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Larval development of *Lesueurina* sp. (Teleostei: Leptoscopidae) with notes on the occurrence of the larvae in a south-western Australian estuary.

Francisco J. Neira* and Daniel J. Gaughan*

Abstract

The larval development of the leptoscopid, *Lesueurina* sp., is described and illustrated from material obtained from the lower Swan Estuary, in south-western Australia. The larvae examined (2.90-12.04 mm) are pelagic, have an elongate, slender body, a short head and gut and 42-48 myomeres. A prominent ventral melanophore on the tail, located between myomeres 29 and 35, is the most distinctive character of the pigmentation. Larvae settle on sandy bottoms at sizes over 13 mm, with all fins developed and formed fringe on the lips. The eyes are located laterally in larvae but migrate to a dorsal position sometime during settlement. Comparisons with similar taxa and the occurrence of the larvae in the Swan Estuary are also discussed.

Introduction

The trachinoid family Leptoscopidae occurs only in the Australasian region (i.e. Australia and New Zealand) and comprises three nominal genera with at least five species (Fowler 1907; Nelson 1984; Watson, Matarese and Stevens 1984; Last and Edgar 1987). In Australia, members of this family have a distribution extending from North Stradbroke Island in Queensland along the southern coast to south-western Australia and also around Tasmania (McCulloch 1915; Scott, Glover and Southcott 1980; Last, Scott and Talbot 1983). The genus *Lesueurina* is presently under review by P. Last (CSIRO, Tasmania) and some of its members appear to be undescribed, including the species from Western Australia which is the subject of the present study and which has been previously known as *Crapatalus arenarius* McCulloch, 1915. Adults of *Lesueurina* species, which are usually found buried in shallow sandy substrates off exposed coastal beaches, are characterized by their small size, elongated and compressed body, the anal fin base longer than that of the dorsal fin, dorsally positioned eyes and pale coloration. They attain a maximum length of 110 mm (Scott *et al.* 1980; Last *et al.* 1983).

Little is known of the reproductive biology of any of the leptoscopids and their eggs and larval stages have never been described in the literature (Watson *et al.* 1984). The gonads of a sandfish from Tasmania, *Lesueurina platycephala,* are well developed from October to March and running ripe between November and December (P. Last, pers. comm.)

This paper describes the larval development of *Lesueurina* sp. using material collected in a south-western Australian estuary. This also constitutes the first

*School of Biological and Environmental Sciences, Murdoch University, Murdoch, Western Australia, 6150.

description of the larval stages of a member of the family Leptoscopidae. Information on the occurrence and distribution of the larvae in the estuary is also presented.

Materials and Methods

Material Examined

A total of 52 larvae, ranging in body length from 2.90 to 12.04 mm, one transformed larva (14.41 mm BL) and one juvenile (26.00 mm BL) were analysed for pigmentation, morphometrics and meristics. Six larvae were deposited in the Australian Museum, Sydney, under the catalogue number I.26990-022.

Collection of Larvae

Larvae of *Lesueurina* sp. were obtained from surface plankton samples collected monthly during 1986 in the lower Swan Estuary (Lat 32°04'S; Long 115°44'E), in south-western Australia. Samples were collected at night using 0.5 mm mesh paired Bongo nets of 0.6 m in diameter. In addition, several juvenile and adult *Lesueurina* sp. were collected using a 3.0 mm mesh beach seine along the surf zone of a beach located outside the estuary. Samples were fixed in 10% formalin and specimens stored in 70% alcohol.

Measurements and Counts

Larvae of *Lesueurina* sp. were measured to the nearest 0.01 mm using a Wild M8 dissecting microscope fitted with an ocular micrometer. Terminology and body measurements of larvae follow Leis and Rennis (1983). All lengths except body length (BL, mm), i.e. the notochord length in preflexion and flexion larvae and the standard length in postflexion larvae, are expressed as a percentage of body length. Myomere counts and ray counts of paired fins were made on the left side of the body. Pigment refers to melanin. Drawings were done with the aid of a drawing tube.

Sixteen larval and four juvenile *Lesueurina* sp. were cleared and double-stained following the technique of Potthoff (1984), as modified from Dingerkus and Uhler (1977), to count fin rays and vertebrae and to determine the sequence of bone ossification. The term "ossified" refers solely to structures stained positively for bone.

Results

Identification

Postflexion larvae of *Lesueurina* sp. were identified by the following combination of characters, which are unique among Western Australian fishes: dorsal and anal fin counts of 32-34 and 37 respectively, the longer base of the anal fin than that of the dorsal fin and the thoracic position of the pelvic fins (McCulloch 1915). The series of larvae were linked together using body pigment, fin ray counts and myomere number.

Description of the larvae

Larvae of *Lesueurina* sp. are characterised by their elongate and slender body, a round and prominent head, a short, coiled gut and a dermal sac which in early larvae encloses most of the body (Figures 1,2). During growth, the head and trunk remain relatively short and the tail becomes laterally compressed and deeper. The smallest larva examined (2.90 mm), which was not in sufficiently good condition to provide a reliable illustration,

Table 1 Morphometric measurements for larval *Lesueurina* sp.. Body intervals are expressed as a percentage of body length. n, number of individuals. Means and standard deviations (in parentheses) are given when n > 1. Blanks indicate character is absent. Specimens indicated by * and ** correspond to a transformed larva and a juvenile respectively. Individuals between dashed lines were undergoing notochord flexion.

Body Length (mm)	n	Head Length	Head Width	Snout Length	Eye Diameter	Body Depth at Pectoral Fin Base	Preanal Length	Pre-Anal Fin Length	Pre-Dorsal Fin Length
2.90	1	20.78	17.20	3.44	6.89	17.20	27.60		
3.74	1	15.56	16.11	2.67	9.66	15.05	24.17		
4.00-4.50	2	16.30 (1.32)	11.17 (0.21)	3.57 (0.44)	7.15 (0.22)	14.90 (0.95)	21.67 (1.09)		
4.50-4.99	4	16.02 (0.62)	12.05 (0.73)	2.59 (0.53)	8.41 (0.36)	13.32 (1.15)	20.36 (1.39)		
5.00-5.49	7	15.52 (1.12)	13.25 (0.89)	2.85 (0.48)	8.09 (0.70)	16.54 (1.41)	21.90 (0.78)		
5.50-5.99	6	18.81 (3.10)	14.23 (1.56)	3.14 (0.71)	9.73 (1.31)	17.54 (1.20)	23.06 (2.29)		
6.00-6.49	6	22.19 (2.83)	14.33 (1.53)	3.82 (0.60)	9.62 (1.53)	17.84 (1.04)	27.17 (2.79)		
6.50-6.99	6	20.62 (2.58)	14.88 (1.03)	4.16 (0.90)	10.19 (1.26)	16.05 (2.79)	25.67 (2.27)		
7.00-7.49	6	20.59 (1.65)	14.41 (1.32)	4.02 (0.75)	9.55 (0.81)	15.68 (0.90)	24.90 (1.70)		
7.50-7.99	8	20.86 (2.18)	13.84 (1.06)	4.59 (0.56)	9.01 (0.82)	16.31 (1.53)	26.36 (2.78)		
8.20	1	19.51	13.41	4.88	8.53	17.68	25.60		
8.50-8.99	2	22.95 (0.12)	13.21 (0.20)	4.21 (0.22)	9.45 (0.02)	13.90 (0.43)	27.33 (0.39)	49.50 (6.31)	65.90 (5.93)
11.56	1	23.18	13.58	5.10	8.82	12.28	27.59	30.18	27.12
12.04	1	23.42	15.94	4.71	6.51	14.65	28.32	28.48	32.88
14.41*	1	22.55	14.08	4.78	6.25	14.08	29.28	29.84	30.95
26.00**	1	24.34	16.49	3.90	4.68	12.80	26.54	28.11	32.79

had no traces of a yolk sac. There are 42-48 myomeres (4-7+37-44, mean = 45.2; S.D. = 1.67; n = 40).

The head is initially compressed and becomes depressed and wider in juveniles. The relative length of the head increases from 15% in preflexion larvae to about 23% in postflexion larvae, whereas the relative width of the head remains about the same as that of the body depth throughout development (Table 1). There are no head spines. The premaxilla, maxilla and dentary form by 5.9 mm and are ossified by 12 mm. Small villiform teeth appear on the dentary and premaxilla by 6.0 mm. The fringe of cirri, which is a characteristic of the adults, are formed on the lips by 14 mm. During development, the snout remains short and the eye relatively large. While the eyes are still located laterally in the largest pelagic larvae examined, they migrate to a dorsal position at some stage before or during settlement. Scales are present in adults over 26.0 mm BL.

The gut remains short and coiled during development and the preanal length varies between 20 and 29% (Table 1). A small swim bladder is visible on the dorsal surface of the gut in all larval stages until it becomes obscured by the body wall in juveniles.

Notochord flexion commences by 6.0 mm and is complete by 8.2 mm (Table 1; Figures 1C, 2A). The vertebral elements, which start to differentiate from head to tail by 8.0 mm, are completely ossified by 12.0 mm. All neural and haemal arches ossify shortly afterwards. Forty five vetebrae were counted in those cleared and double-stained larvae in which the vertebrae were clearly developed.

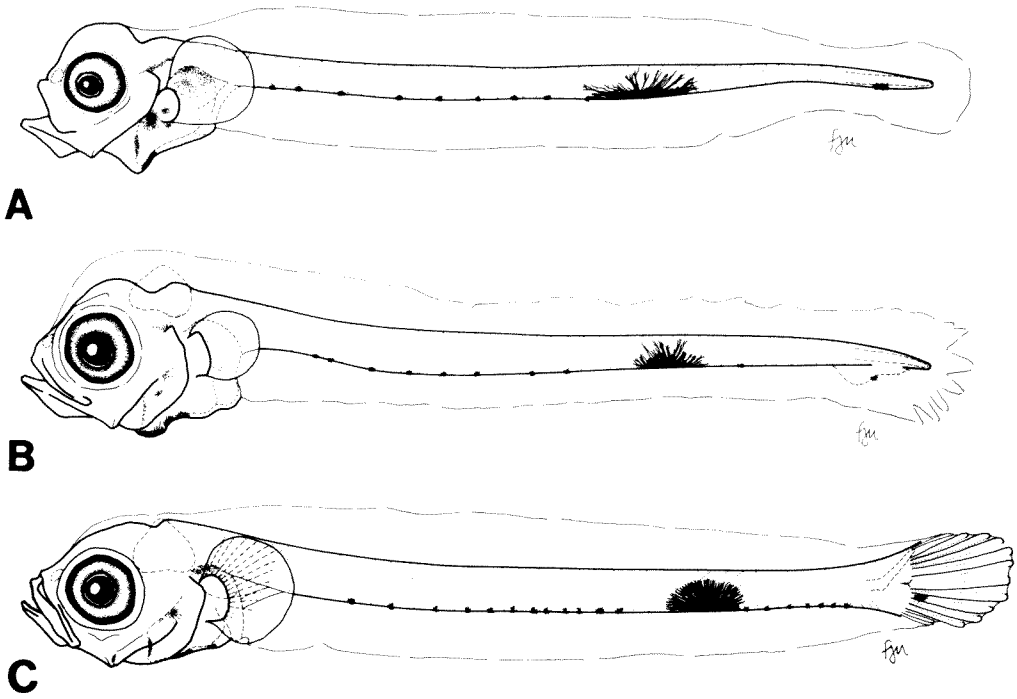

Figure 1 Larvae of the sandfish, *Lesueurina* sp., caught in the lower Swan Estuary in September 1986. (A) 4.47 mm larva. (B) 5.94 mm larva. (C) 7.43 mm larva.

Development of Fins

Preflexion larvae of *Lesueurina* sp. possessed pectoral fin buds. The pectoral fin rays start to form sequentially from dorsal to ventral by 7.0 mm and all 19-20 rays are formed by 8.2 mm. The rays of the caudal fin start to appear during notochord flexion and all 5+5 principal caudal fin rays, with 4/4 procurrent rays, are developed by 7.0 mm, i.e. before flexion is complete (Figure 1C).

The first rays of the anal fin appear on the posterior part of the tail by 8.3 mm. These form sequentially from tail to head and all 37 elements are present by 11.0 mm (Figure 2A, B). There is no gap between the anus and the origin of the fully formed anal fin. The first dorsal fin rays appear on the posterior part of the tail shortly after the formation of the first anal rays. These also form sequentially from tail to head and all 32-34 elements are present by 11.0 mm. Neither dorsal nor anal fins develop spines. Pelvic-fin buds are visible in the thoracic region at about 9.0 mm and all I,5 rays are formed by 11.0 mm (Figure 2C).

Pigmentation

Larvae of *Lesueurina* sp. remain lightly pigmented during development. In small preflexion larvae, only the eye and gut are pigmented and few melanophores are

present ventrally along the tail. A single melanophore at the angle of the jaw and one on the gular region appear at about 6.0 mm and 7.9 mm, respectively. Scattered melanophores appear on the snout, upper and lower jaws and opercular areas in larvae over 14.0 mm.

In all larvae, internal pigment is present on the dorsal surface of the gut and the swim bladder. A very conspicuous internal stellate melanophore is always present on the anterior surface of the peritoneum (Figures 1, 2). Pigment over this area intensifies during development and becomes obscured by the body wall in juveniles. A few scattered melanophores are also present externally on the ventral surface of the gut and these increase in number during development.

The dorsal and lateral surfaces of the trunk and tail remain unpigmented during most of development. A few scattered melanophores appear in these areas by 14 mm and a series of horizontal rows of fine dark spots along the trunk and tail are present in juveniles. Pigment on the ventral surface of the tail consists initially of a single row of 7-15 melanophores (Figure 1A). Throughout development, the number of

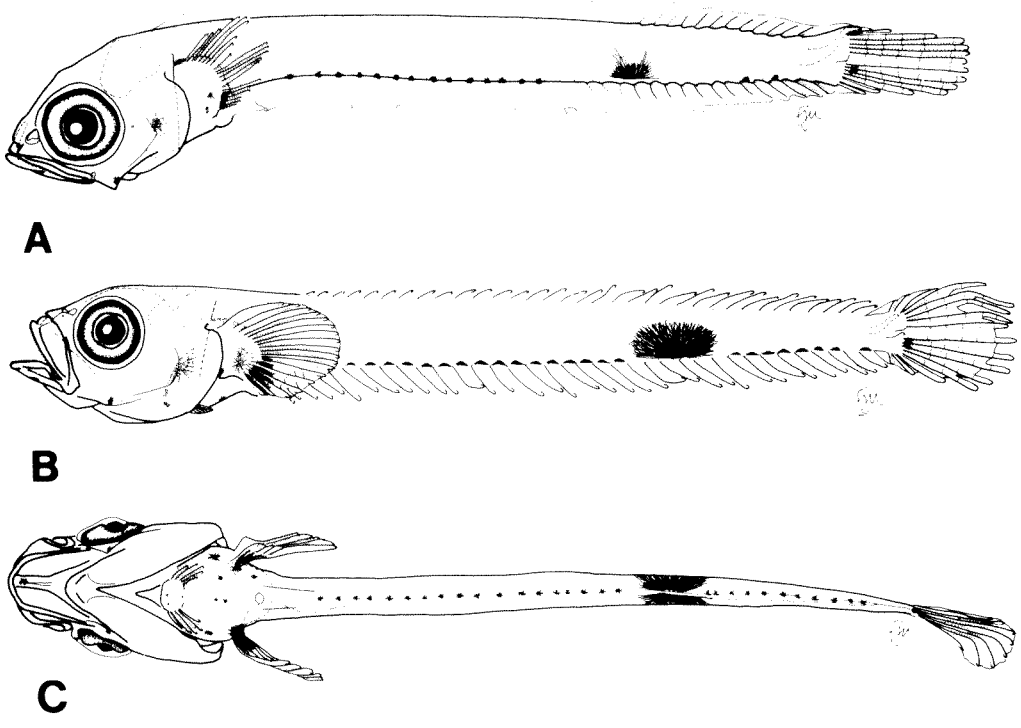

Figure 2 Larvae of the sandsfish, *Lesueurina* sp., caught in the lower Swan Estuary. (A) 8.76 mm larva. (B) 11.56 mm larva. (C) Ventral view of larva illustrated in B showing the thoracic position of the pelvic fins. The larvae illustrated in A and B were collected in October and August 1986 respectively.

melanophores increase along the ventral surface of the tail until they correspond to about one per myomere. In addition, there is one melanophore at the tip of the notochord. This caudal melanophore remains at the lower base of the caudal fin in postflexion larvae (Figure 2B). A very large and conspicuous melanophore, which extends dorsally to the midline, is present between myomeres 29 and 35 in the ventral surface of the tail in all larval *Lesueurina* sp. (Figures 1,2). This melanophore decreases in size by 14.0 mm and is no longer visible in juveniles.

Pigment appears on the internal surface of the lower half of the pectoral fin base by 7.8 mm. Pigment intensifies in this area by 8.5 mm and extends along the lower six pectoral fin rays by 11.0 mm (Figure 2, B & C). All other fins remain unpigmented.

Discussion

Larval Development

There are no published descriptions of the larval development of a leptoscopid in the literature (see Watson *et al.* 1984). Furthermore, there are no records of the reproductive biology of members of this Australasian family. Although the morphology and size of the spawned eggs of *Lesueurina* sp. are not known, all other trachinoid except species of the Trichodontidae, deposit single pelagic eggs and their larvae hatch in a poorly-developed stage at sizes between 2.2 and 4.4 mm (Watson *et al.* 1984). Considering that spawning mode, incubation period and development at hatching tend to be correlated, the size of the smallest *Lesueurina* sp. collected during this study (2.90 mm) suggest that this species, as with most trachinoid species with small newly-hatched larvae, also spawn pelagic eggs. By contrast, trichodontid fishes deposit a mass of demersal eggs and their larvae hatch at 14.7 mm after a period of incubation which last between two and 12 months (Breder and Rosen 1966; Watson *et al.* 1984).

The larval development of *Lesueurina* sp. is consistent with that of other trachinoid fishes that have an elongate and slender body (Watson *et al.* 1984). Larval *Lesueurina* sp., as in all described trachinoid larvae, are also pelagic, do not pass through specialized stages and gradually transform into the demersal juvenile at a length greater than 13.0 mm. Trachinoid families share some characters with the suborder Percoidei, from which they are presumed to be derived, and some with the Blennioidei (Watson *et al.* 1984). While Percoidei characters retained in trachinoid fishes are assumed to be primitive, those of the Blennioidei are assumed to be advanced (Watson *et al.* 1984). In the Leptoscopidae, both the small size of *Lesueurina* sp. larvae at hatching and their pelvic fin count of I,5 represent a primitive, percoid condition. By contrast, their elongate and slender body, a myomere number of 42-48 and the early formation of their pectoral fins with respect to the dorsal and the anal fins could be considered as advanced, blennioid conditions.

Compared to the larvae of other trachinoid families, those of *Lesueurina* sp. share most of their characters with those of the Trichonotidae, including the light pigmented body and the lack of preopercular spines (Leis and Rennis 1983; Watson *et al.* 1984). However, apart from meristic and morphometric differences, the pectoral fins in

Lesueurina sp. develop before and not after the formation of the dorsal and anal fins as is the case with trichonotid larvae (Leis and Rennis 1983; Watson *et al.* 1984).

The lateral position of the eyes in larval *Lesueurina* sp. are the only apparent specialization during their larval life. The eyes migrate to a more dorsal position during or after settlement as the juveniles adopt their burrowing habits in the soft sandy bottoms of surf zones. By contrast, there are no obvious specializations in other trachinoid larvae during larval life (Leis and Rennis 1983; Watson *et al.* 1984). The large ventral melanophore on the tail, which is no longer visible in juveniles, is the most valuable character for identifying *Lesueurina* sp. during larval life. The light pigmented body of larval *Lesueurina* sp. during their pelagic phase is reflected later in the juveniles which are also very pale.

Similar Taxa

Larvae of *Lesueurina* sp. are distinguished from other similar larvae by a combination of characters which include the elongate and slender body, the short head and gut, the base of the anal fin longer than that of the dorsal fin, 42-48 myomeres and the prominent tail melanophore (Figures 2, 3). Larvae of *Lesueurina* sp. may resemble in some respects, however, those of other families with elongate larvae such as some ophidiid and nemophin blenniid larvae. Ophidiid larvae can be separated from those of *Lesueurina* sp. by their longer gut, their gadiform caudal fin and the presence of one or two rays on the pelvic fins (Leis and Rennis 1983; Gordon, Markle and Olney 1984). Larvae of nemophin blennies are best distinguished by the heavily pigmented head, the large canines and 30-135 myomeres (Watson 1983). Moreover, in contrast to the larvae of *Lesueurina* sp., those of both the ophidiid and nemophin blenniid larvae have the base of the dorsal fin longer than the base of the anal fin (Gordon *et al.* 1984; Matarese, Watson and Stevens 1984).

Occurrence in the Swan Estuary

Larvae of *Lesueurina* sp. examined in this paper were found from June to November 1986 and peak numbers were obtained between June and October. All larvae were collected in the area of the lower Swan Estuary between 0.3 and 9.0 km from the estuary mouth. The newly settled larva of 14.41 mm, which was too badly damaged to provide a reliable illustration, was caught by seining in the surf zone of a nearby beach in October 1986.

The presence of most larval stages of *Lesueurina* sp. in the lower Swan Estuary is surprising since the adults have never been recorded in this or any other estuary in Australia (Chubb *et al.* 1979; Last *et al.* 1983; Loneragan, Potter and Lenanton 1987). Moreover, leptoscopid larvae have never been recorded in any of the previous ecological studies on ichthyoplankton of Australian coastal waters (e.g. Jenkins 1986; Ramm 1986; Miskiewicz 1987; Steffe and Pease 1988). Although the presence of these larvae suggest that this species may spawn in the lower Swan Estuary, breeding probably occurs predominantly in coastal marine waters adjacent to the estuary where this species is typically found. Settlement of larval *Lesueurina* sp. appears to occur at sizes over 13 mm, as indicated by the fact that the largest larva collected by plankton

gear measured 12.04 mm, whereas the smallest specimen obtained in the beach seines measured 14.41 mm.

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