Afr. J. mar. Sci. 25: 177–183
2003

DESCRIPTION OF LARVAL *CYNOGLOSSUS ZANZIBARENSIS* (TELEOSTEI: CYNOGLOSSIDAE) FROM THE TSITSIKAMMA COAST, SOUTH AFRICA

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The early development and the temporal distribution of *Cynoglossus zanzibarensis* larvae are described, based on specimens collected along the Tsitsikamma coast, South Africa. The yolk sac is evident in larvae of up to 3.4 mm body length (*BL*). There are 46–57 (6–9 + 37–50) myomeres and the gut extends to 37, 36 and 31% *BL* in preflexion, flexion and postflexion larvae respectively. Flexion is initiated by 5.6 mm *BL* and is complete in all larvae >7.8 mm *BL*. Two elongate dorsal fin rays are visible by 3.5 mm *BL*, and a single medial pelvic fin bud appears by 6.2 mm *BL*. Eye migration is initiated in larvae >7.0 mm *BL* and complete by 11.6 mm *BL*. Pigment is concentrated over the ventral and lateral gut area, as well as along the dorsal and ventral trunk and tail surfaces. Lateral tail pigment becomes heavier in postflexion larvae. The larvae of *C. zanzibarensis* are compared with previously described tonguefish species, including the congeneric *C. capensis*, which has fewer dorsal and anal fin rays (D103–110, A81–88 compared with D116–124, A92–103), 2–4 elongate dorsal rays compared with 2 and a larger size at flexion (9.9 mm *BL* compared with 6.6 mm *BL*).

Key words: *Cynoglossus zanzibarensis*, larval development and description, South Africa, Tsitsikamma

In a study on the description and dynamics of the nearshore ichthyoplankton assemblage along the Tsitsikamma coast, South Africa, Wood (1998) illustrated and described the larval stages of 28 fish species. These species represented 37.3% of the taxa identified in the Tsitsikamma assemblage, providing an indication of the paucity of knowledge on ichthyoplankton taxonomy from the neritic region along the south-east coast of South Africa. The family Cynoglossidae consists of three genera and 13 species in southern African waters (Heemstra 1986). The genus *Cynoglossus* alone contains nine of these species, *C. zanzibarensis* and *C. capensis* being the only two whose distributional ranges encompass waters off the South-East Cape. Eggs and larvae of *C. capensis* found off the Cape Peninsula have been described by Brownell (1979).

The nearshore ichthyoplankton communities off South Africa, in particular the South-East Cape, have not been studied extensively. Anders (1975), Beckley (1985, 1986, 1993), Harris (1996), Shelton and Kriel (1980) and Whitfield (1989) dealt with such aspects as distribution and transport mechanisms and community structures in different zones. Along the south-eastern seaboard, specific work on the neritic ichthyoplankton west of Algoa Bay has been restricted to surveys carried out along the Tsitsikamma coast (Tilney and Buxton 1994, Tilney *et al.* 1996, Wood 1998). Cynoglossidae are found worldwide in temperate and tropical waters (Heemstra 1986), adult *C. zanzibarensis* being found between the cool Benguela Current off the Western Cape to the warm waters off Kenya on the East African coast. Juvenile and adult *C. zanzibarensis* are widely distributed over the shelf between Cape Agulhas and Port Alfred (Smale and Badenhorst 1991). They are important prey for several demersal teleost species, such as Cape gurnard *Chelidonichthys capensis*, lesser gurnard *C. queketti*, jacopever *Helicolenus dactylopterus* and shallow-water Cape hake *Merluccius capensis* along the South and West Cape coasts (Roel and Macpherson 1988, Meyer and Smale 1991, McPhail 1997).

The aims of this paper are to describe and to illustrate the early larval stages of *C. zanzibarensis*, based on a size series of preflexion, flexion and postflexion specimens caught along the south-east coast of South Africa.

MATERIAL AND METHODS

Plankton samples were collected monthly from August 1993 to October 1996, except when conditions were not favourable (Table I). Most collections were taken using a 57-cm diameter Bongo net fitted with 505- or 333-µm mesh nets. A centrally mounted flowmeter in the mouth of one net was used to measure the volume of water filtered. Double oblique tows

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Manuscript received January 2001; accepted February 2002

Table I: Monthly number caught, mean size and size range, and development stages of *C. zanzibarensis* larvae from the Tsitsikamma coast for all stations combined for the period August 1993–October 1996

Month	Number caught	Mean size (mm, ±*SD*)	Size range (mm)	Developmental stages
		1993		
August	34	3.82 (1.55)	1.9–10.2	PreF, F, PostF
September	Not sampled			
October	Not sampled			
November	16	5.17 (2.28)	2.6–9.5	PreF, F, PostF
December	Not sampled			
		1994		
January	Not sampled			
February	1	1.8	–	PreF
March	0			
April	Not sampled			
May	1	3.2	–	PreF
June	Not sampled			
July	Not sampled			
August	3	4.88 (0.75)	4.05–5.5	PreF
September	0			
October	Not sampled			
November	147	4.08 (1.32)	1.3–10.06	PreF, F, PostF
December	0			
		1995		
January	16	4.98 (1.83)	2.8–9.5	PreF, F, PostF
February	0			
March	1	4.0	–	PreF
April	12	6.32 (2.13)	3.9–10.1	PreF, F, PostF
May	Not sampled			
June	1	5.5	–	PreF
July	0			
August	6	9.07 (4.16)	4.8–17.0	PreF, F, PostF
September	Not sampled			
October	65	4.47 (2.37)	2.0–14.3	PreF, F, PostF
November	2	4.5 (0.71)	4.0–5.0	PreF
December	Not sampled			
		1996		
January	0			
February	0			
March	0			
April	25	7.04 (3.93)	1.5–16.3	PreF, F, PostF
May	0			
June	Not sampled			
July	0			
August	Not sampled			
September	Not sampled			
October	0			

PreF = preflexion
F = flexion
PostF = postflexion

were taken to a depth of 18.5 m (1 m from the bottom inshore and between 37 and 56 m from the bottom at the offshore stations). In October 1995 and April 1996, samples were collected using an opening-closing RMT 1×6 net fitted with six 333-µm mesh nets, which was capable of sampling at discrete depths (to within 2 m of the bottom). Electronic flowmeters provided the volume of water sampled by each net. Counts of larvae were converted to numbers per 100 m^3 of water filtered. Most sampling was carried out from a 7-m skiboat over the Middlebank reef (Fig. 1), approximately 1.4 n. miles offshore. Additional samples were taken off the Bloukrans and Elands rivers (Fig. 1) during research cruises by F.R.S. *Algoa* and F.R.S. *Africana*. Samples were placed in a solution of 5% formalin buffered in seawater. After two weeks samples

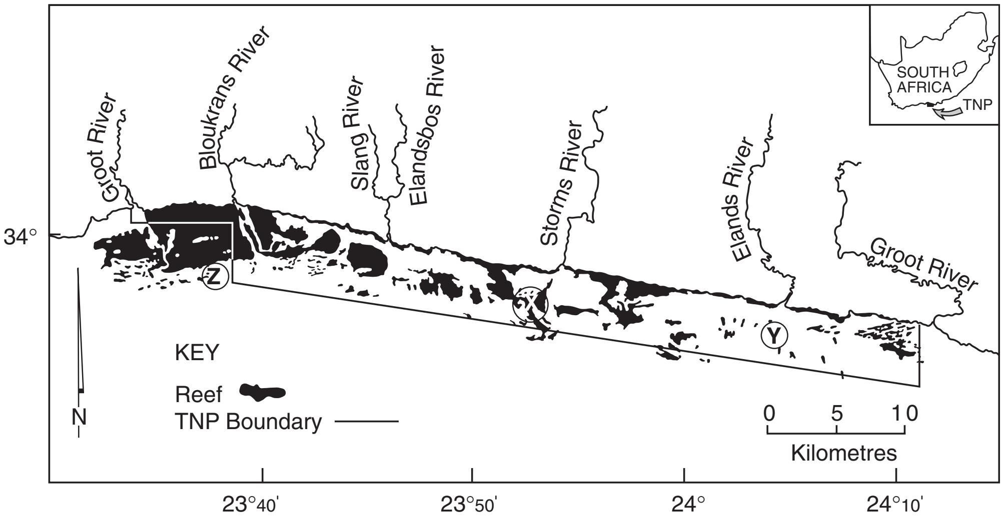

Fig.1: The Tsitsikamma coast. The seaward boundary of the Tsitsikamma National Park is indicated by the solid line. X = Middlebank, Y = site off Elands River, Z = site off Bloukrans River

were rinsed in distilled water and transferred to 70% ethanol.

In the laboratory all larvae were removed from the samples with the aid of a dissecting microscope. Cynoglossid larvae were identified using the descriptions of Brownell (1979), Leis and Trnski (1989) and Olivar and Fortuño (1991), and from specimens collected during a preliminary ichthyoplankton survey of the Tsitsikamma region (Tilney and Buxton 1994). Body length (*BL*, mm) was measured from the tip of the snout to the tip of the notochord to the nearest 0.1 mm using a calibrated eyepiece micrometer. In order to standardize measurements, the fixation period was set at two weeks and measurements were taken only after four months' preservation in 70% ethanol.

Description of larvae

The size series method described by Powles and Markle (1984) was employed to identify *C. zanzibarensis*, dorsal and anal fin counts being used in late flexion animals for positive identification (Heemstra 1986).

A total of 35 larvae of between 2.4 and 16.3 mm *BL*, representing all developmental stages, were selected from the collections. Those to be cleared and stained for morphological features such as fin rays, myomeres, vertebrae and spination were first measured and then stored in 95% ethanol before being processed, according to the method of Potthoff (1984). Larvae were drawn with the aid of a *camera lucida*. The pattern of melanophore distribution was illustrated and described, but xanthophores were not illustrated. All terminology follows that of Leis and Trnski (1989), and the following body measurements were made: body depth (*BD*), body length (*BL*), eye diameter (*ED*), head length (*HL*), pre-anal length (*PAL*), pre-dorsal fin length (*PDL*) and snout length (*SnL*). All measurements were expressed as percentage of body length.

Specimens used for the description and illustrations are stored in the J. L. B. Smith collection at the South African Institute for Aquatic Biodiversity (RUSI numbers 57 443–57 444).

RESULTS

Description

The number, mean size, size range and developmental stages of larvae captured each month are presented in Table I.

Preflexion larvae (Fig. 2) are elongate and moderately compressed. After notochord flexion, they become deeper bodied, especially around the head and trunk, and very compressed. Body depth appeared highly variable during flexion (Table II), perhaps attributable to varying levels of gut fullness at the time of

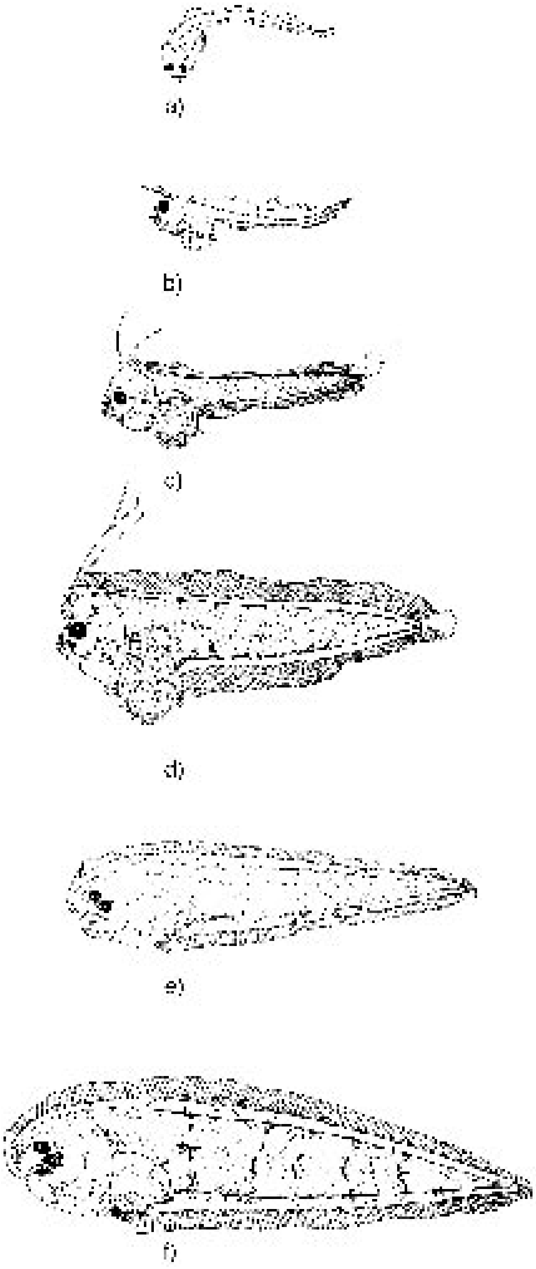

Fig. 2: Larvae of the *C. zanzibarensis* collected from the Tsitsikamma coast: (a) preflexion stage (yolk sac) – 3.4 mm *BL*, (b) preflexion stage – 3.7 mm *BL*, (c) preflexion stage – 5.8 mm *BL*, (d) flexion stage – 6.4 mm *BL*, (e) postflexion stage – 11.6 mm *BL*, (f) postflexion stage – 15.1 mm *BL*

Table II: Morphometrics (as a proportion of body length) for *C. zanzibarensis* larvae from the south-east coast of South Africa

Parameter	Preflexion	Flexion	Postflexion
PAL	0.30–0.37	0.33–0.36	0.30–0.31
PDL	0.04–0.07	0.02–0.03	0.00–0.006
HL	0.17–0.18	0.18–0.21	0.20–0.22
SnL	0.08–0.09	0.07–0.08	0.09–0.10
ED	0.05–0.06	0.03–0.05	0.03–0.04
BD	0.24–0.28	0.28–0.37	0.23–0.25

BD = Body depth
BL = Body length
ED = Eye diameter
HL = Head length
PAL = Pre-anal length
PDL = Pre-dorsal fin length
SnL = Snout length

measuring. There are 46–57 (6–9 + 37–50) myomeres. Larvae up to 3.40 mm *BL* still possess a yolk sac with numerous small, densely concentrated oil globules. The gut protrudes well below the ventral level of the body margin and is short, coiled and compact, ranging between 30 and 37% *BL* in preflexion and flexion larvae respectively. This ratio reduces after flexion and ranges from 30 to 31% *BL* in postflexion stages (Table II). The anus projects to the right of the midline behind the origin of the anal fin. The head is small, with a short, rounded snout. There is a marginal increase in head length relative to the body length, with a maximum of 18, 21 and 22% *BL* in preflexion, flexion and postflexion larvae respectively (Table II). The formation of the rostral hook begins soon after flexion, and it quickly covers the snout to well past the anterior margin of the mouth after eye migration. The mouth extends as far back as the posterior margin of the pupil. Small teeth are visible by 4.5 mm *BL* and become more numerous and finer with development. The eye is small and round, its diameter decreasing from a minimum of 5% *BL* in the preflexion stage to 3% *BL* in flexion and postflexion larvae (Table II). Migration of the right eye to the left side of the head is initiated in larvae >7.0 mm *BL*, and is complete by 11.6 mm *BL*. Though flexion is initiated in some larvae as early as 5.6 mm *BL*, most larvae first show signs of flexion around 6.0 mm *BL*, and all those >7.8 mm *BL* are postflexion. A pectoral fin bud is present, but no rays ever differentiate, and it is lost during late flexion, soon after the onset of eye migration. The dorsal and anal fin anlagen appear at about the same time. The first two incipient dorsal rays are elongate and are first visible at approximately 3.5 mm *BL*. By late flexion, they are reduced and become the shortest of the dorsal rays. As larvae grow and the rostral hook develops and moves forward, so does the origin of the dorsal fin until it is directly over the tip of the snout in late postflexion larvae. The single medial pelvic fin bud appears by 6.2 mm *BL* and contains five incipient rays. Fin counts in the largest specimen were D123, A102, $P_2$5, C9 and, with the exception of the caudal fin rays (which number 10 in adults), conform to fin counts for adult *C. zanzibarensis* (Heemstra 1986). Remnants of the finfold around the caudal region are still visible after flexion and before the appearance of the first incipient caudal fin rays.

Pigment

All larval stages have faint traces of pigment at the angle of the lower jaw (Fig. 2). Yolk sac and preflexion larvae have scattered pigment on the preoperculum, operculum and over the mid- and hind-brain regions. Additional pigment is visible on both jaws, beneath the lower jaw and on the snout just anterior to and above the eye in the larger preflexion specimens. Flexion larvae have considerably more head pigment, with both jaws, the surface beneath the lower jaw, the snout, mid- and hind-brain, otic capsule, preoperculum and operculum all bearing some degree of pigment. The rostral hook arising from near the anterior section of the dorsal fin anlage is peppered with small pigment spots. Head pigment is quite extensive in postflexion larvae, covering most surfaces including the rostral hook, but it is light compared with flexion specimens. Yolk-sac larvae possess a few small melanophores on the lateral surface of the foregut and ventrally on the mid- and hindgut beneath the remnant yolk sac.

During early preflexion stages the ventral and lateral gut pigment, consisting of small spots and patches, is heavier and more widespread than in the yolk-sac stage, but by the later preflexion stages, gut pigment mostly consists of small stellar melanophores. Pigmentation on the gut has expanded to include the dorsal section in flexion larvae, but by the postflexion stage this is much reduced. During the yolk-sac stage, the dorsal and ventral midlines of the tail are covered by a longitudinal series of small melanophores, which run almost to the tip of the notochord. The midline tail pigment extends to the notochord tip and the dorsal section of the trunk during preflexion, and a few melanophores appear on the medio-lateral surface of the trunk above the gut. The finfold bears isolated groups of small melanophores in yolk-sac and preflexion larvae, and the pectoral fin bears a mixture of stellar melanophores and pigment patches during preflexion. Midline tail and trunk pigmentation in flexion larvae is similar to that seen in preflexion specimens, except that it is heavier with some melanophores and pigment patches overlapping onto the caudal and anal fin anlagen as well as the dorso- and ventro-lateral surfaces. Groupings of medio-lateral pigment are found on the tail as far back as the 34th postanal myomere. Immediately prior to being lost, the pectoral fin in flexion larvae is heavily pigmented. In postflexion specimens, midline pigment on both dorsal and ventral surfaces of the trunk and tail still covers from the nape to the tip of the notochord, but is not as dark, whereas the dorsal and anal fin anlagen are more extensively covered than before. Six vertical bars of pigment begin to form on the tail of larger larvae, with small groups of dorso- and ventro-lateral pigment still present. The base of each dorsal, anal and caudal fin ray is marked by a very small, faint melanophore. The fin membranes also bear a scattering of melanophores.

DISCUSSION

The larvae of 20 cynoglossid species have been described worldwide (some of them tentatively), 5 *Symphurus* species, 14 *Cynoglossus* species and *Paraplagusia japonica* (Ahlstrom *et al*. 1984). Among those families whose early developmental stages could be confused with the cynoglossids are the carapids, some ophidioids and other pleuronectiforms (Leis and Trnski 1989). However, carapid larvae have a higher myomere count, no elongate ray on the head and no caudal fin, whereas ophidioids have flesh-like protuberances on the gut, more myomeres, paired pelvic fins, no elongate dorsal rays, and pectoral fins with rays. Many characters are used to distinguish cynoglossids from other flatfish, including myomere totals, pre- and post-anal myomere ratios, pectoral fin shape, fin ray counts, extent of gut protrusion, mouth size, eye size and shape, head spination, and pigment patterns.

Cynoglossid larvae hatch at <2.5 mm total length (*TL*), with the single known exception being *C. abbreviatus,* which measures between 3.18 and 3.45 mm *TL* upon emergence (Fujita *et al*. 1986). Newly hatched *C. abbreviatus* larvae possess a large yolk sac (also evident on a 3.4 mm *BL C. zanzibarensis* larva described here), with absorption being completed at 4.7–5.6 mm *TL*, eight days after hatching (Fujita *et al*. 1986). Leis and Trnski (1989) report that flexion takes place between 6.6 and 9.8 mm *BL* for Indo-Pacific cynoglossids, and Brownell (1979) showed that flexion was attained by 9.9 mm standard length (*SL* – tip of snout to point of notochord flexion) in *C. capensis*, slightly larger than the 7.8 mm *BL* observed here for *C. zanzibarensis*. Transformation and flexion occur at a larger size within the sub-family Symphurinae than in the Cynoglissinae (Fujita *et al*. 1986). The size at which eye migration is initiated in *C. zanzibarensis* (7.0 mm *BL*) is comparable with most other cynoglossid larvae, except *C. abbreviatus*, in which migration is initiated only at 11.2 mm *TL* (Fujita *et al*. 1986). Larvae of *C. capensis* and *C. zanzibarensis* can be distinguished by their unique pigment patterns, fin element counts in late flexion specimens (fewer in *C. capensis*), size at completion of flexion (larger in *C. capensis*), size at metamorphosis (smaller in *C. capensis*) and the number of elongate dorsal rays. *C. capensis* may have between two and four elongate anterior dorsal rays, whereas *C. zanzibarensis* has only two. In addition, the elongate dorsal rays appear at a smaller size in *C. zanzibarensis*. The majority of other tonguefish larvae have two elongate dorsal rays, like *C. zanzibarensis*, but *C. arel* has two or three, *C. monopus* has between two and four and all Symphurinae have four or five (Fujita *et al*. 1986). The only other cynoglossid species whose larvae could potentially be found within the study area is *Symphurus variegatus*. According to Heemstra (1986), adult *S. variegatus* are found off East London, but their fin count of D 93–100, A 88–95 differentiates them from those described here. The largest *C. zanzibarensis* measured in this study (15.1 mm *BL*) should still be considered a larva, even though eye migration and formation of the rostral hook appeared complete, because caudal fin ray development was incomplete and the pelvic fin still contained five elements. All other cynoglossid species have four pelvic rays at the metamorphosis and juvenile stages (Heemstra 1986, Leis and Trnski 1989).

ACKNOWLEDGEMENTS

I thank Rhodes University, the Foundation for Research and Development, the Marine Living Resources Fund, South African National Parks, Nestlé, and First National Bank for their financial support. I am grateful to the crew of Natpark *Aonyx*, Messrs J. Allen, K. Pieterse and J. Ndawo, and the crews of the F.R.S. *Africana* and F.R.S. *Algoa*. Special thanks are due to Ms E. Heemstra (South African Institute for Aquatic Biodiversity [SAIAB]) for her time and patience in educating me in the delicate art of larval illustration, and to Ms J. Wright (SAIAB) for her help with the staining and clearing of specimens. Dr P. D. Cowley (SAIAB) and Mr S. L. Brouwer (formerly Department of Ichthyology and Fisheries Science, Rhodes University; now Marine & Coastal Management [MCM]) are thanked for their comments on an earlier draft of this paper.

LITERATURE CITED

AHLSTROM, E. H., AMAOKA, K., HENSLEY, D. A., MOSER, H. G. and B. Y. SUMIDA 1984 — Pleuronectiformes: development. In *Ontogeny and Systematics of Fishes*. Moser, H. G., Richards, W. J., Cohen, D. M., Fahay, M. P., Kendall, A. W. and S. L. Richardson (Eds). *Am. Soc. Ichthyol. Herpetol., Spec. Publ.* **1**: 640–670.

ANDERS, A. S. 1975 — Pilchard and anchovy spawning along the Cape east coast. *S. Afr. Shipp. News Fishg Ind. Rev.* **30**(9): 53, 55, 57.

BECKLEY, L. E. 1985 — Tidal exchange of ichthyoplankton in the Swartkops Estuary mouth, South Africa. *S. Afr. J. Zool.* **20**(1): 15–20.

BECKLEY, L. E. 1986 — The ichthyoplankton assemblage of the Algoa Bay nearshore region in relation to coastal zone utilization by juvenile fish. *S. Afr. J. Zool.* **21**(3): 244–252.

BECKLEY, L. E. 1993 — Linefish larvae and the Agulhas Current. In *Fish, Fishers and Fisheries. Proceedings of the Second South African Marine Linefish Symposium, Durban, October 1992*. Beckley, L. E. and R. P. van der Elst (Eds). *Spec. Publ. oceanogr. Res. Inst. S. Afr.* **2**: 57–63.

BROWNELL, C. L. 1979 — Stages in the early development of 40 marine fish species with pelagic eggs from the Cape of Good Hope. *Ichthyol. Bull., J. L. B. Smith Inst. Ichthyol.* **40**: 84 pp.

FUJITA, S., KITAJIMA, C. and G. HAYASHIDA 1986 — Induction of ovarian maturation and development of eggs, larvae and juveniles of the tonguefish, *Cynoglossus abbreviatus*, reared in the laboratory. *Japan. J. Ichthyol.* **33**(3): 304–315.

HARRIS, S. A. 1996 — Larval fish assemblages of selected estuaries and coastal systems in KwaZulu-Natal, South Africa. Ph.D. thesis, University of Zululand, South Africa: 208 pp. + References & Appendices I–V.

HEEMSTRA, P. C. 1986 — Cynoglossidae. In *Smiths' Sea Fishes*. Smith, M. M. and P. C. Heemsta (Eds). Johannesburg; Macmillan: 865–868.

LEIS, J. M. and T. TRNSKI 1989 — The Larvae of Indo-Pacific Shorefishes. Honolulu; University of Hawaii Press: 371 pp.

McPHAIL, A-S. 1997 — The Cape gurnard, *Chelidonichthys capensis*, a commercially exploited by-catch species in the South African hake-directed trawl fishery. M.Sc. thesis, Rhodes University, South Africa: 126 pp.

MEYER, M. and M. J. SMALE 1991 — Predation patterns of demersal teleosts from the Cape south and west coasts of South Africa. 2. Benthic and epibenthic predators. *S. Afr. J. mar. Sci.* **11**: 409–442.

OLIVAR, M-P. and J-M. FORTUÑO 1991 — Guide to ichthyoplankton of the southeast Atlantic (Benguela Current Region). *Scientia Mar., Barcelona* **55**: 1–383.

POTTHOFF, T. 1984 — Clearing and staining techniques. In *Ontogeny and Systematics of Fishes*. Moser, H. G., Richards, W. J., Cohen, D. M., Fahay, M. P., Kendall, A. W. and S. L. Richardson (Eds). *Am. Soc. Ichthyol. Herpetol., Spec. Publ.* **1**: 35–37.

POWLES, H. and D. F. MARKLE 1984 — Identification of larvae. In *Ontogeny and Systematics of Fishes*. Moser, H. G., Richards, W. J., Cohen, D. M., Fahay, M. P., Kendall, A. W. and S. L. Richardson (Eds). *Am. Soc. Ichthyol. Herpetol., Spec. Publ.* **1**: 31–33.

ROEL, B. A. and E. MACPHERSON 1988 — Feeding of *Merluccius capensis* and *M. paradoxus* off Namibia. *S. Afr. J. mar. Sci.* **6**: 227–243.

SHELTON, P. A. and F. KRIEL 1980 — Surface drift and the distribution of pelagic-fish eggs and larvae off the south-east coast of South Africa, November and December 1976. *Fish. Bull. S. Afr.* **13**: 107–109.

SMALE, M. J. and A. BADENHORST 1991 — The distribution and abundance of linefish and secondary trawlfish on the Cape south coast of South Africa, 1986–1990. *S. Afr. J. mar. Sci.* **11**: 395–407.

TILNEY, R. L. and C. D. BUXTON 1994 — A preliminary ichthyoplankton survey of the Tsitsikamma National Park. *S. Afr. J. Zool.* **29**(3): 204–211.

TILNEY, R. L., NELSON, G., RADLOFF, S. E. and C. D. BUXTON

1996 — Ichthyoplankton distribution and dispersal in the Tsitsikamma National Park marine reserve, South Africa. *S. Afr. J. mar. Sci*. **17**: 1–14.

WHITFIELD, A. K. 1989 — Ichthyoplankton in a southern African surf zone: nursery area for the postlarvae of estuarine associated fish species? *Estuar. coast. Shelf Sci*. **29**(6): 533–547.

WOOD, A. D. 1998 — A contribution towards the taxonomy of the ichthyoplankton species community and an understanding of its dynamics along the south-east coast of South Africa. Ph.D. thesis, Rhodes University, South Africa: 338 pp.