paralarvae in the region could therefore add significantly to local knowledge of cephalopods. Also, because some species of cephalopods are important commercially in southern African waters (Lipiński 1990, Augustyn *et al.* 1992, 1994), knowledge of their life cycle helps towards better management (Augustyn *et al.* 1992, 1994). A large-scale programme was therefore devised to collect and to identify paralarvae and to investigate various aspects of their occurrence and biology, particularly in the region where the main commercially exploited species, *Loligo vulgaris reynaudii*, is found.

Identification of loliginid paralarvae is not particularly difficult (Sweeney *et al.* 1992). Unfortunately, however, no criteria were available to distinguish between the two most common loliginids in the region, *Loligo vulgaris reynaudii* and *Lolliguncula mercatoris*. Therefore, questions of identification had to be overcome before any other studies could be undertaken. The importance of such work should not be underestimated. In a paper published recently, the sites in the north (Fig. 6a, c of Augustyn *et al.* 1994) reported to lie in the paralarval distribution of *Loligo* actually lie within the paralarval distribution of *Lolliguncula*.

MATERIAL AND METHODS

Loligo vulgaris reynaudii of known parentage: Station 1 (Fig. 1) — one batch of 30 paralarvae hatched from eggs collected 24 September 1990 by means of a bottom trawl in a depth of 106 m (bottom temperature 12–13°C). Hatching was induced by placing the eggs in a bucket of warm water (18°C).

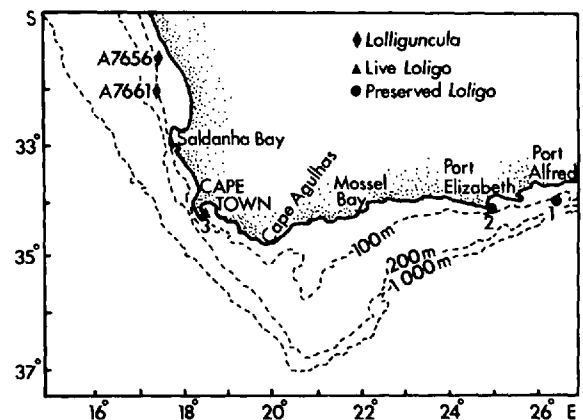


Fig. 1: Distribution of the stations at which material was collected

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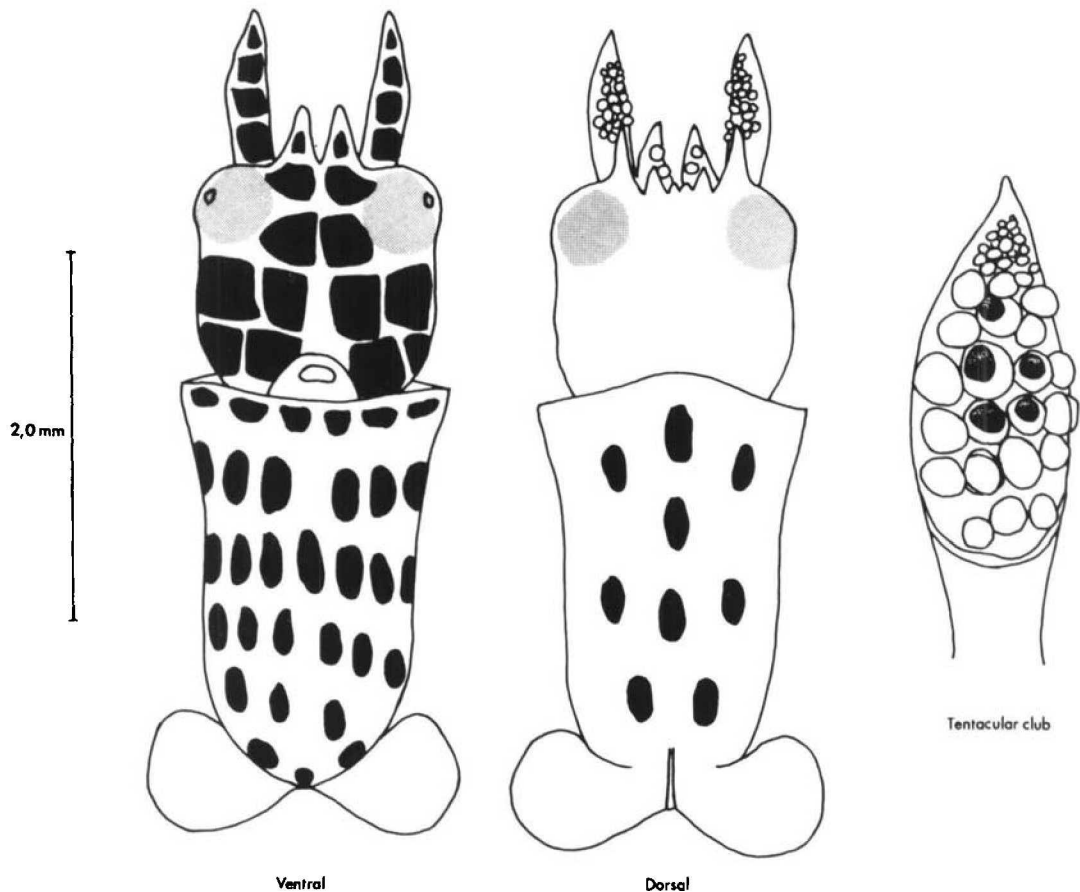


Fig. 2: *Loligo vulgaris reynaudii* of known parentage, preserved hatchling I of, ML 2,4 mm

Station 2 — one batch of 34 hatchlings, hatched from eggs collected by a diver in Seal Bay (Fig. 1) in shallow water (about 25 m) on 1 December 1986. Kept in the tank for several days. Hatching was not induced.

Loligo vulgaris reynaudii hatchlings observed live: Mature females were caught in March 1993 in False Bay (Fig. 1) and several egg pods were laid down in the holding tank one week later. Observations (six paralarvae with most consistent patterns) were made three days after paralarvae were hatched. Hatching itself was natural.

Lolliguncula mercatoris: no paralarvae of known parentage. All material investigated was collected by means of a standard Bongo net (Posagy and Marak 1980) towed from F.R.S. *Africana* during cruises in February and August 1988 and in January 1989 to the West Coast (Fig. 1). All plankton collected was sorted for cephalopod paralarvae, and all loliginid paralarvae

were subsequently selected for identification to species. Special attention was paid to eight Bongo samples from the northernmost part of the region investigated, because it was suspected that they may contain *Lolliguncula* paralarvae. *Loligo* is uncommon in the northern part of the west coast of South Africa (Augustyn 1991).

The hatchlings and the planktonic paralarvae were examined under a dissecting microscope with dark field illumination. Live loliginid paralarvae have both dark- and light-coloured chromatophores. In observing and drawing the chromatophore patterns (available only for *Loligo vulgaris reynaudii*), the methods proposed by McConathy *et al.* (1980), as improved by Segawa *et al.* (1988) and Baeg *et al.* (1992), were employed. On preserved paralarvae, however, only the dark chromatophores are easily visible. For the preserved material, an earlier convention was followed (Vecchione 1982) to describe patterns based on

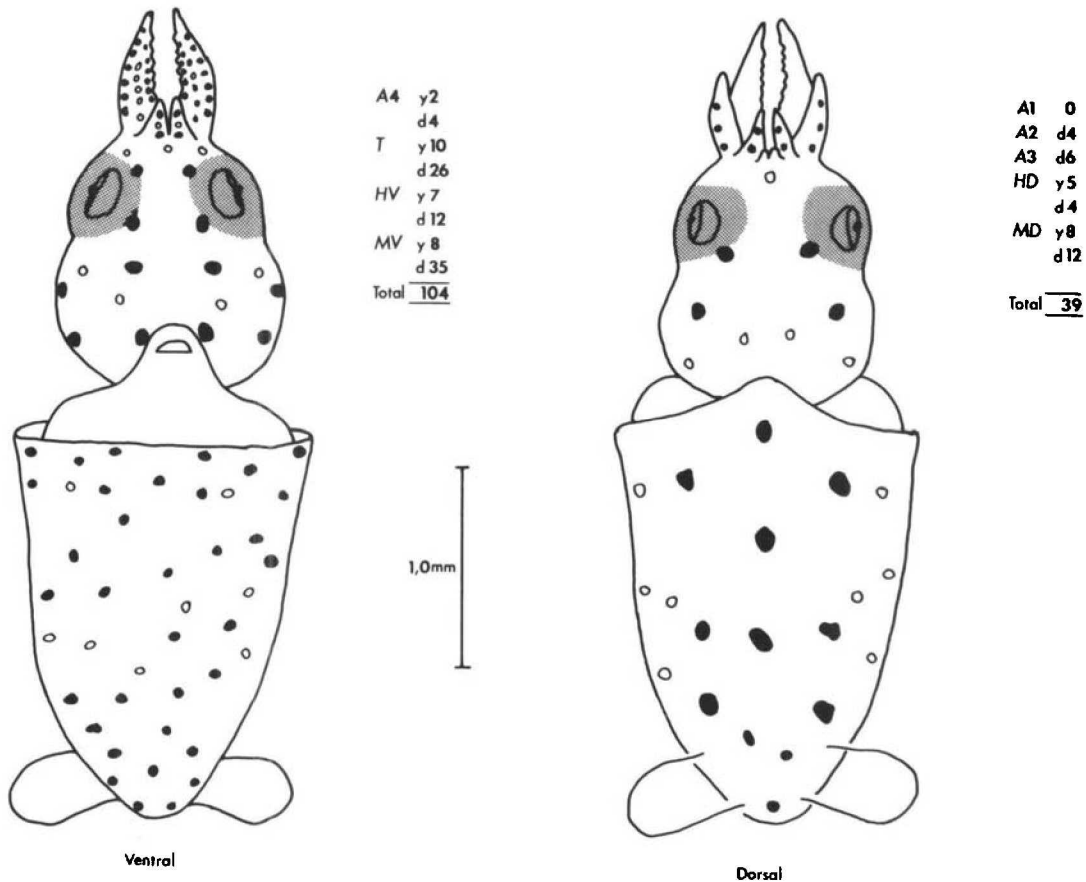


Fig. 3: *Loligo vulgaris reynaudii* hatchling I observed live, ML 2.2 mm. The numbers of chromatophores are also given as y (yellow) or d (dark reddish) — A1, arm of pair I; A2, arm II; A3, arm III; A4, arm IV; T, tentacle; HD, dorsal side of head; HV, ventral side of head; MD, dorsal side of mantle; MV, ventral side of mantle

these dark chromatophores only.

RESULTS

All specimens examined had characters typical of loliginid paralarvae (Hanlon *et al.* 1992). These characters include the presence of corneal membranes, the precocious development of ventral and ventrolateral arms, biserial arm suckers, chromatophores more numerous on the ventral than on the dorsal mantle surface, and well-developed, rounded, subterminal fins.

Of the two samples of *Loligo v. reynaudii* hatchlings obtained from egg masses, the one of 30 paralarvae from Station 1 (Fig. 1) was in good condition,

although many had external yolk sacs and probably had hatched prematurely. The second sample, of 34 specimens from Station 2 (Fig. 1), appeared to be fully developed hatchlings, but most had suffered from substantial bleaching of the chromatophores resulting from preservation. Nevertheless, it was possible to find sufficient specimens in these two samples to describe the general morphology and the chromatophore patterns. Particularly noteworthy characters included the comparatively large fins, the short broad tentacular clubs, nine large dark chromatophores on the dorsal surface of the mantle, and patches of four large dark chromatophores on the ventral surface of the head posterior to each eyeball (referred to as "cheek patches"). These hatchlings were similar to those of *Loligo vulgaris vulgaris*, as illustrated in Hanlon *et al.* (1992).

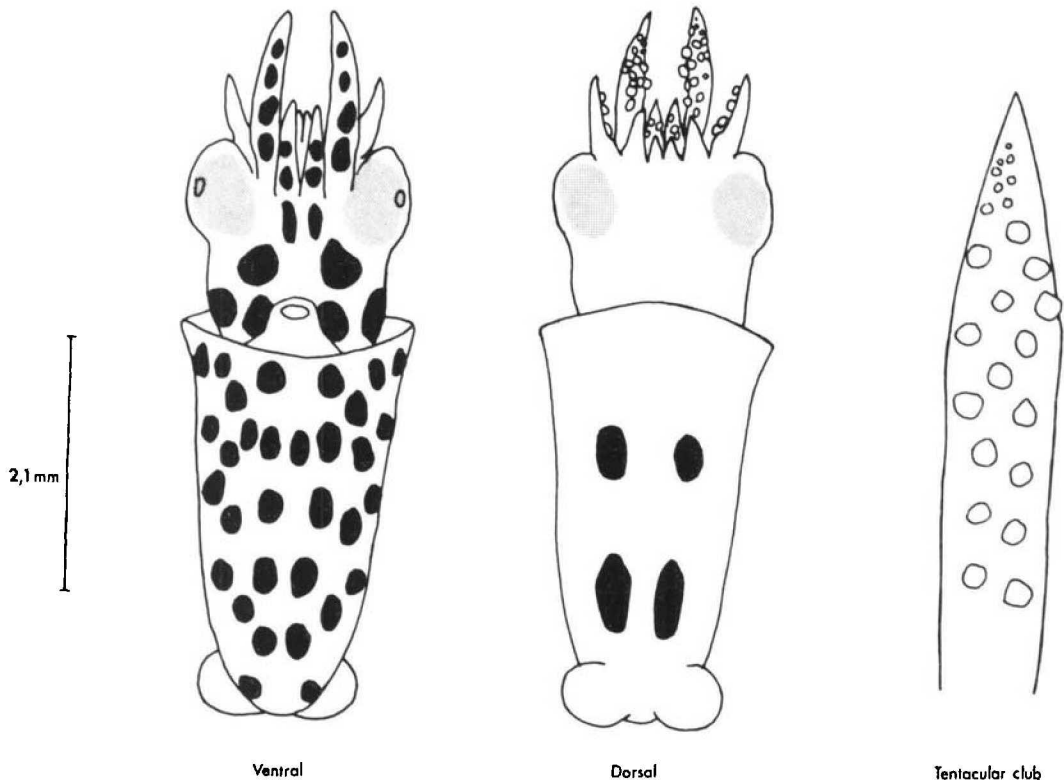


Fig. 4: *Lolliguncula mercatoris* from plankton collections, *ML* 3,5 mm

In the sample of hatchlings observed live, most of the characters listed above could be confirmed, but another three smaller dark chromatophores (in addition to the nine large chromatophores) were also observed on the distal part of the mantle.

Of the nine net-collected paralarvae, one matched the morphology, particularly the tentacular clubs, of the specimens hatched from egg masses. Another specimen could not be identified because it was badly bleached and the mantle was missing. The remaining seven paralarvae were distinct in fin and tentacle morphology from the hatchlings mentioned above. On two specimens the chromatophores, although somewhat bleached, were sufficiently clear to determine the pattern, which was quite different from that of the *Loligo* hatchlings. They had very few chromatophores on the dorsal mantle and had cheek patches of three chromatophores each, similar to the pattern on paralarvae of *Lolliguncula brevis* (McConathy *et al.* 1980, Vecchione 1982). The description below of *Lolliguncula mercatoris* paralarvae is based on these seven net-collected paralarvae.

Loligo vulgaris reynaudii (Figs 2, 3)

PRESERVED PARALARVAE

Seal Bay hatchling, 1 December 1986; 2,4 mm mantle length (*ML*). Fins paddle-shaped, broad with short bases, each fin (measured along dorsal midline) much wider than long, appearing to meet at posterior tip of mantle. Mantle broad, with nine large dorsal chromatophores and numerous (c. 31) ventral chromatophores arranged roughly in slightly oblique rows, the row at anterior mantle margin clearly distinct. Head squarish, approximately equal in width to mantle opening, devoid of dark chromatophores dorsally but with 10 on ventral surface, arranged in two cheek patches of four each posterior to eyes and a pair between the eyes. Ventral arms each with two aboral chromatophores. Tentacles with four aboral chromatophores each. Tentacular clubs broad, much wider than tentacle stalks, a slightly raised ridge separating the clubs from the tentacle stalks. Proximal row of club suckers with three suckers, all others tetraserial,

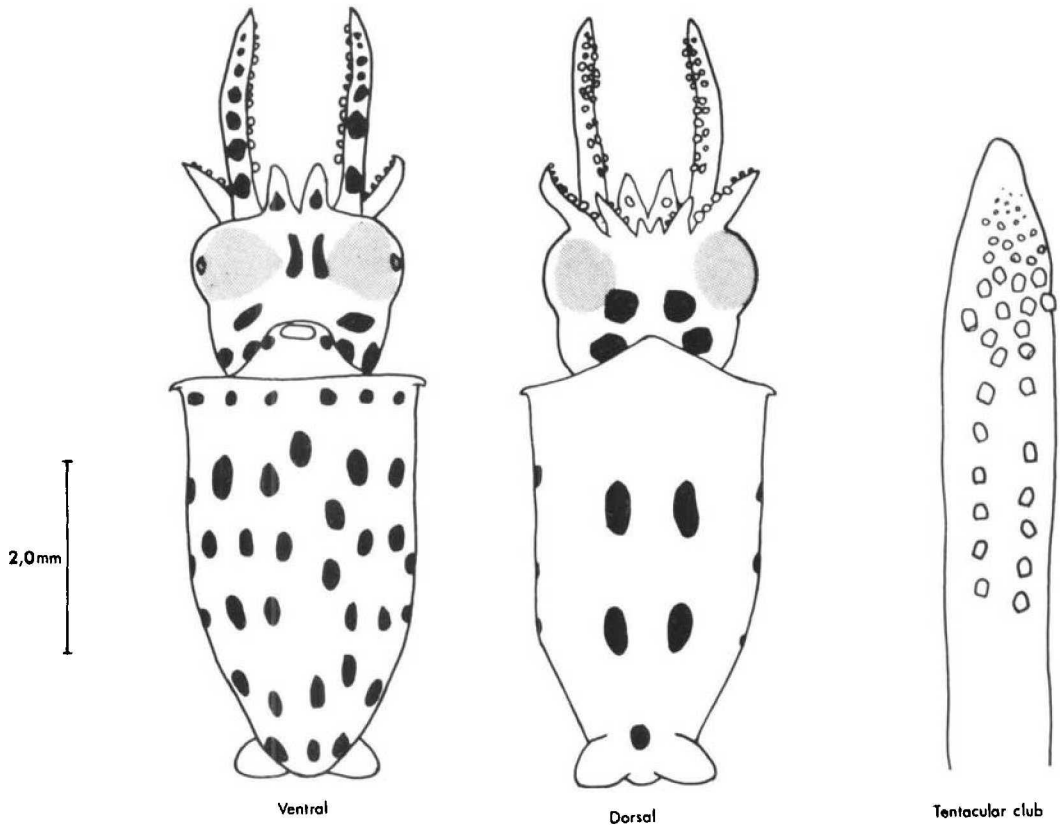


Fig. 5: *Lolliguncula mercatoris* from plankton collections, *ML* 4,6 mm

suckers sufficiently large to appear crowded on club surface.

LIVE PARALARVAE

False Bay hatchling, March 1993; 2,2 mm *ML*. More chromatophores visible than on preserved hatchlings, but basic pattern consistent with description given above. Nine clear large dorsal dark chromatophores on the mantle and two patches of four large dark chromatophores ventrally on head.

Lolliguncula mercatoris (Figs 4, 5)

F.R.S. *Africana* Station A7661, 24 August 1988, 3,5 mm *ML*. Fins round, small, each almost circular in outline, separated at posterior mantle. Mantle

narrow with two pairs of dorsal chromatophores and numerous (c. 32) ventral chromatophores arranged irregularly. Head narrow, with protruding eyes, devoid of dark chromatophores dorsally but with eight on ventral surface, arranged in two cheek patches of three each, posterior to eyes, and a pair between the eyes. Ventral arms each with two aboral chromatophores. Tentacles with four aboral chromatophores each. Tentacular clubs narrow, not much wider than, or distinctly separated from, tentacle stalks. Proximal suckers arranged in pairs, increasing to series of 3–4 suckers per row. Suckers small, rather widely spaced.

F.R.S. *Africana* Station A7656, 24 August 1988, 4,6 mm *ML*. Similar to above specimen, but with the following exceptions. Fins slightly wider, ovate rather than circular. One additional chromatophore on dorsal mantle between fins. Anterior row of chro-

matophores on ventral mantle more clearly differentiated. Two pairs of chromatophores on dorsal surface of head. Tentacles long and narrow, with six pairs of small suckers proximally.

DISCUSSION

Based on the material at hand, paralarvae of *Loligo vulgaris reynaudii* can be distinguished from those of *Lolliguncula mercatoris*. The characters of most importance include the chromatophore patterns, especially the cheek patch, and the tentacular club structure. *Loligo vulgaris reynaudii* has cheek patches of four chromatophores and comparatively broad and robust clubs. The cheek patches of *Lolliguncula mercatoris* consist of three chromatophores, and the clubs are narrower, with several pairs of suckers in the carpal area. Re-examination of the specimens reported by Augustyn *et al.* (1994) shows that *Lolliguncula* was incorrectly reported as *Loligo* at the northernmost stations of the area of their report (Fig. 6 of Augustyn *et al.* 1994).

The specific status of the South African *Loligo* has been the subject of some debate. The South African *Loligo reynaudii* d'Orbigny, 1845 was originally distinguished from the common Mediterranean *L. vulgaris* Lamarck, 1798 on the basis of its shorter arms and more slender shape. Several authors have questioned the taxonomic status of the South African species (Adam 1952, Voss 1962, Roper *et al.* 1984). In the most recent analysis of the differences, Augustyn and Grant (1988) compared morphology and protein electrophoresis between the taxa and found statistically significant differences in many of the morphological characters. Although the two taxa are separated geographically, Augustyn and Grant (1988) concluded that the biochemical differences between the taxa were not as great as would be expected in distinct species. They therefore concluded that the disjunction in distribution is fairly recent (Pliocene) and that *L. reynaudii* should be considered a subspecies of *L. vulgaris*.

A paralarva of *L. vulgaris vulgaris* was drawn by Hanlon *et al.* (1992) from preserved specimens. Comparisons between preserved paralarvae of different species should be made only on the basis of the most consistent and clearly distinct characters, backed up (if possible) with comparisons of live material. However, live material should also be treated with caution because of great individual variability and ontogenetic changing of light (yellow) chromatophores into the dark (red and/or brown) ones (Packard 1985, Segawa *et al.* 1988).

The paralarvae of *L. mercatoris* should be compared with those of *Lolliguncula brevis* from the

Gulf of Mexico, described by Vecchione (1982). Both species have cheek patches of three chromatophores. This, however, should not be regarded simply as a generic character, because *Loligo opalescens* hatchlings also have cheek patches of three chromatophores (Fig. 1D of McConathy *et al.* 1980). Re-examination of Gulf of Mexico specimens has revealed also that club structure in *L. brevis* is similar to that in *L. mercatoris*, including the presence of 1–3 pairs of suckers in the carpal region. The major difference in paralarval morphology between the two species is the precocious development of dorsal chromatophores on the mantle of *L. mercatoris*.

Brakoniecki (1986) erected the genus *Afrololigo* because he felt that *L. mercatoris*, although obviously related, was sufficiently different from other species of *Lolliguncula* morphologically and biogeographically to warrant generic distinction. Alexeyev (1992) took this one step further when he examined a small sample of *L. mercatoris* and concluded that the females have structures on the ink sac which appear to be similar to the photophores found in both sexes of some other loliginids. Alexeyev (1992) therefore removed *L. mercatoris* from *Lolliguncula* and placed it under Brakoniecki's generic name (i.e. *Afrololigo*), in his new subfamily Uroteuthinae. Until these structures on the ink sac are shown to be homologous with other loliginid photophores, the developmental similarities between *L. mercatoris* and *L. brevis* suggest that a more conservative interpretation should be retained. Therefore, *L. mercatoris* is retained here within the genus *Lolliguncula*.

Perhaps more interesting are the similarities between the paralarvae of both species of *Lolliguncula* and the adult morphology of the genus *Pickfordiateuthis*. The latter is the single genus, consisting of one described and several undescribed species in the family Pickfordiateuthidae, the only myopsid squids other than the loliginids. Among its diagnostic characters, currently considered to be of familial importance, are subterminal fins and biserial suckers on the carpus of the tentacular clubs. The fact that these characters are shared with paralarval *Lolliguncula* suggests that *Pickfordiateuthis* should be considered a neotenous loliginid.

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