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EGGS AND LARVAE OF THE SANTER *CHEIMERIUS NUFAR* (PERCIFORMES: SPARIDAE) FROM KWAZULU-NATAL, SOUTH AFRICA

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The santer *Cheimerius nufar* is a common reef fish on the east coast of South Africa and a popular target for offshore anglers. The eggs and larvae are described from specimens reared in the laboratory, from aquarium-spawned eggs and eggs collected at sea. Comparisons with eggs and larvae of other local sparids are made and data are presented on the seasonal occurrence of santer eggs in plankton samples.

The santer *Cheimerius nufar* (Ehrenberg, 1830) is a sparid of moderate size that lives in the western Indian Ocean, including the Red Sea, Persian Gulf, coast of Oman, east coast of Africa, Madagascar and the Mascarene Islands (Bauchot and Smith 1984, Smith and Smith 1986, Randall 1995). It occurs to a depth of about 200 m along the coast of KwaZulu-Natal (PAG, pers. obs.), where it is more commonly known as the "soldier" and it comprises about 7% of reef-fish catches made by anglers (Marine and coastal Management, unpublished data). It can attain a total length of 75 cm and a mass of 6 kg, but most santer in catches are between 1 and 3 kg. The breeding season off KwaZulu-Natal is from June to November, with peak spawning between August and October (Garratt 1985); off the Western and Eastern Cape, santer spawn during summer (Gilchrist 1916, Coetzee 1983). As spawning has also been recorded from the Gulf of Aden (Druzhinin 1975), it has been suggested that santer breed along the entire east coast of Africa (Garratt 1985).

Development of eggs and larvae has been described for several inshore sparid species from the KwaZulu-Natal coast (Brownell 1979, Beckley 1989), but there are no descriptions of the larvae of offshore species. This paper describes and illustrates the development of *C. nufar* eggs and larvae derived from fertilized aquarium-spawned eggs and from plankton net hauls off the south coast of KwaZulu-Natal. Data are also presented on the seasonality of *C. nufar* eggs off the south coast of KwaZulu-Natal.

MATERIAL AND METHODS

The major source of santer eggs for this study was the main display tank at Sea World, located on the beach front in Durban. The surface of this tank is exposed to indirect sunlight during the day and to weak artificial illumination at night. The temperature in the tank remained within 1°C of surf temperatures throughout the year. Spawning of santer in the tank was spontaneously within half an hour of sunrise and ranged from 05:00 to 06:50 local time during the months July through October (Garratt 1991). The first egg collections were made in September 1987, using a plankton net of 300-µm mesh, towed through the surface waters of the tank at 08:00–08:30. Eggs were reared in 50-ℓ glass aquaria containing seawater at 20–23°C, with light aeration and a single fluorescent light above each aquarium. The initial food supplied was the rotifer *Brachionus plicatilis*; the water in the aquarium was maintained a light green colour from an outdoor culture of *Chlorella* sp. Later, rotifers were supplemented with newly hatched nauplii of *Artemia* sp. and copepods from plankton hauls at sea. At Sea World, 75- and 110-ℓ aquaria were used for rearing, as described by Garratt *et al*. (1989).

At sea, fish eggs were usually collected passively from an anchored boat off Park Rynie (30°20´S, 30°44´E) on the KwaZulu-Natal south coast. A D-shaped plankton net, with a 40 cm bar and 300-µm mesh, was used. The net was designed to float with the bar skimming the surface, and the centre of the arch weighted to keep the mouth vertical in the water as the net was towed. Towing duration was 10 minutes. The volume of water filtered (measured for 48 of the approximately 500 samples processed) ranged between 23 and 108 m^3 (mean = 53 m^3). All samples were taken 4–5 km offshore, in depths ranging from 30 to 60 m. Sampling was conducted between 10:00 and midday.

Eggs were transported to the laboratory in sealed 25-ℓ buckets containing seawater. After concentration into glass dishes, eggs were sorted into "species" (or

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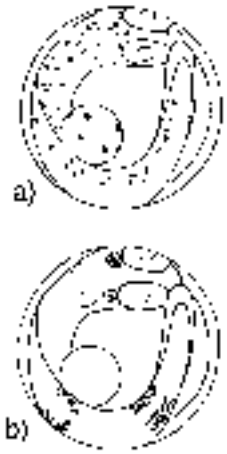

Fig. 1: A 24 h egg of *Cheimerius nufar* (0.80 mm in diameter) – (a) melanophore pattern, (b) xanthophore pattern; RUSI 56119

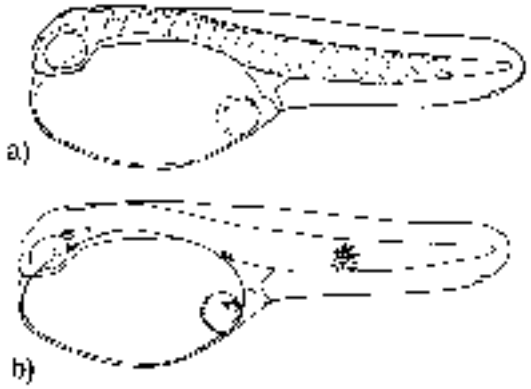

Fig. 2: *Cheimerius nufar* larva at 36 h (*BL*=2.1 mm fresh, 2.0 mm preserved); RUSI 56118. Stellate melanophores are dorsally located along the body – (a) melanophore pattern, (b) xanthophore pattern

groups of similar species) under the microscope and placed in 500-mℓ glass bowls containing clean seawater for hatching. Large batches of eggs, suitable for further rearing attempts, were placed in 50-ℓ tanks as described above. Positive identification of *C. nufar* eggs was achieved by rearing the larvae to recognizable juveniles and by comparing eggs with those collected from the spawning of *C. nufar* in the tank at Sea World.

Drawings were made from preserved specimens with the aid of a stereomicroscope fitted with a *camera lucida* drawing device. Xanthophore diagrams were made from photographs of anaesthetized fish. Live specimens were anaesthetized with MS-222 and photographed in shallow watch-glass dishes using a 35 mm SLR camera mounted on the microscope. Larvae were photographed on both black and white backgrounds, the former to highlight the xanthophores and the latter for the melanophores. There was some difficulty in differentiating between xanthophores and melanophores on a single monochrome (black ink) drawing, so, where the two pigments were present, they are shown on separate drawings.

Table I: Morphometric data of *Cheimerius nufar* larvae and juveniles expressed as a percentage of body length

Body length (mm)	*n*	% of body length				
		Body depth	Head length	Snout length	Eye diameter	Preanal length
2.0–2.9	5	27	19	3.8	7.6	35
3.0–3.9	3	28	22	6.2	9.3	41
4.0–4.9	3	25	25	7.5	9.1	48
5.0–5.9*	1	25	25	9.6	9.6	48
7.0–7.9	1	33	36	10.5	13.1	59
8.0–8.9	3	39	41	11.7	15.2	65
9.0–9.9	2	37	37	9.5	12.7	63
10.0–10.9	2	39	37	13.2	14.1	61
11.0–11.9	2	35	38	11.6	13.3	63
12.0–12.9	3	37	39	10.5	13.0	63
13.0–13.9	2	41	41	13.5	12.7	65
14.0–14.9	2	37	36	10.8	13.2	63
17**	1	39	38	11.4	12.6	62
19**	1	41	42	15.2	12.1	64
21**	1	36	37	9.7	13.0	62

* = Flexion
** = Juveniles

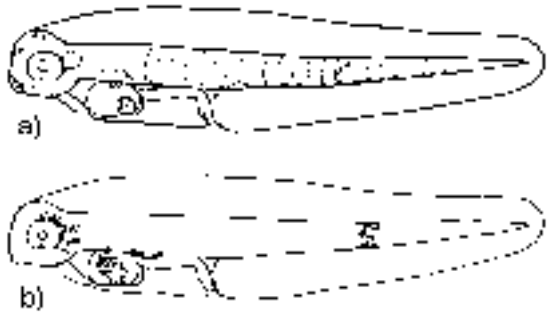

Fig. 3: *Cheimerius nufar* larva at 48 h (*BL*=2.8 mm fresh, 2.5 mm preserved); RUSI 56120. Stellate melanophores were scattered over the body as they migrated ventrally – (a) melanophore pattern, (b) xanthophore pattern

Fig. 4: *Cheimerius nufar* larva at 72 h (*BL*=3.2 mm fresh, 2.7 mm preserved); RUSI 56121– (a) melanophore pattern, (b) xanthophore pattern

All the material used in this study was preserved in neutralized 5% formalin and then transferred to 70% ethanol. The samples are kept at the J.L.B. Smith Institute of Ichthyology, South Africa, under the catalogue numbers RUSI 56118 – 56894. Three juveniles (RUSI 54042: 2 specimens and RUSI 28380) were x-rayed for vertebral counts.

Terminology and body measurements of larvae follow Leis and Trnski (1989), except that their "inner" and "outer preopercular spines" are designated here as spines on the preopercle ridge and preopercle edge respectively. Measurements of body length and various body parts for the larvae were taken with an ocular micrometer. Body lengths (*BL*) of specimens are of notochord length for preflexion and flexion larvae, and standard length for postlarvae. Lengths of fresh specimens were measured on anaesthetized larvae or before they were fixed in formalin; preserved specimens were measured after (at least) 24 h in formalin. Some specimens were cleaned and stained for bone and cartilage using the methods of Potthoff (1984). All references to age (hours or days) include the egg stage, unless indicated by DAH (days after hatch). The last dorsal and anal fin rays are split to the base, but counted as a single ray, because they are serially associated with a single pterygiophore.

RESULTS AND DISCUSSION

Egg and embryo development

The fresh (newly spawned) egg was spherical and 0.78–0.95 mm in diameter, with a smooth chorion, clear unsegmented yolk, narrow perivitelline space, and usually a single oil globule (0.17–0.19 mm in diameter). Some eggs occasionally had a second (much smaller) oil globule. In fresh eggs, the oil globule was distinctly pink when the transparent egg is viewed on a white background. This aided in distinguishing *C. nufar* eggs from other eggs in the sample. In addition, this was one of the very few species whose eggs were usually collected fresh (before the embryo was visible), suggesting early morning spawning, as found in the Sea World tank (Garratt 1991).

The embryo was clearly visible in the egg at 9 h (21°C), and the oil globule was clear to light amber. Tiny melanophores covered the embryo evenly and sparse stellate melanophores were present on the underside of the oil globule (as seen in the buoyant position, with the oil globule dorsally).

At 24 h (Fig. 1a), the melanophore pattern of the embryo intensified, and three zones of xanthophores were visible: a pair of greenish-yellow spots, one behind each eye, each comprising 6-8 dots; second, a yellow patch on the midtrunk region and third, a patch of yellow dots midtail. The latter two patches appeared initially as lines of greenish-yellow dots, the midtrunk patch of two lines of 12–15 dots each and the midtail patch consisting two lines of 15–20 dots each. These lines of dots became consolidated into the patches seen in the newly hatched larva. Just before hatching, the midtrunk patch became associated with the oil globule and spread over the oil globule dorsally (Figs 1a, 2b). Hatching occurred at 30–33 h (21°C).

Larval development

GENERAL MORPHOLOGY

Morphometric data for *C. nufar* larvae 2.0–5.9 mm *BL*, postflexion larvae 7.0–19.9 mm *BL* and three juveniles 17–21 mm *BL* are given in Table I.

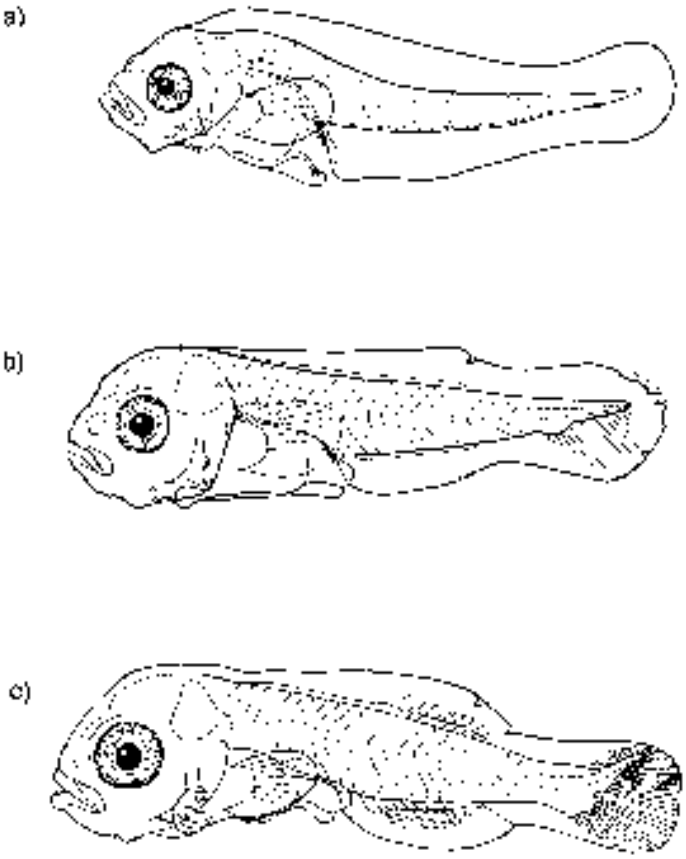

Fig. 5: *Cheimerius nufar* larva at (a) 6 days (*BL*=3.8 mm fresh, 3.5 mm preserved), RUSI 56122 – all yellow pigment has disappeared and black pigment is much reduced; (b) 14 days (*BL*=4.8 mm preserved), RUSI 56123 – dark pigmentation has intensified, particularly over the gut; (c)17 days (*BL*=5.9 mm fresh, 5.5 mm preserved), RUSI 56124 – drawn from a faded, preserved specimen

In the 2.0 mm newly-hatched larva (Fig. 2), the eyes were unpigmented and the lens was barely discernible. In the 2.5 mm larva (Fig. 3), the eye was pigmented, the lens distinct and the otic capsule was round and larger than the eye lens; yellow pigment was more obvious, but not fully developed at 72 h (2.7 mm, Fig 4). The mouth was not formed in the 2.0 and 2.5 mm larvae, but the mouth was open in the 2.7 mm larva. In the newly hatched larva (Fig. 2), the yolk sac was three times the size of the head, with the oil globule at the rear of the yolk. In the 2.5 mm larva (Fig. 3), the yolk sac was about the size of the head and the posterior part of the gut extended to the edge of the ventral fin fold. In the 2.7 mm larva (Fig. 4) – preserved for several years (fresh length probably 3.2 mm), the yolk sac was as large as the eye; the posterior part of the gut curved down to the edge of the ventral fin fold, with a small gap posterior to the rectum. The yolk sac was fully absorbed, the gut well developed and the critical first-feeding stage was reached at an age of 6 days (3.5 mm, Fig. 5a).

Flexion commenced at 14 days (4.8 mm, Fig. 5b) and was completed by 21 days (5.7 mm, Fig. 6a).

There were 24 myomeres. Preflexion larvae (2.0–4.8 mm preserved larvae) had 8–10 preanal myomeres. Flexion and postflexion larvae had 9–11 preanal myomeres. Vertebral counts for three juveniles totalled 24 (10 abdominal and 14 caudal vertebrae), including the terminal vertebral element.

The 3.5 mm larva (Fig. 5a), and other santer larvae up to 6 mm (e.g. Fig. 5b), had a crenulate dorsal head profile (in lateral view), formed by two transverse depressions in the front of the cranium. This crenulate head profile was not apparent on a preserved 8.5 mm

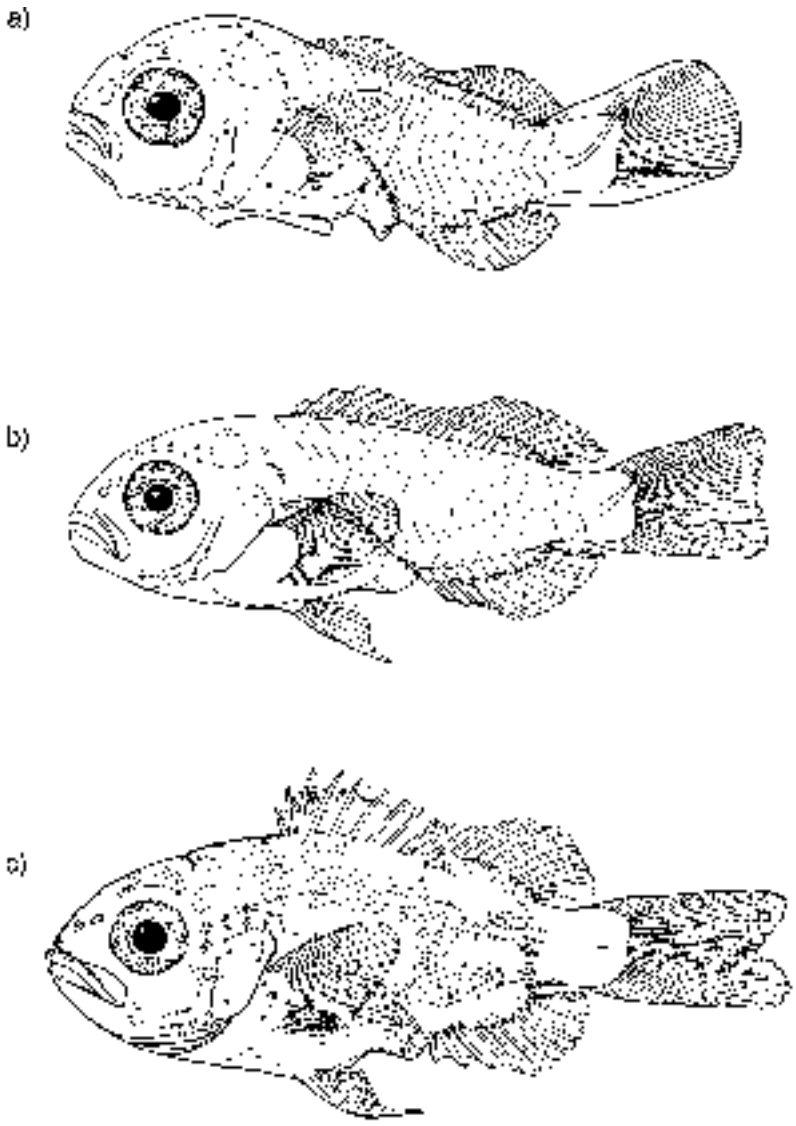

Fig. 6: *Cheimerius nufar* larva at (a) 21 days (*BL*=5.7 mm preserved), RUSI 56125; (b) 30 days (*BL*=8.5 mm preserved), RUSI 56126; (c) 32 days (*BL*=11.0 mm; fin count D XI,11, A III,8), RUSI 56127 – scales not shown

larva (perhaps obscured by the thicker opaque skin and muscles of this larger specimen, Fig. 6b). The gas bladder (Fig. 5b) remained inconspicuous throughout development and was clearly visible in only four preserved specimens.

The lower jaw protruded well in front of the upper jaw in the 2.7 mm larva (Fig. 4) and protruded slightly at 3.5 mm (Fig. 5a). The jaws were equal in the 4.8 mm larva (Fig. 5b) and in larger larvae. Minute teeth were visible on the front of the lower jaw from 5.5 mm. Nares were differentiated in larvae of 7.5–8.0 mm (Fig. 6b).

Transformation to the juvenile stage was at 40–47 days, at a body length of 17–19 mm.

HEAD SPINATION

Spines were not visible on the head of larvae < 3.0 mm.

The preopercle spines were the first to appear, with three distinct spines on the preopercle edge and two small spines on the preopercle ridge of the 3.5 mm larva (Fig. 5a). The 4.8 mm preflexion larva (Fig. 5b) had a large spine at the posterior end of the lower limb of the preopercle edge, preceded by a moderate spine, which was preceded by a small spine. There was also a small spine on the middle of the upper limb of the preopercle edge and four minute spines on the preopercle ridge; the interopercle of this larva had a small spine just posterior to the large preopercle spine. At flexion (Fig. 5c), there was one large spine and three moderate spines on the edge of the preopercle, three minute spines on the preopercle ridge and one small interopercle spine (as in the preflexion larva). The preopercle spines of the slightly larger (5.7 mm) postflexion larva (Fig. 6a) were well developed, with six large and two small spines on the preopercle edge and four on the ridge; there were also two small interopercle spines on this larva. The 8.5 mm larva (Fig. 6b) had 10 small spines on the preopercle edge, two small spines on the preopercle ridge and two small interopercle spines. The 11 mm larva (Fig. 6c) had 13 small spines on the preopercle edge, four minute spines on the preopercle ridge, five small spines on the interopercle and a small spine on the subopercle.

Two small supracleithral spines were present on each side of the head of the 4.8 mm larva (Fig. 5b); a minute pterotic spine was visible on the right side of the head of this preflexion larva, but it could not be seen on the left side; pterotic spines were not apparent on the larger larvae that were examined. The 5.5 mm flexion larva (Fig. 5c) also had two supracleithral spines on each side, and the 8.5 mm larva (Fig. 6b) had five small supracleithral spines.

A small post-temporal spine was visible dorsal to the supracleithral spines of the 5.7 and 8.5 mm postflexion larvae (Figs 6a b). The 11 mm larva (Fig. 6c) had four supracleithral spines and one post-temporal spine; the opercle of this larva ended in a flat point. The opercle strut of a 17 mm juvenile ended in a flat point on the left side and in a rudimentary spine on the right opercle; the edges of the preopercle, interopercle and subopercle had several weak (flexible) serrae. The 19 mm juvenile also had a flat point (right hand side) or small spine (left hand side) at the rear tip of the opercle. Juveniles of 20–21 mm had the preopercle edge smooth or with a few minute weak serrae, no serrae on the preopercle ridge and 0–3 interopercle serrae.

FIN DEVELOPMENT

No pectoral fin buds were visible on the 2.0 mm yolk-sac larva, but the 2.7 mm larva had pectoral fin buds (without visible rays). The 3.5 mm larva (Fig. 5a) had a few faint (poorly differentiated) rays on the fan-shaped pectoral fins, and the ventral pectoral-fin rays were poorly developed (indistinct) on the 5.7 mm larva. The full complement of 16 pectoral fin rays were present on the 11 mm larva.

Several caudal fin anlagen were visible ventral to the posterior end of the notochord of the 4.8 mm preflexion larva (Fig. 5b) and hypural anlagen and most caudal fin rays were visible on the 5.5 mm flexion larva (Fig. 5c). Segmentation was discernible on the caudal rays of the 5.7 mm postflexion larva (Fig. 6a) and the full complement of principal caudal rays (9+8) was present on the 8.5 mm larva (Fig. 6b).

Dorsal and anal fin anlagen were just beginning to form in the 4.8 mm larva and were present as distinct (countable) elements on the 5.5 mm flexion larva (Fig. 5c). A full complement of dorsal and anal fin elements (D XI,10; A III,9) were developed in the 5.7 mm postflexion specimen (Fig. 6a), but segmentation was not visible on the dorsal or anal fin rays; the posterior margins of the dorsal and anal fins were separate from the median fin fold. The posteriormost dorsal and anal fin spines were clearly differentiated from the segmented rays on the 8.5 mm larva (Fig. 6b), with the third anal fin spine having developed initially as a soft ray (Fig. 6a).

Although the pelvic fins are the last fins to form in the santer, they develop quickly. A small pelvic fin bud (flap of skin) was situated midway between the cleithral symphysis and the anus of the 5.7 mm larva. The pelvic fins of the 8.5 mm larva (Fig. 6b) already reached the anus, with the spine somewhat differentiated from the five soft rays, and the first soft ray was elongated and unbranched. In the 11 mm larva (Fig. 6c), the proximal four pelvic fin rays were branched and segmented; the first ray was unbranched, segmented and reached the base of the third anal fin spine.

SCALE DEVELOPMENT

Scales were beginning to form in the midlateral region of the body on the 8.5 mm larva. Ctenoid scales completely cover the body and the opercle, and the lateral line was complete on the 11 mm larva. There were ctenoid scales on the cheek of the 17 mm juvenile.

PIGMENTATION

Melanophore migration to the ventral position along the body of the larva is rapid. At hatch, most melanophores were confined to a series running along the dorsal surface of the body (Fig. 2), but before the yolk sac is fully absorbed and before eye

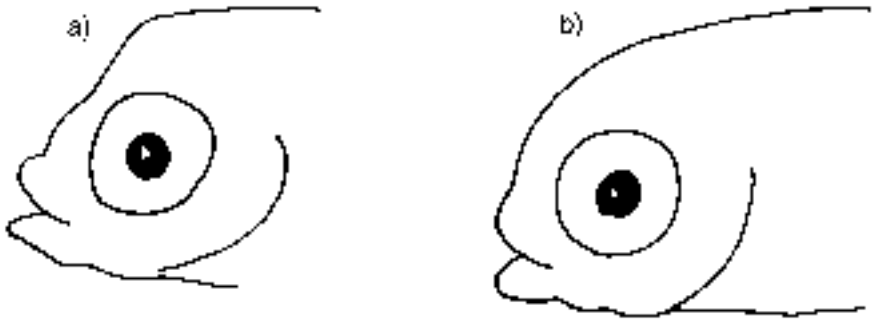

Fig. 7: Head profiles of 5-day old larvae of (a) *Cheimerius nufar* and (b) *Chrysoblephus puniceus*

pigment develops, the melanophores move to the ventral surface of the body. At 48 h, some melanophores occupied an intermediate position laterally on the body, but by 72 h (Fig. 3), most were ventral. At 3.5 mm (Fig. 5a), the dorsal surface of the gut was covered with minute melanophores, and there was a black spot on the ventral surface of the gut just anterior to the anus. There was also a small spot at the side of the lower jaw, two dots in the temporal region, one at the dorsal end of the preopercle, three dots in a row posterior to the otic capsule and a series of 3–5 melanophores on the cleithral symphysis. At 14 days (4.8 mm), gut pigmentation was particularly heavy (but not obvious in the drawing of the faded, preserved larva, Fig. 5b). Unfortunately, most of the melanophores of the larger, preserved larvae (Figs 5b, c and 6a, b) had faded during several years of storage in formalin. At 47 days (18 mm), the juvenile appeared similar to the adult, with five faint, dark vertical bars visible on the body.

On hatching, the three larger xanthophore patches described above for the 24 h embryo (Fig. 1) were constant and characteristic. In dorsal view, the eye and midtail patches were paired, as seen in the egg (Fig. 1). In addition, some specimens had one or two yellow dots in the nasal or preorbital region. In 20 specimens, zero, one and two dots were noted in eight, eight and four specimens respectively. Some specimens also had a single xanthophore dot on the cheek and/or yolk and/or midtrunk region. Generally, however, there were only two or three xanthophore spots on a larva. At 48 h, the shrinking yolk caused the xantho-phore over the gut to split away from that associated with the oil globule. At 72 hours (2.7 mm, Fig. 4), the xanthophores posterior to the eyes and on the oil globule became stringy, and with the shrinking of the yolk sac, they almost coalesced. All xanthophores disappeared by the sixth day (3.5 mm, Fig. 5a).

Comparisons with similar larvae of sympatric species

Of a total of 38 sparid species that occur off KwaZulu-Natal, the larvae and early juveniles of only several species have been described in the literature.

Argyrozona argyrozona (Valenciennes, 1830) – The eggs of *A. argyrozona* (Gilchrist 1916, Davis and Buxton 1996) are of similar size to that of santer eggs, and the larva was reported by Gilchrist (1916) to have three patches of greenish-yellow pigment. Davis and Buxton (1986) did not note fresh chromatophores on the larvae, but the preflexion larvae they described and illustrated (their Figs 1b, c) lacked cranial melanophores, whereas santer larvae at that stage have melanophores over the front of the head. The spines on the head and supracleithrum of *Argyrozona* develop later (at a larger size) than they do in santer, and the 8.6 mm larva of *Argyrozona* illustrated by Davis and Buxton (1996) did not show the elongated first pelvic fin ray that was apparent on the 8.5 mm santer larva examined in this study.

Diplodus cervinus (Smith, 1844) – The 3.9 mm preflexion larva and 7.4 mm postflexion larva of *D. cervinus* illustrated by Brownell (1979, Figs 96, 97) are much more densely pigmented over the trunk and rear of the head than are santer larvae of similar size. The 3.5 and 4.8 mm preflexion santer larvae are more robust (body depth [*BD*] = 25–28% *BL*) than a 4.3 mm *D. cervinus* larva (*BD* = 20% *BL*). Preflexion santer larvae have prominent head spines, but the 3.3 and 3.9 mm larvae of *D. cervinus* illustrated by Brownell (1979) have no head spines. Development of the dorsal and anal fins is completed at a smaller size in santer (5.7 mm) than in *D. cervinus* (> 7.4 mm).

Diplodus sargus (Smith, 1844) – The eggs and yolk-sac larvae of *D. sargus* illustrated by Brownell (1979, Figs 98–101) show much more xanthophore pigmentation than santer eggs and larvae, and the

postflexion larva (32 DAH) is more densely covered with melanophores. The 2.9 and 4.5 mm preflexion *D. sargus* larvae (Brownell 1979, Figs 102–103) are more elongate (*BD* = 13–19% *BL*) than 2.7 and 4.8 mm santer larvae (*BD* = 25–27% *BL*), and the 4.5 mm *D. sargus* larva has no head spines (possibly overlooked, because they are small and inconspicuous), whereas santer larvae of 3.5 and 4.8 mm have prominent preopercle spines. Development of the dorsal and anal fins is complete at a smaller size in santer (5.7 mm) than in *D. sargus* (> 8.0 mm).

Chrysoblephus puniceus (Gilchrist & Thompson, 1908) – In the present study, the species most similar in size of egg and appearance of eggs and larvae was *C. puniceus*. Eggs of *C. puniceus* and santer could not be separated in the plankton, because they both have a pink oil globule when fresh and are of the same size range. Flexion and early postflexion santer larvae share with *C. puniceus* larvae the characteristics of a relatively spiny head with crenulate cranium (frontals), robust body and little or no gap between anus and anal fin. Late flexion larvae of *C. puniceus* and santer have the first pelvic fin ray elongate. Newly hatched *C. puniceus* larvae have more scattered xanthophores in the region behind the eyes. In addition, at the 3–5 day stage, the more-rounded forehead and snout distinguish santer from *C. puniceus* (Fig. 7). Preflexion larvae of *C. puniceus* have melanophores dorsally on the midbrain, several spots on the midbrain and a ventral series starting with a large blotch below the pectoral bases, and three more in a row on the isthmus. There is also a spot on the anterior edge of the anus and the gut is more heavily pigmented dorsally than in preflexion santer larvae. Postflexion *C. puniceus* larvae have the forebrain and snout pigmented. There is a band of pigment spots laterally along the body midline, starting under the fifth dorsal spine and extending to beyond the last dorsal ray, and a series of dots along the rear part of the dorsal fin base and extending onto the caudal peduncle. The prominent ventral melanophores on the gut are still present. Internally, the dorsal surface of the gut is heavily pigmented. In general, preserved larvae of *C. puniceus* tend to be more heavily pigmented than are santer larvae.

Gymnocrotaphus curvidens Günther, 1859 – The 5.4 mm larva of *G. curvidens* illustrated by Brownell (1979, Fig. 106) is similar to santer larvae of the same size, but it has a deeper body (*BD* = 37% *BL* v. 25% *BL* in santer) and the pelvic fins are better developed in the *G. curvidens* larva (pelvic fins were not apparent in santer < 6 mm). Larger larvae can be separated by dorsal and anal fin counts.

Lithognathus mormyrus (Linnaeus, 1758) – Although similar in size to santer eggs, the eggs of *L. mormyrus* (Brownell 1979) can be distinguished by the xanthophore pattern of the embryo and newly hatched larva. The 3.4 mm preflexion larva of *L. mormyrus* (Brownell 1979, Fig. 113) lacks the prominent propercle spines found on the 3.5 mm santer larva (Fig. 5).

Pachymetopon blochii (Valenciennes, 1830) – The eggs of *P. blochii* are larger (1.06–1.28 mm) than santer eggs, and the embryo has xanthophores anterior to the eyes (Brownell 1979, 16 DAH and Fig. 116) which are lacking in santer embryos. Preflexion larvae of *P. blochii* lack head spines (Brownell 1979, 20 DAH, Figs 120, 121).

Spondyliosoma emarginatum (Cuvier, 1830) – The smallest preflexion larva of *S. emarginatum* (2.7 mm) illustrated by Beckley (1989) does not show melanophores on the front of the head, whereas melanophores are present on the front of the head of the 2.5 mm santer larva examined here (Fig. 3). The preopercle spination of *S. emarginatum* larvae is weaker than that of santer larvae, and Beckley (1989) does not mention or illustrate any other spines on the head of the *S. emarginatum* larvae she examined. Her figures show the front head profile of *S. emarginatum* preflexion larvae as smooth or with a single indentation (versus crenulate in santer larvae).

Brownell's "Species 5" (1979, Fig. 180) – The egg is similar in size to santer eggs and the xanthophore pattern on the yolk-sac larvae is also similar to yolk-sac larvae of santer. However, these larvae are more elongate than santer larvae, and the 16 DAH (3.9 mm) larva of Brownell's "Species 5" (Fig. 184) has a dense patch of melanophores dorsally at the middle of the tail, which is absent in santer larvae.

Acanthopagrus berda (Forsskål, 1775), *Rhabdosargus sarba* (Forsskål, 1775), *R. holubi* (Steindachner, 1881) *and Crenidens crenidens* (Forsskål, 1775) – Larvae of these species differ from santer larvae in having weak head spination, a smooth anterior cranium profile, more slender body and moderate to large gap between anus and anal fin (ADC, pers. obs.). The xanthophore patterns of the embryos of these species also differ from that of santer embryos.

Spicara axillaris (Boulenger, 1900) (Family Centracanthidae) – Judging from the illustrations of Brownell (1979), the newly hatched larva of *S. axillaris* has a similar xanthophore pattern to that of santer. However, the larger yolk-sac larvae (2 and 4 DAH, 3.0 and 3.4 mm respectively, Brownell's Figs 88 and 89) have lost the xanthophore over the gut and have melanophores at the anterior end of the yolk, which are lacking in the 72 h (2.7 mm) santer larva examined here (Fig. 4). The larger (3.4 and 4.8 mm) preflexion larvae of *S. axillaris* (Brownell's Figs 90 and 91) lack the conspicuous preopercle spines of santer larvae. At 14 days

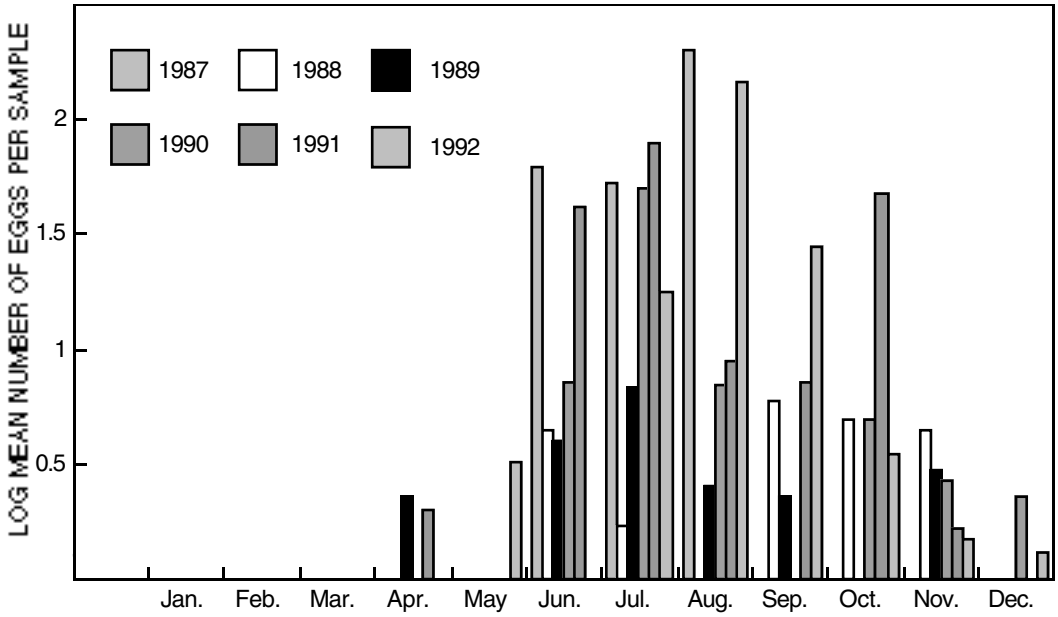

Fig. 8: Seasonal occurrence of *Cheirmerius nufar* eggs in plankton samples, mostly from the Park Rynie area on the KwaZulu-Natal south coast

(4.8 mm) santer larvae have a deeper (more robust) body and lack the prominent melanophores ventrally on the gut of the 16 DAH (4.8 mm) *Spicara* larva (Brownell, Fig. 91). Eggs of *Spicara* are larger (1.10–1.28 mm diameter, with an oil globule of 0.21–0.24 mm) than most sparid eggs.

Seasonal occurrence of *C. nufar* eggs

The occurrence of *C. nufar* eggs in the plankton for the period April 1987–December 1992 is shown in Figure 8. Eggs were usually first encountered in June of each year and occurred through to November. In 1987, samples were not collected from September to December because of flood conditions. All eggs were confirmed by hatching and later (3–4 days) examination of the larvae when the eyes were fully developed.

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