

Larvae of *Belonepterygion fasciolatum* (Plesiopidae: Acanthoclininae)

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ABSTRACT. Larvae of *Belonepterygion fasciolatum* (in the plesiopid subfamily Acanthoclininae) are described based on two postflexion, pelagic specimens from Espirito Santo, Vanuatu (5.7 mm SL) and Magnetic Island, Great Barrier Reef, Australia (6.3 mm SL), as well as two settled individuals (9.4 and 11.9 mm SL) from One Tree Island, Great Barrier Reef, Australia. Distinct morphological characteristics of acanthoclinins form early in development (c. 6 mm SL), including weak head spination limited to a single opercular spine, a large oblique mouth and three unbranched lateral lines. Dorsal and anal fins have many more spines than soft rays, dorsal and anal fin spines have thickened fleshy pads distally, the body is relatively slender with a deep, short caudal peduncle. Pigmentation consists of melanophores more-or-less evenly distributed across the trunk and head as well as a pale brown background (not obvious melanophores, the colour of skin and muscle) on the body that intensifies with growth. These are the first tropical acanthoclinin larvae to be reported. For reasons that are unclear, larvae of tropical and warm-temperate acanthoclinin species are rare in collections, but cool-temperate acanthoclinin larvae can be abundant.

YERMAN, MICHELLE N., & JEFFREY M. LEIS, 2011. Larvae of *Belonepterygion fasciolatum* (Plesiopidae: Acanthoclininae). *Records of the Australian Museum* 63(1): 79–83.

The plesiopid subfamily Acanthoclininae (formerly considered a separate family, see Mooi, 1993) consists of 13 species in four genera of small (210 mm, max. standard length), Indo-Pacific reef-associated fishes. Two of the genera, *Acanthoplesiops* (Regan) and *Belonepterygion* (McCulloch) are found on shallow tropical coral and rocky reefs. Of the other two, *Beliops* (Hardy) is found in both tropical and temperate areas whereas *Acanthoclinus* (Jenyns) is confined to temperate regions of Australia and New Zealand (Hardy, 1984; Neira, 1998; Smith-Vaniz & Johnson, 1990). The single species of *Belonepterygion* is distinguished from those of *Acanthoplesiops* and *Beliops* by the presence of three lateral lines compared to one in the latter two genera, and from *Acanthoclinus* by dorsal and anal-fin spine and ray counts (Smith-Vaniz & Johnson, 1990).

Acanthoclinin early-life history is poorly known, but seems to be broadly similar to that described for other plesiopid subfamilies (Neira, 1998; Leis & Trnski, 2004). Both ovarian and spawned eggs have been described for *Belonepterygion fasciolatum* (Ogilby) (Mooi, 1990; Gill & Mooi, 1993) while only spawned eggs are described for *Acanthoclinus littoreus* (Forster), formerly recognized as two species, namely *Acanthoclinus quadridactylus* (Bloch & Schneider) and *Acanthoclinus trilineatus* (Griffin) (Smith-Vaniz & Johnson, 1990). Spawned eggs are of moderate size (c. 1.4–1.7 mm diameter) and are bundled as demersal, spherical egg masses (5–8 cm in diameter) held together by adhesive threads (Jillet, 1968a,b; Johnson, 1984; Mooi, 1990). The threads are attached evenly on eggs in both species, with *B. fasciolatum* having twice as

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many attachments as *A. littoreus* (see Mooi, 1990). Larvae of only three acanthoclinin species have been described or illustrated in the literature: *Beliops xanthokrossos* (Hardy) (Neira, 1998; Neira *et al.*, 1998) from western Australia, and *A. littoreus* (as *A. quadrydactylus*, Jillet, 1968a,b; Crossland, 1981) and *A. quadrydactylus* (see Crossland, 1982) from New Zealand. Fin meristics of *A. quadrydactylus* in Crossland (1982) (D XIX, 4; A X, 4) do not correspond to *A. quadrydactylus* (now considered a synonym of *A. littoreus*). Of the species found in New Zealand waters, the fin meristics correspond only to *Acanthoclinus marilynae* (Hardy), hence we consider Crossland's illustration to be *A. marilynae*. Acanthoclinin larvae hatch at about 4.7 mm (Jillet, 1968a,b) and settle at 6.3–9.4 mm after a relatively short pelagic larval period with direct development (based on the largest pelagic larva and smallest settled individual examined in this study).

Belonepterygion fasciolatum is considered one of the more widespread species in the subfamily occurring from southern China to southern Queensland and Lord Howe Island, Australia. Despite its widespread distribution, larvae of this species were previously unknown. Our purpose here is to describe larvae of this species based on specimens from plankton tows in Australia and Vanuatu, and compare them with two small, apparently recently settled individuals from Australia.

Materials and methods

Two pelagic specimens of postflexion *B. fasciolatum* larvae were examined: 5.7 mm SL (NSMT PL710, Vanuatu [c. 15°15'S 166°50'E], plankton tow) and 6.3 mm SL (AMS I.24206-004, near Magnetic Island, central Great Barrier Reef, Australia [19°05'S 146°51'E] oblique Tucker Trawl). The larva from the Great Barrier Reef was fixed in formalin and both were preserved in 70% ethanol at the time of this study. Measurements and abbreviations follow Leis & Carson-Ewart (2004). Lengths are standard length (SL), and percentages are of SL unless noted otherwise. Pigment refers to background colour of larvae and melanophores in preserved specimens. Specimens were examined under a dissecting microscope and measured using an ocular micrometer. Illustrations were prepared with the aid of a camera lucida and a digital graphics tablet. Two settled specimens, 9.4 and 11.9 mm SL from One Tree Island (23°30'S 152°05'E), Great Barrier Reef, Australia (AMS I. 20210-039) were also examined. In addition, a pelagic larva (5.2 mm SL) of *Beliops xanthokrossos* was also studied (AMS I.43381-001 Wreck Point [31°32'S 155°34'E], Western Australia, 50 cm diameter plankton net).

Larvae were identified as *B. fasciolatum* through characteristics listed by Hardy (1984): specifically the dorsal-fin count of D XVII–XX, 4–5, anal-fin count A X–XII, 3–5, as well as the presence of three unbranched lateral lines. This combination of characters distinguishes them from all other fish species in the Indo-Pacific.

Results

Descriptions of larvae

Larvae of *B. fasciolatum* (Fig. 1) are elongate and of moderate body depth (BD, 34.3% at 5.7 mm and 28.2% at 6.3 mm) and are laterally compressed with the smaller specimen possessing 27 myomeres. Only the posteriormost myomeres are discernable on the larger specimen.

The gut is coiled and extends slightly beyond midbody. The gas bladder is located dorsal to the anterior portion of the gut. Either no gap (VAFL, 0% in the smaller specimen) or a small gap (VAFL, 3.2% in the larger specimen) exists between the anus and the anal fin.

The head is large (34.0–38.0% SL) with a rounded dorsal profile and prominent lower jaw angle. The snout is short (19.2–22.6% HL), concave at 5.7 mm and convex at 6.3 mm. Preanal length is shorter in the small specimen (3.65 mm) compared to the larger specimen (4.13 mm). The eye is small (31–45% HL) and round. The nasal pit is not bridged over in the smaller specimen, but the membranous bridge is forming in the larger specimen. The mouth is large and moderately oblique: 30° in the smaller specimen and 55° in the larger specimen, below the horizontal. The maxilla reaches almost to the posterior edge of the pupil in the smaller specimen but only to the anterior edge of the pupil in the specimen. Teeth could not be seen as lips are fleshy and the mouth of both specimens is closed and could not be opened without risk of damage. An incipient opercular spine is apparent in both specimens where only the shaft of the spine is present without a distinct tip. There are no other spines on head or pectoral girdle.

All fins are fully formed. Both specimens are in the postflexion stage and have: D XIX, 4; A X or XII, 4; P₂ I, 2 and 16 (8+8) caudal fin rays (C). In the smaller specimen many of the pectoral fin rays on the left side of the specimen were damaged, however, the right hand side had 17 rays. The larger specimen lacked a full complement of pectoral fin rays on both sides due to damage to the specimen. Adults possess 17–19 pectoral fin rays.

The membrane on dorsal spines is degraded in the smaller specimen but present in the larger specimen, where it extends almost to the tip of the spines and rays. In adults, this membrane is incised to about half of the length of the spine section anteriorly, decreasing posteriorly so that by the last 4 rays the membrane reaches the tips. In addition, spines have fleshy pads distally and the membrane on anal-fin spines is incised about one third the length of the element; the incision decreasing posteriorly. For larvae the tips of dorsal and anal fin spines also have thick fleshy pads (in smaller specimen, dorsal fin spines II–VII and in the larger specimen only on dorsal fin spine IV, probably due to damage). Posterior-most soft rays of dorsal and anal fins with membrane. Pelvic-fin spine 40% longer than second ray in smaller specimen; broken in the larger specimen, but longer than the ray. Second pelvic-fin ray slender and unbranched. First pelvic-fin ray branched, longer than spine, and much longer than second ray. Caudal peduncle is short (8 and 7% SL) and deep (14 and 12% SL), so that larvae appear squared off posteriorly.

No scales are present on either of the specimens examined. However, three unbranched lateral lines (dorsolateral, midlateral and ventrolateral) run along length of trunk and tail in the form of three single long depressions.

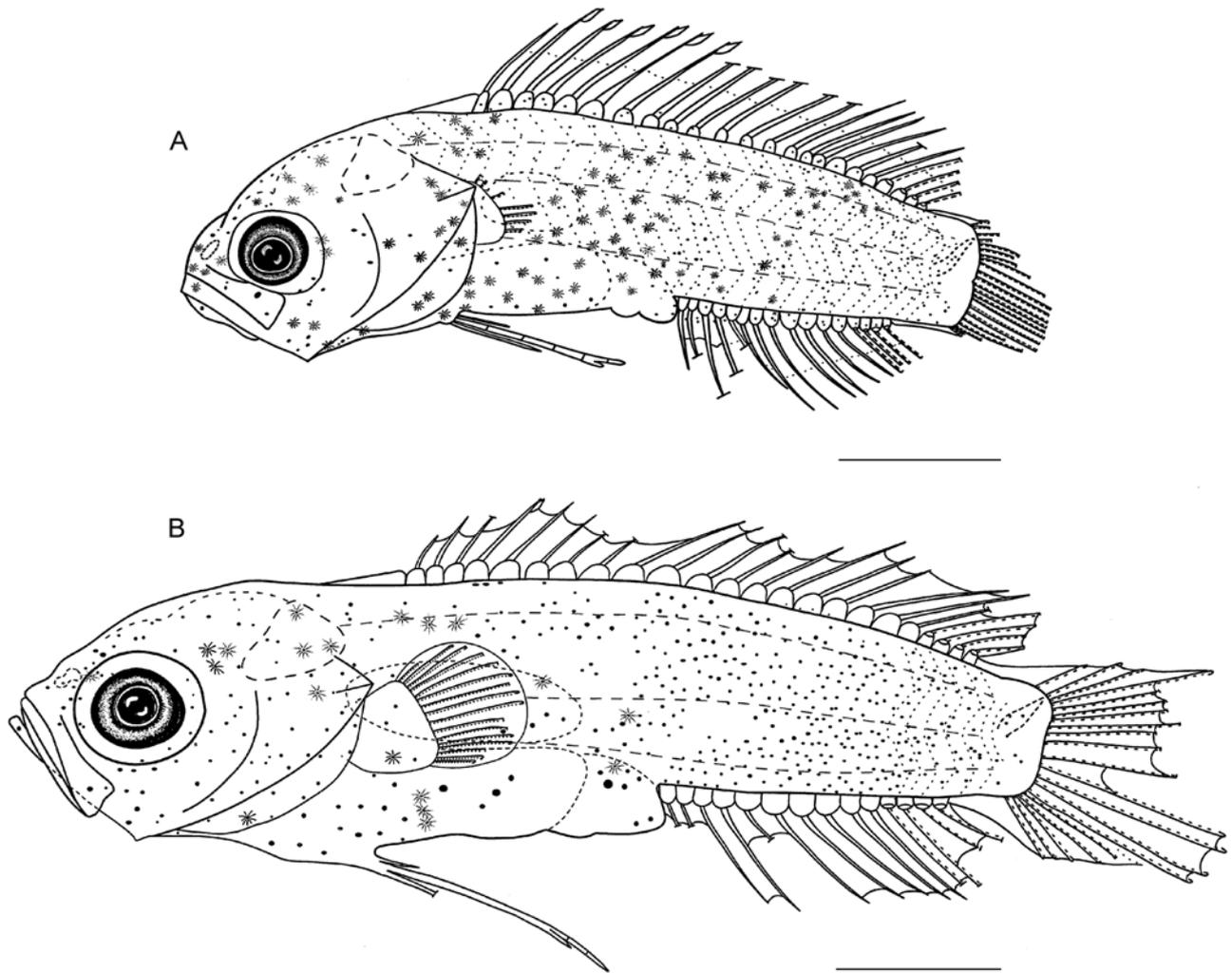


Fig. 1. Larvae of *Belonepterygion fasciolatum*. No scales were present on either of the specimens. The dashed lines on the trunk and tail represent lateral lines (three single long depressions). Background pigmentation not shown in illustrations. (A) 5.7 mm SL (NSMT PL710); postflexion; note opercular spine forming. (B) 6.3 mm SL (AMS I.24206-004); postflexion; note reduction in body depth compared to 5.7 mm specimen. Scale bars = 1 mm.

Background pigmentation (not obvious melanophores, but apparently, the colour of skin and muscle) on the body is pale brown that intensifies in larger sized specimen. This background pigmentation is not shown in the illustrations. Stellate melanophores are randomly distributed on the smaller specimen and contracted melanophores dominate the larger specimen. One to two melanophores are present on the bases of spines and rays of the dorsal, anal, pectoral and pelvic fins. Pigmentation extends to all bases and the posterior-most portion of dorsal-fin spines IV–IX and on the first soft ray. The membrane between each spine and to the first ray has the background pigmentation in the larger specimen. Background pigmentation is also present on the membrane between the first spine and first anal-fin ray in the larger specimen. The membrane between the first four anal-fin spines in the smaller specimen is degraded. Caudal, pelvic and pectoral fins are unpigmented. Small melanophores are distributed evenly on body from caudal peduncle to tip of snout.

Settlement-sized specimens

The 9.4 mm SL settled specimen possessed scales forming on the mid-body between the level of the ninth dorsal spine and first ray. The body is fully scaled in the 11.9 mm SL specimen. In both settled individuals the opercular spine has a pointed tip. In adults, the posterodorsal angle of the opercle is produced as a short, rounded spine (Hardy, 1984). In the 9 mm SL specimen, background pigmentation has intensified and pigment is present on all but the first dorsal-fin spines and rays (extending two thirds along each element) and on the fin membrane. In the 11.9 mm SL settlement-sized specimen, this pigmentation reaches the distal end of spines and rays, except that the first dorsal spine remains unpigmented. At 9.4–11.9 mm SL, pigment is present on anal-fin spines and rays including the membrane in between, and some pigmentation is present on the base of the pelvic spine and rays. At 9.4 mm SL pigmentation has begun to form on the caudal rays and membrane from the middle to

distal end and this intensifies by 11.9 mm SL. Numbers of distinct melanophores decrease on the body on settlement-sized specimens yet remain concentrated on the head.

Discussion

Larval development apparently takes place rather quickly in *B. fasciolatum*, with all fins formed by 5.7 mm, and settlement occurring by 9 mm. Although the size at hatch is unknown (probably about 4–5 mm based on other acanthoclinins), it seems that the pelagic phase of this species is brief, as reflected by the rarity of larvae in plankton collections. Jillet (1968a) estimated the pelagic larval duration (PLD) to be as long as 3 months in New Zealand waters. Although growth rates of cold water species are likely to be slower, and thus PLDs longer than those in warmer waters, this inference was based on the seasonal timing of the first egg mass to be discovered and the first appearance of a recruit, a fish c. 10 mm (washed up on shore). Thus, this estimate should be considered with caution, because it may be an overestimate of PLD.

We have examined many larvae from within the range of this species, and have found only the two larvae of *B. fasciolatum* described here, both from inshore locations. Changes over settlement are minimal, and consist primarily of pigment changes, development of the opercular spine tip and the beginning of scale formation. Therefore, larval development of *B. fasciolatum* can be characterized as direct, probably brief, and likely to take place inshore. In contrast, it appears that larval acanthoclinins are reasonably common in plankton hauls in the temperate inshore waters of New Zealand (Crossland, 1981, 1982). Despite having non-pelagic eggs and an apparently brief, inshore larval phase, *B. fasciolatum* has a wide distribution.

Larvae of only four of the 13 species of acanthoclinins are known (*A. littoreus*, *A. marilynae*, *B. xanthokrossos* and *B. fasciolatum*), yet all share certain morphological characteristics. With the exception of *A. marilynae* which has a longer snout (38% HL), larger head (27% SL) and more elongate body (BD = 19% SL), all have a similar overall body shape and are heavily pigmented with numerous melanophores. Larvae of *B. fasciolatum* and *B. xanthokrossos* possess 26–27 myomeres and lack pigment on the posterior portion of the caudal peduncle. All fins are fully formed by 5.7 mm SL and settlement occurs between 9.4 and 11.9 mm SL for *B. fasciolatum* and around 13.1 mm SL for *B. xanthokrossos* (Neira, 1998; Neira *et al.*, 1998). Head spination is weak with only a single opercular spine, which is less pronounced in *B. fasciolatum*. Although no published

description or illustration of any acanthoclinin larva includes mention of preopercular spines, Johnson (1984) lists larvae of Acanthoclinidae as having the “preopercular posterior margin and sometimes lateral ridge with very small spines or serrations”. Johnson (pers. comm.) had no specimens upon which to base his description, and relied on two published descriptions Jillet (1968b) and Crossland (1982), neither of which mention preopercular spination. Johnson informed us that this description of spination was “probably wrong”, which seems to be the case.

Larvae of *B. fasciolatum* have a greater body depth (28–34%) than *B. xanthokrossos* (21–23%). Anal-fin counts also differ between these species with *B. fasciolatum* having XI, 4 compared to X, 2–3 in *B. xanthokrossos*. Moreover, larvae of *B. xanthokrossos* have more pigment on the head and body, and lack pigment on the pectoral, caudal and anal fin membranes before settlement. In contrast, larvae of *B. fasciolatum* examined have pigmentation on the anal fin but the pectoral fins are unpigmented in settlement larvae examined. Based on specimens hatched from field-collected egg masses, Jillet (1968a) described larval development in *A. littoreus* up to 5.5 mm. By that length and in the preflexion stage, the overall shape of the body, gut and pigmentation pattern are consistent with those of other acanthoclinin larvae. However, fins were not fully formed, thus larvae were not as developed in the smallest larva examined in this study at 5.7 mm. A larva of *A. littoreus* in a later developmental stage (size not noted) was illustrated but not described by Crossland (1982). Again, the shape of the body and gut and the fairly even distribution of melanophores across the trunk and gut, were consistent with those described for other acanthoclinin larvae. Similarly, Crossland (1981) illustrated, but did not describe a larva of *A. marilynae* which also possessed morphological features of acanthoclinins, albeit with a more slender body (BD = 19% SL; Table 1).

Larvae of non-acanthoclinin plesiopids are similar to those of acanthoclinines. Larvae are moderately deep and laterally compressed. The head is moderate to large and the gut is long and fully coiled in larvae less than 5 mm. The gas bladder is located dorsal to the anterior portion of the gut and is usually small and inconspicuous. Scales are not present prior to settlement. Differences include spine and ray counts on all fins. In non-acanthoclinins the number of dorsal and anal-fin spines is lower and the number of rays greater compared to acanthoclinins. Pectoral and pelvic-fin ray counts are also greater in non-acanthoclinin larvae, plus the fin elements are generally developed at smaller sizes in acanthoclinins. Non-acanthoclinins possess a greater number of caudal fin rays (17–18, compared to 16 for acanthoclinins).

Table 1. Morphometric (mm) and meristic values for larvae of *Belonepterygion fasciolatum*. SL, standard length; PAL, preanal length; PDL, predorsal length; HL, head length; ED, eye (orbit) diameter; SnL, snout length; BD(P), body depth, depth at level of pectoral fin base (P) and anus (A); D, dorsal fin; A, anal fin; P₁, pectoral fin; P₂, pelvic fin; C, caudal fin; LL, lateral lines.

SL	PAL	PDL	HL	ED	SnL	BD(P)	BD(A)	D	A	P ₁	P ₂	C	LL
5.67	3.65	1.94	1.98	0.90	0.37	1.55	1.46	XIX, 4	XII, 4	17 ^a	I, 2	8+8 = 16	3
6.32	4.13	2.35	2.11	0.65	0.53	1.70	1.46	XIX, 4	X, 4	16 ^b	I, 2	8+8 = 16	3

^a Measurement taken from right side of specimen.

^b Some rays missing.

In addition, non-acanthoclinin plesiopid larvae have 24–40 myomeres; 24–35 in most genera and 37–40 in the Australian temperate genus *Trachinops* (Günther). Larvae can also be lightly (e.g., *Trachinops*) to heavily pigmented (e.g., *Beliops*) with no melanophores around posterior region of caudal peduncle in heavily pigmented larvae.

Pelagic acanthoclinin larvae have only been reported by Crossland (1981, 1982), Neira, (1998) and this study. Larvae of the temperate species *A. littoreus* are reasonably abundant in plankton hauls (with >50 collected in areas close to shore) off the coast of New Zealand (Crossland, 1981, 1982). In contrast, larvae of tropical species such as *B. fasciolatum* and *B. xanthokrossos* are rare. We have observed only two specimens of *B. fasciolatum* and <10 larvae of *B. xanthokrossos* were collected from coastal waters off Fremantle, Western Australia in an extended study (F.J. Neira, pers. comm.).

ACKNOWLEDGMENTS. We thank Bob Hartwick for donating the AMS specimen and Keiichi Matsuura for loaning the NSMT specimen. The initial discovery of the NSMT specimen in the Tokyo collection was made possible with support from NSMT to JML via the 2009 Larval Fish Workshop. Dave Johnson clarified the aspects of his landmark 1984 publication. Francisco Neira provided additional information on *B. xanthokrossos*. Buz Wilson provided invaluable assistance with the graphics tablet and software used to create the figures and Sue Bullock gave much needed advice on the illustrations. Amanda Hay commented on the manuscript.

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