Larval Development of the Australian Devilfish, *Gymnapistes marmoratus* (Teleostei: Scorpaenidae)

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ABSTRACT: The larval development of the devilfish, *Gymnapistes marmoratus*, is described from material collected in the Swan and Peel-Harvey Estuaries in southwestern Australia. Larvae of *G. marmoratus* examined (2.6–9.3 mm BL) are pelagic and characterized by a deep and compressed, lightly pigmented body; a moderately short gut; 29 myomeres; complex head spination; and large, pigmented fan-shaped pectoral fins which form early in development. Notochord flexion occurs between 4.8 and 6.0 mm BL and transformation between 6.8 and 10.9 mm BL.

The majority of head spines in *G. marmoratus* form before the postflexion stage. These include parietal, supraocular, preopercular, nasal, pterotic, posttemporal, and some suborbital spines. The suborbital stay develops after flexion; the nuchal and three of the anterior preopercular spines disappear in juveniles. The caudal complex of larval *G. marmoratus* includes well-fused hypural elements 1 and 2 and hypural elements 3 and 4, a reduced fifth hypural bone, and a parhypural element.

In addition to larval development, comparisons with similar taxa and the occurrence of the larvae in the Swan Estuary are discussed.

Scorpaeniform fishes are represented in southwestern Australia by one marine species of each of *Centropogon*, *Scorpaena*, *Maxillicosta*, *Gymnapistes*, and *Glyptauchen* and three of *Neosebastes* (Hutchins and Thompson 1983; Hutchins and Swainston 1986). The larval stages of none of these genera have been described except for those of *Scorpaena*, which were described from larvae caught elsewhere (see Moser et al. 1977; Washington et al. 1984a). The present paper describes for the first time the larval development of the sole species of the genus *Gymnapistes*, *G. marmoratus*, using material collected in the Swan and Peel-Harvey Estuaries in southwestern Australia. This paper also includes information on the occurrence and distribution of the larvae in the Swan Estuary.

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Manuscript Accepted March 1989.
Fishery Bulletin, U.S. 87: 889–898.

The devilfish, *Gymnapistes marmoratus*, also known as the soldier fish or South Australian cobbler, is a marine species common in seagrass beds of coastal embayments and estuaries of southern Australia. It occurs between southern Sydney in New South Wales and Fremantle in Western Australia and occurs also in Tasmania (Hutchins and Thompson 1983; Last et al. 1983; Hutchins and Swainston 1986). Juveniles are relatively common in both the lower Swan Estuary and the Peel Inlet, in southwestern Australia (Chubb et al. 1979; Potter et al. 1983).

The population of *G. marmoratus* studied by Grant (1972) in the D'Entrecasteaux Channel, southern Tasmania, spawned at the beginning of spring at approximately two years of age. In the Gippsland Lakes, Victoria, the adults apparently spawn over an extended period with a peak in winter (Ramm 1986). Larvae of this species have been collected from July to October in Port Phillip Bay, Victoria, with peak abundance occurring in August (Jenkins 1986).

MATERIALS AND METHODS

Collection of Larvae

Larvae of *G. marmoratus* were obtained from plankton samples collected monthly during 1986 in the lower Swan Estuary (lat. 32°04′S, long. 115°44′E). Samples were obtained at night using 0.6 m diameter paired bongo nets, with 0.5 mm mesh, which were towed horizontally 0.5 m below the surface for 10 minutes. Transforming and juvenile *G. marmoratus* were caught in the Peel-Harvey Estuary (32°35′S, 115°45′E) using a 3.0 mm mesh beach seine. Samples were fixed in 10% formalin and specimens were stored in 70% alcohol.

Material Examined

A total of 22 larvae, ranging in body length (BL) from 2.6 to 6.8 mm, were used to describe pigmentation, morphometrics, and meristics. One transforming larva (9.3 mm BL) and seven benthic juveniles, ranging from 10.9 to 16.8 mm BL, were also examined. Ten representative larval *G. marmoratus* were deposited in the Western Australian Museum (Perth) under the catalogue number P-29814-001.

Measurements and Counts

Larval and juvenile *G. marmoratus* were measured to the nearest 0.1 mm using a Wild M8[1] 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 fin ray counts of paired fins were made on the left side of the body. Pigment refers to melanin. Illustrations were done with the aid of a drawing tube.

Six larval, one transforming, and three juvenile *G. marmoratus* were cleared and double stained for bone and cartilage following the technique of Potthoff (1984), as modified from Dingerkus and Uhler (1977). These specimens were used to count fin rays and vertebrae, to determine the sequence of bone ossification, and to describe the development of both the head spines and the caudal complex. The term "ossified" refers solely to structures stained positively for bone. The terminology used for describing the head spination and the caudal complex was modified from that of Washington et al. (1984a) and Feeney (1986) respectively.

RESULTS

Identification

Larvae were identified as scorpaenids by the well-developed head spination, the continuous dorsal fin, and the large, fan-shaped, pigmented pectoral fins (Leis and Rennis 1983). Specimens were initially assembled in a series according to the degree of formation of the pectoral fins which, when fully formed, have 11 fin rays. Large specimens were identified as *G. marmoratus* by dorsal and anal fin ray counts of XIII, 9 and III, 6 respectively and the elongate infraorbital spine (Scott et al. 1980; Last et al. 1983). Fin ray counts, head spination, and body pigment were used to link larvae and juveniles.

Description of Larvae

Larvae of *G. marmoratus* are pelagic prior to transformation. Larvae are initially elongated, becoming deep-bodied (12–36% BL) and laterally compressed with development (Table 1, Figs. 1, 2). The smallest larva illustrated (3.3 mm, Fig. 1A) possesses pectoral fin buds and a dermal sac enclosing most of the body but has neither head spines nor traces of yolk sac. The head length increases from 13% BL in preflexion larvae to 38% BL in postflexion larvae (Table 1). The mouth is formed by 3.3 mm and teeth appear along the premaxilla and dentary at 6.8 mm. The gut is coiled and short in small larvae. The preanal length increases from 35% BL in preflexion larvae to 61% BL in postflexion larvae (Table 1, Figs. 1, 2). There is a moderate gap between the anus and the origin of the anal fin in postflexion larvae (Fig. 2). A prominent swimbladder becomes visible above the gut from about 3.3 mm, but it is no longer externally visible by 10 mm.

Larval *G. marmoratus* possess 29 myomeres. Double-stained specimens have 28 vertebrae (Table 2). Notochord flexion commences by 4.8 mm and is complete by 6.0 mm. Transformation from the pelagic larva to the benthic juvenile occurs between 6.8 and 10.9 mm (Fig. 2A, B).

Fin Development

The development of fins in larval and juvenile *G. marmoratus* is summarized in Table 2. Pectoral fins develop very rapidly, attaining a length of 44% BL in postflexion larvae (Table 1, Fig. 2A). Incipient fin rays of the pectoral fin are visible by 3.3 mm, and all 11 fin rays are formed by 4.7 mm. The caudal fin starts to form by 4.6 mm and is completely developed shortly after notochord flexion is complete (Figs. 2A, 4C). The dorsal and anal fin anlagen appear by 5.0 mm, i.e., prior to completion of notochord flexion, and the rays start to form sequentially from tail to head. Rays and spines, both dorsal (XIII, 9) and anal (III, 6), are developed by 9.0 mm (Table 2). Pelvic buds are visible by 4.8 mm and fin rays are formed by 9.3 mm.

Pigmentation

Larval *G. marmoratus* are lightly pigmented prior to transformation. In preflexion larvae, the

[1]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

TABLE 1.—Morphometric measurements for larval, transforming, and juvenile *Gymnapistes marmoratus*. 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. Individuals indicated with * and ** correspond to a transformed larva and juveniles respectively. Individuals between dashed lines were undergoing notochord flexion.

Body length (mm)	*n*	Head length	Snout length	Eye diameter	Body depth at pectoral fin base	Pectoral fin length	Preanal length	Predorsal fin length
2.6	1	17.7	3.4	7.6	12.7	7.6	38.4	.
2.7	1	13.7	2.8	7.9	14.4	15.2	36.1	.
3.3	1	17.8	2.9	7.5	17.8	19.0	38.7	.
4.0	1	19.6	4.6	7.6	16.6	20.6	40.2	.
4.6	1	19.6	3.8	7.2	15.0	27.8	35.2	.
4.7	1	22.4	4.7	7.1	17.5	31.2	41.6	.
4.8	1	23.9	5.7	7.8	23.5	32.9	45.7	.
5.0	1	25.2	4.3	8.3	25.0	35.6	47.0	54.8
5.1	2	23.4(0.10)	5.7(0.50)	7.6(0.05)	21.4(1.25)	35.2(0.15)	45.4(2.50)	58.6(*n* = 1)
5.2	1	24.3	6.0	7.1	21.0	33.7	45.5	.
5.3	1	23.9	5.4	8.1	22.0	33.1	49.3	56.1
5.5	1	30.4	7.5	8.5	24.3	34.0	49.6	59.6
5.7	1	29.2	6.5	8.7	24.6	38.0	54.5	58.5
5.8	1	32.0	8.8	8.4	27.6	42.4	50.7	28.9
5.9	1	27.6	5.3	8.7	24.9	35.7	51.6	57.2
6.0	2	30.0(0.49)	7.9(0.75)	7.5(0.00)	24.9(1.33)	34.6(0.08)	51.6(1.08)	59.8(0.00)
6.1	1	32.4	7.0	8.5	26.6	35.7	57.8	32.1
6.2	2	29.6(2.45)	7.5(0.75)	8.1(0.10)	27.6(0.95)	34.6(0.60)	54.7(1.45)	28.8(0.95)
6.8	1	32.6	9.0	8.4	27.7	43.9	57.2	30.6
9.3*	1	33.3	7.4	9.8	30.5	31.2	62.8	29.0
10.9**	1	34.0	6.8	9.9	32.3	27.1	63.1	27.8
13.9**	1	35.6	6.9	10.2	33.9	30.3	60.4	24.5
14.1**	1	36.0	8.7	9.2	33.8	32.6	64.1	30.3
15.1**	1	37.6	6.3	10.9	35.7	34.7	60.3	23.9
15.7**	1	36.6	6.7	10.3	31.8	29.2	60.5	23.2
15.8**	1	36.7	8.2	9.7	36.7	29.8	61.6	23.1
16.8**	1	38.6	7.5	10.1	31.9	30.1	61.3	21.7

head has one melanophore at the angle of the lower jaw, one ventral melanophore at the gular area, and a group of internal melanophores at the base of the hindbrain. All of these melanophores are retained (Figs. 1, 2). Melanophores appear on the midbrain by 4.9 mm and develop over the snout, opercular, and gular areas by 6.0 mm.

The dorsal surface of the swimbladder and ventral surface of the gut are pigmented in preflexion larvae. A single row of melanophores occurring along the ventral surface of the gut in small larvae persists throughout development (Figs. 1, 2). Melanophores appear externally on the lateral surface of the trunk by 6.2 mm and expand over the gut area by 9.5 mm (Fig. 2A, B). A single row of 16–22 melanophores is present on the ventral surface of the tail in preflexion larvae, each melanophore spaced about one per myomere. This single row of melanophores becomes double along the anal fin base in postflexion larvae. Pigment appears on the dorsal surface of the body by 5.5 mm and, shortly after, on the lateral surface of the body. Transition from larval to juvenile pigmentation begins by 6.8 mm. Juveniles develop blotches of pigment on the head, trunk, and dorsal and anal fin membranes (Fig. 2B).

Melanophores appear on the pectoral fins by 3.3 mm (Fig. 1A), extend distally on each pectoral ray by 4.6 mm, and remain along the edges of the distal portion of the rays throughout development (Fig. 2A). In larvae over 10 mm, patches of pigment form on the pectoral fin bases and on the fin membranes (Fig. 2B). Melanophores appear on the dorsal and anal fin membranes by 6.0 mm, and patches of pigment form on the membranes of these fins by 10 mm. The

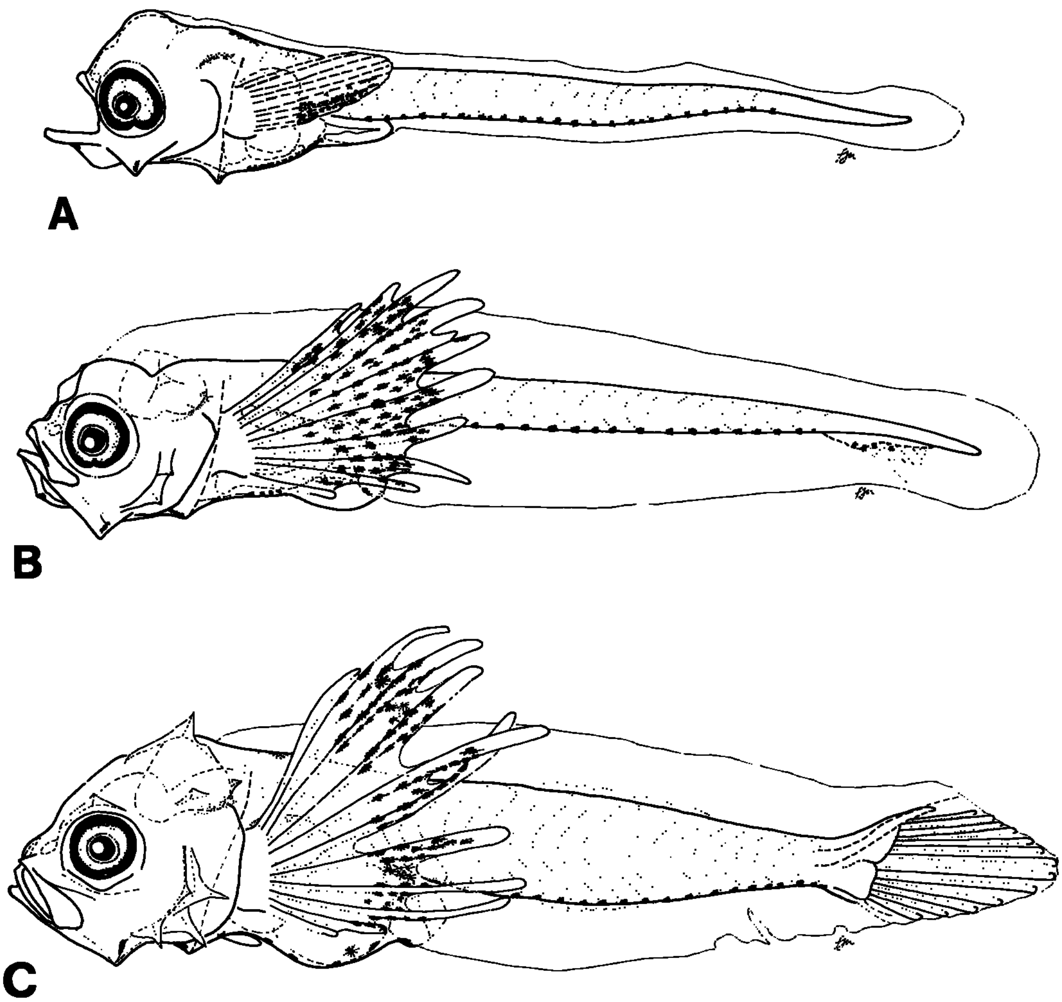

FIGURE 1.—Larvae of the devilfish, *Gymnapistes marmoratus*, caught in the lower Swan Estuary in July 1986. (A) 3.3 mm BL larva. (B) 4.6 mm BL larva. (C) 5.1 mm BL larva; note pelvic fin buds.

TABLE 2.—Fin ray development and vertebral counts in larval, transforming, and juvenile *Gymnapistes marmoratus*. Vertebrae were counted only in cleared and double-stained specimens (denoted by *) in which vertebrae were clearly differentiated. Other blanks indicate character is absent. Pectoral and pelvic fin ray counts were made on the left side of the body. Procurrent fin rays are shown as dorsal/ventral elements.

Body length (mm)	*n*	Stage	Dorsal fin	Anal fin	Pectoral fin	Pelvic fin	Caudal fin rays	Procurrent rays	Vertebrae
2.6	1	Preflexion			bud				
2.7	1	Preflexion			bud				
3.3	1	Preflexion			8				
4.0*	1	Preflexion			10				
4.6	1	Preflexion			10				
4.7*	1	Preflexion			11		9		
4.8	1	Flexion			11	bud	10		
5.0*	1	Flexion	anlage	anlage	11	bud	5+5		28
5.1	2	Flexion	anlage	anlage	11	bud	7+5		
5.2*	1	Flexion	anlage	anlage	11	bud	5+5		28

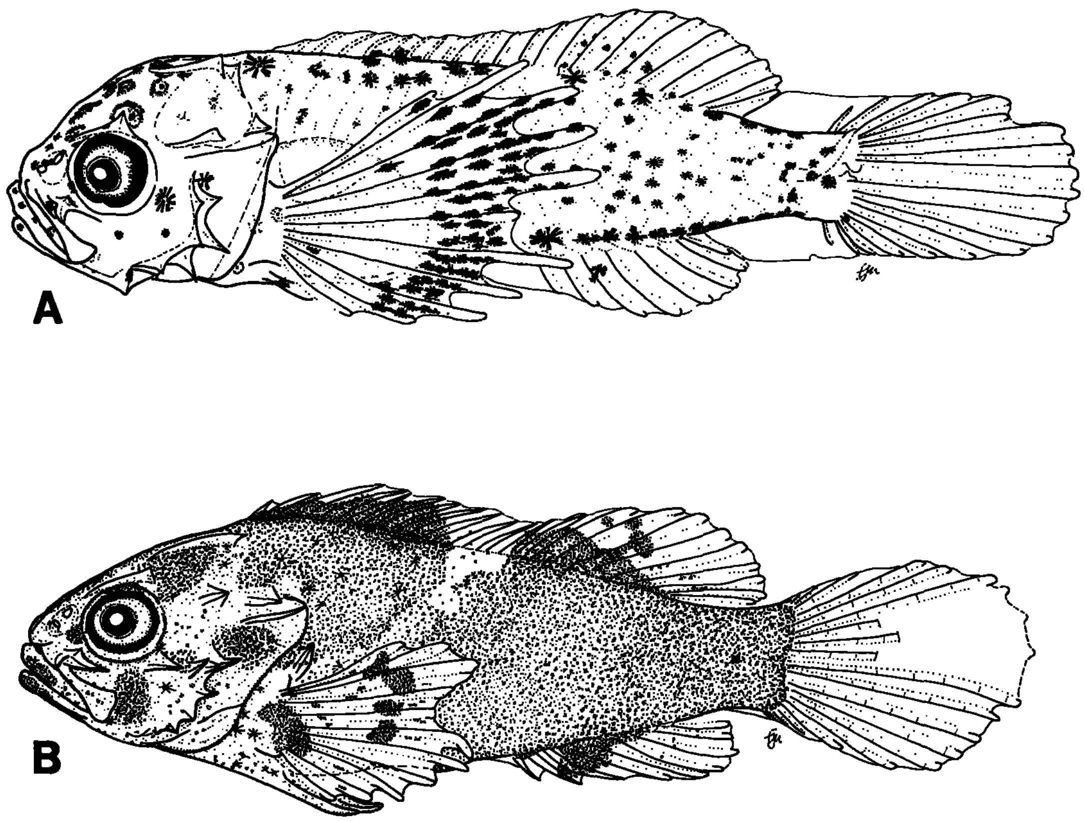

FIGURE 2.—Larva and juvenile of the devilfish, *Gymnapistes marmoratus*. (A) 6.2 mm BL larva collected in the Swan Estuary in July 1986. (B) 10.9 mm BL juvenile collected in the Peel-Harvey Estuary in August 1985; dashed lines indicate damaged caudal fin.

TABLE 2.—*Continued.*

Body length (mm)	*n*	Stage	Dorsal fin	Anal fin	Pectoral fin	Pelvic fin	Caudal fin rays	Pro-current rays	Verte-brae
5.3*	1	Flexion	8	6	11	bud	6+7	1/0	28
5.5	1	Flexion	8	5	11	bud	7+6	1/0	
5.7	1	Flexion	9	7	11	bud	7+6	1/1	
5.8	1	Flexion	10	7	11	bud	7+6	1/1	
5.9	1	Flexion	9	7	11	bud	7+7	1/2	
6.0	2	Flexion	9–10	7–8	11	bud	7+6	1/2–1	
6.1	1	Postflexion	9	8	11	bud	7+7	2/3	
6.2	2	Postflexion	19–22	III,5	11	bud	7+6	1–2/3	
6.8*	1	Postflexion	21	III,6	11	bud	7+7	3/3	28
9.3*	1	Transforming	XIII,9	III,6	11	I,5	7+7	5/5	28
10.9	1	Juvenile	XIII,9	III,6	11	I,5	7+7	5/5	
13.9	1	Juvenile	XIII,9	III,5	11	I,5	7+7	6/6	
14.1*	1	Juvenile	XIII,9	III,6	11	I,5	7+7	6/5	28
15.1*	1	Juvenile	XIII,9	III,6	11	I,5	7+7	6/5	28
15.7	1	Juvenile	XIII,9	III,6	11	I,5	7+7	6/5	
15.8	1	Juvenile	XIII,9	III,6	11	I,5	7+7	6/6	
16.8*	1	Juvenile	XIII,9	III,6	11	I,5	7+7	7/6	28

caudal fin remains unpigmented throughout development.

Development of Head Spines

Larvae of *G. marmoratus* have complex and well developed head spination (Fig. 3). Two posterior preopercular spines (PPO_2 and PPO_3) appear simultaneously at 4.6 mm (Fig. 1B; see Figure 3 for abbreviations also). Two more posterior preopercular spines (PPO_1 and PPO_4) develop by 5.7 mm and a fifth (PPO_5) by 10 mm. The PPO_1 spine becomes enlarged in juveniles, reaching a relative length of ca. 12% BL (Fig. 3D). Two anterior preopercular spines (APO_2 and APO_3) form by 4.8 mm, followed by a third anterior preopercular spine (APO_1) by 5.4 mm. All spines of both the anterior and posterior preopercular margins merge by 6.8 mm and only the APO_1 spine, the enlarged PPO_1 spine, and the PPO_{2-5} spines remain in juveniles (Fig. 3D).

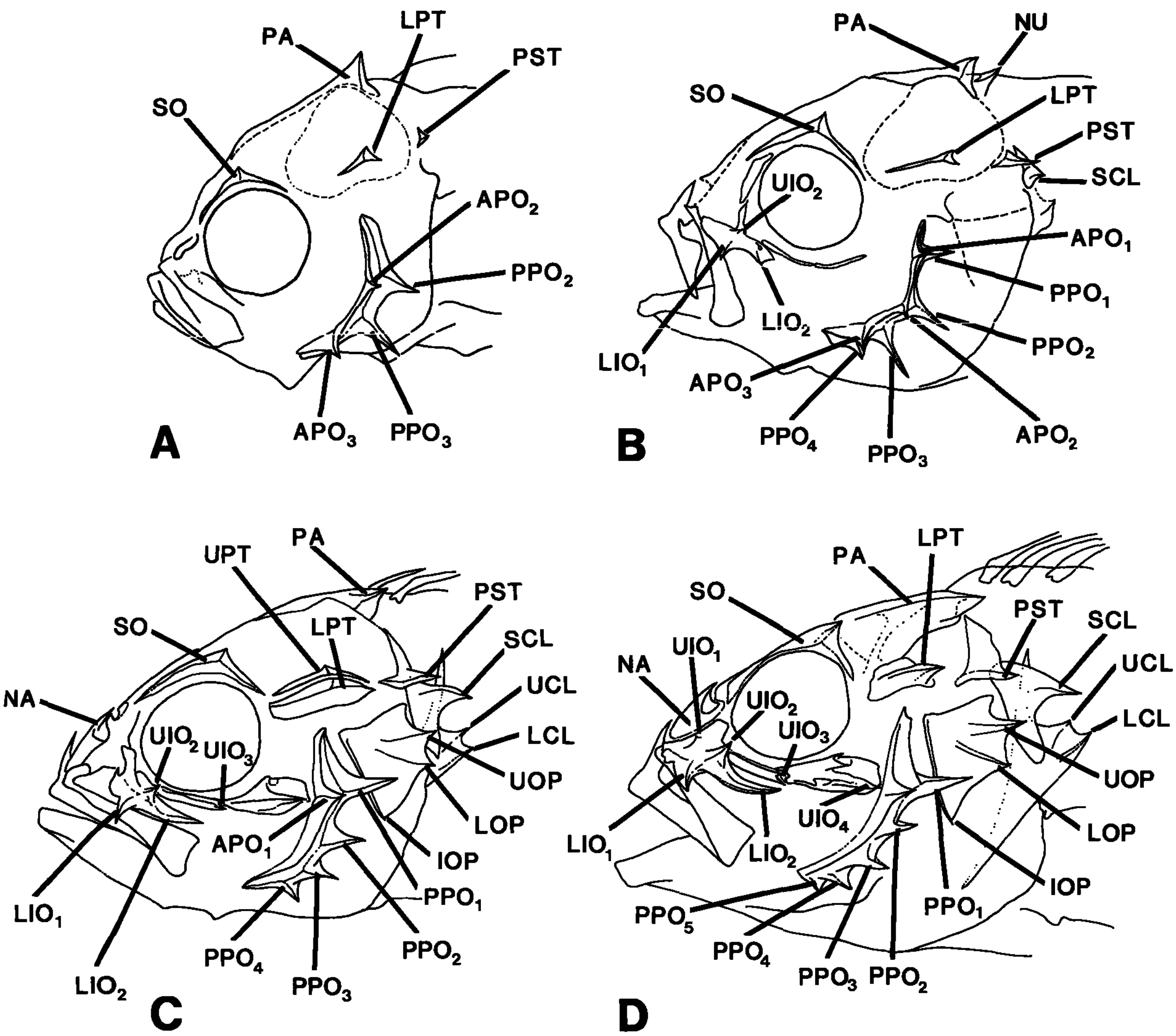

FIGURE 3.—Head spination in cleared and double-stained larval, transforming and juvenile *Gymnapistes marmoratus*. (A) 5.3 mm BL larva. (B) 6.8 mm BL larva. (C) 9.3 mm BL transforming larva. (D) 14.1 mm BL juvenile. Abbreviations: APO_1, 1st anterior preopercular; APO_2, 2nd anterior preopercular; APO_3, 3rd anterior preopercular; IOP, infraopercular; LCL, lower cleithral; LIO_1, 1st lower infraorbital; LIO_2, 2nd lower infraorbital; LOP, lower opercular; LPT, lower pterotic; NA, nasal; NU, nuchal; PA, parietal; PPO_1, 1st posterior preopercular; PPO_2, 2nd posterior preopercular; PPO_3, 3rd posterior preopercular; PPO_4, 4th posterior preopercular; PPO_5, 5th posterior preopercular; PST, posttemporal; SCL, supracleithral; SO, supraocular; UCL, upper cleithral; UIO_1, 1st upper infraorbital; UIO_2, 2nd upper infraorbital; UIO_3, 3rd upper infraorbital; UIO_4, 4th upper infraorbital; UOP, upper opercular; UPT, upper pterotic.

The parietal spines (PA) develop prior to flexion and are retained in juveniles but become blunt. The nuchal spines (NU) appear posterior to the parietal spines by 5.7 mm and disappear by 9.0 mm (Fig. 3C). The lower pterotic (LPT) and supraocular (SO) spines appear simultaneously at 4.8 mm and the posttemporal spine (PST) by 5.1 mm. A small upper pterotic spine (UPT) appears dorsal to the lower pterotic spine (LPT) by 9.0 mm and fuses to the LPT spine by 10.0 mm. All LPT, SO, and PST spines persist in juveniles (Figs. 2B, 3C, D).

The second upper infraorbital (UIO_2) and the first lower infraorbital (LIO_1) spines form simultaneously at 5.5 mm. The second lower infraorbital spine (LIO_2), which forms by 6.8 mm underneath the eye, grows backwards as a recurved hook reaching a relative length of ca. 16.5% BL in juveniles (Fig. 3B, C, D). The nasal (NA), upper and lower cleithral (UCL, LCL), and the upper opercular, lower opercular, and infraopercular (UOP, LOP, IOP) spines form during transformation and remain in juveniles (Fig. 3D).

Development of the Caudal Complex

The development of the caudal complex in larval *G. marmoratus* is illustrated in Figure 4. Three nonossified hypural elements (HY_1, HY_3, HY_4) form at about 4.7 mm ventral to the notochord (N) (Fig. 4A). The third and fourth hypural elements (HY_3, HY_4) fuse to form a plate by 5.3 mm (Fig. 4B), leaving a small fora-

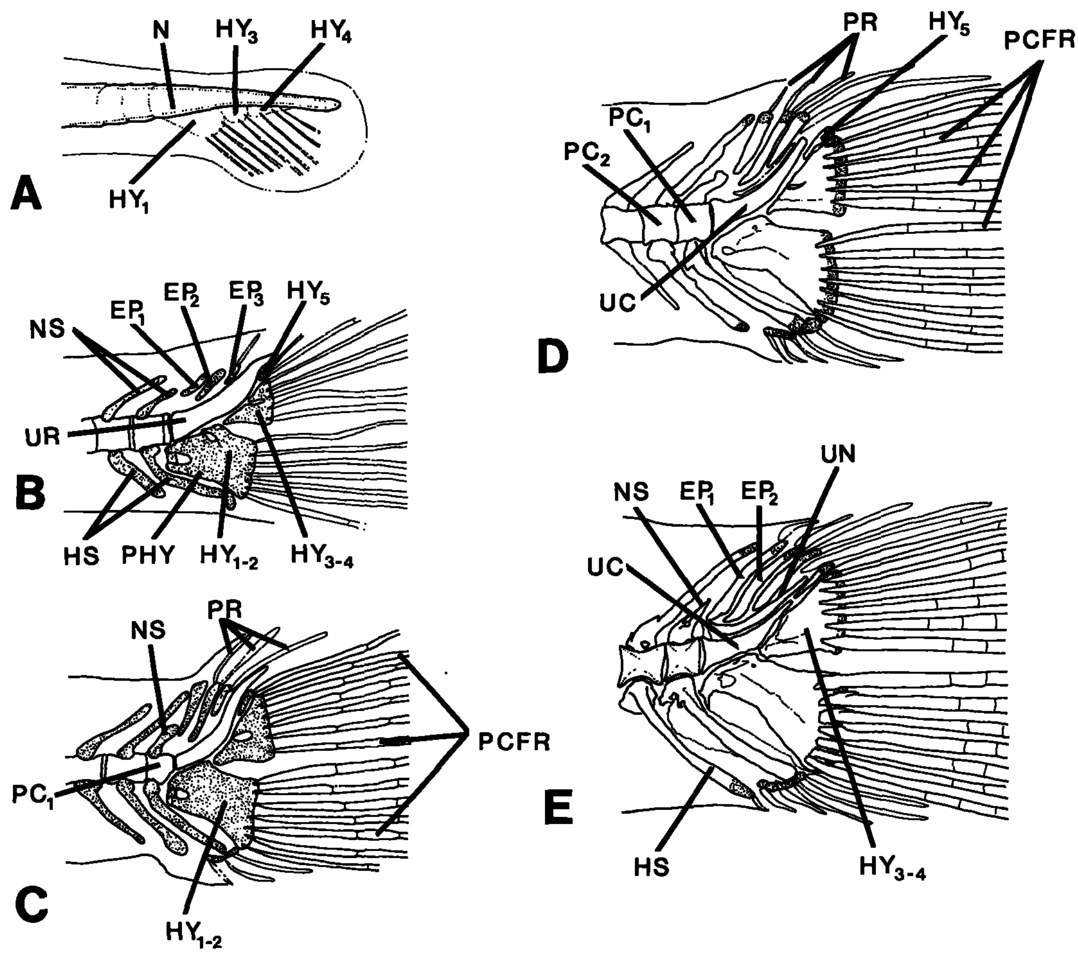

FIGURE 4.—Development of the caudal complex in cleared and double-stained larval, transforming, and juvenile *Gymnapistes marmoratus*. (A) 4.7 mm BL larva. (B) 5.3 mm BL larva. (C) 6.8 mm BL larva. (D) 9.3 mm BL transforming larva. (E) 14.1 mm BL juvenile. Shaded areas represent elements stained with alcian blue. Abbreviations: EP, epural; HS, haemal spine; HY, hypural; N, notochord; NS, neural spine; PC, preural centrum; PCFR, principal caudal fin ray; PHY, parhypural; PR, procurrent ray; UC, ural centrum; UN, uroneural; UR, urostyle.

men which disappears in juveniles (Fig. 4E). A fifth, reduced, hypural element (HY_5) forms ventral to the tip of the notochord by 5.3 mm and remains discrete from the upper hypural plate (HY_{3-4})in juveniles (Fig. 4B, E). Two distinct foramina are visible in the lower hypural plate (HY_{1-2}) by 5.3 mm. The distal foramen results from the fusion between HY_1 and HY_2 elements, whereas the proximal foramen is probably the result of the fusion between the lower plate (HY_{1-2}) and the parhypural element. Only the proximal foramen remains in juveniles (Fig. 4E). One principal caudal fin ray (PCFR) is attached to the uppermost hypural element (HY_5), six to the upper hypural plate (HY_{3-4}), and seven to the lower hypural plate (HY_{1-2}) by 6.8 mm. Both the HY_{1-2} and HY_{3-4} plates ossify by 9.0 mm and remain discrete from each other and from the ural centrum (UC) in juveniles (Fig. 4E).

Three epural elements (EP_1, EP_2, EP_3) appear dorsal to the urostyle (UR) at about 5.3 mm, with a single procurrent ray attached to the EP_3 (Fig. 4B). Ventral procurrent rays appear by 7.5 mm and the number increases to seven dorsal and six ventral procurrent rays by 16.8 mm (Table 2). A uroneural (UN) starts to form dorsal to the ural centrum by 9.0 mm, and it is completely formed by 14.0 mm (Fig. 4D, E). Nonossified neural (NS) and haemal (HS) spines form simultaneously shortly after flexion is commenced and all are ossified by 9.0 mm. The neural spine on the first preural centrum (PC_1) is reduced (Fig. 4, C, E).

DISCUSSION

Comparisons to Subfamilies of the Scorpaenidae

The larval development of *G. marmoratus* follows a similar pattern to that observed in other scorpaenid species (Washington et al. 1984a). The sequence of fin formation in larval *G. marmoratus* parallels that of larvae of the subfamilies Sebastinae and Scorpaeninae, except that the pelvic fins in *G. marmoratus* are completely formed following, rather than prior to, the formation of the anal and dorsal fins. Notochord flexion in larval *G. marmoratus* (4.8–6.0 mm) occurs at similar sizes to that observed in scorpaenine larvae (4.0–6.0 mm) but earlier than in sebastine (6.0–12.0 mm) and sebastolobine (6.0–7.3 mm) larvae (Washington et al. 1984a). In addition, transformation of *G. marmoratus* larvae occurs much earlier (6.8–10.9 mm) than in the larvae of the other three subfamilies (10.0–20.0 mm) (Washington et al. 1984a).

The majority of the head spines of *G. marmoratus* develop before the postflexion stage, as is the case in other scorpaenid larvae. The parietal spines are not as prominent as in sebastine and scorpaenine larvae and lack the serrations usually found in the parietal spines of the larvae of these subfamilies (Washington et al. 1984a). The small nuchal spines, which disappear in juveniles, are excluded from the parietal ridges and never exceed in length those of the parietal spines, as has been observed in other scorpaenine larvae. In addition, all anterior preopercular spines except the APO_1 spine disappear in larval *G. marmoratus* after flexion has been completed; the same spines disappear in sebastine larvae (Washington et al. 1984a). The prominent suborbital stay of larval *G. marmoratus* (LIO_2 spine), which starts to develop after flexion, is venomous in adult specimens (Hutchins and Thompson 1983; Last et al. 1983). In contrast to larval *G. marmoratus*, this suborbital spine is absent or incomplete in sebastine, scorpaenine, and sebastolobine larvae. The absence of a suborbital spine has been suggested as a plesiomorphic condition in Scorpaeniformes (Washington et al. 1984b).

The presence of well-fused hypurals 1 and 2 (lower hypural plate) and hypurals 3 and 4 (upper hypural plate) in the caudal complex of larval *G. marmoratus* represent a derived character in scorpaeniform fish according to Washington et al. (1984b). By contrast, the presence of both a reduced fifth hypural element (HY_5) and a parhypural element represents a plesiomorphic condition, which in turn suggests that this monospecific genus still retains characters that correspond to a more generalized type of scorpaenid. More information is needed, however, on related genera of the Scorpaenidae to provide a more detailed comparison of these characters in larval *G. marmoratus* and to suggest relationships within the suborder Scorpaenoidei.

Distinguishing Larval Characters

Larval *G. marmoratus* can be distinguished from other scorpaenid larvae that occur within its geographical range by the possession of 29 myomeres, the dorsal fin count of XIII, 9, and their large and distinctively pigmented fan-shaped pectoral fins which form early in development. Larvae of *Scorpaena* are distinguished from *G. marmoratus* by a lower number of myomeres, whereas *Maxillicosta* and *Neosebastes* possess a higher number of pectoral fin rays (18–21) (Scott et al. 1980; Leis and Rennis 1983). Larvae of *Centropogon* and *Glyptauchen* are distinguished from *G. marmoratus* by their possession of a higher number of spines (15–18) in the dorsal fin (Washington et al. 1984b). Juvenile *G. marmoratus* can also be distinguished from other known scorpaenids in the area by their distinctive head spination and scaleless skin (Hutchins and Thompson 1983).

Larvae of *G. marmoratus* can be confused with some platycephalids and triglids, which also have pigmented pectoral fins and well-developed head spination. However, platycephalid larvae have numerous small melanophores scattered over the body surface, depressed heads with flattened snouts, and smaller parietal spines (Leis and Rennis 1983). Triglid larvae can be distinguished from *G. marmoratus* by the depressed profile of their heads and by large pectoral fins in which the lowest three rays become detached during transformation (Washington et al. 1984a).

Occurrence of Larvae in the Swan Estuary

Gymnapistes marmoratus larvae were found in surface waters of the Swan Estuary between July and September 1986, and peak numbers were obtained in July (Neira, unpubl. data). Larvae were collected in the area of the lower Swan Estuary located between 3.0 and 9.0 km upstream from the estuary mouth. The transforming larva and juveniles from the Peel-Harvey Estuary were collected by beach seines in October and August 1985 respectively. The occurrence of larvae and juveniles from both estuaries indicates that a population of *G. marmoratus* from southwestern Australia spawns in late winter and early spring. This spawning period is coincident with that reported in other regions of southern Australia such as Tasmania (Grant 1972), Port Phillip Bay (Jenkins 1986), and the Gippsland Lakes (Ramm 1986).

ACKNOWLEDGMENTS

I would like to thank B. B. Washington, J. M. Leis, and I. C. Potter for their helpful comments on the manuscript. Thanks are also due to D. Gaughan, L. E. Beckley, and M. Cliff for their help in the collection of the larvae. This research was carried out during the term of a Murdoch University Research Studentship given to the author.

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