

**Transforming Specimens of Two Righteye
Flounders, *Atheresthes evermanni* and
*Reinhardtius hippoglossoides***

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Early ontogeny of the North Pacific flatfishes (family Pleuronectidae) has long been comprehensively studied (i.e. Pertseva-Ostroumova, 1961). However, information on early life history series is still incomplete for some species, such as *Atheresthes evermanni* and *Reinhardtius hippoglossoides*. Although pelagic larvae of these two species have been reported (Schmidt, 1904; Jensen, 1935; Pertseva-Ostroumova, 1961), transforming specimens have remained unknown. Recently, transforming specimens referable to these large sized righteye flounders were collected from the western North Pacific. In this paper, their external and some internal morphology is described, with some comments on their transformation.

The specimens were fixed in 10% buffered sea water formalin. Counts and measurements followed Hubbs and Lagler (1958), and for osteological observations, 3 specimens of *A. evermanni* were stained using the method of Dingerkus and Uhler (1977). For this paper, metamorphosis was roughly divided into three stages, according to the degree of eye migration. The specimens are deposited in the Department of Zoology, National Science Museum (Nat. Hist.), Tokyo (NSMT-PL).

Atheresthes evermanni Jordan and Starks
(Japanese name: Abura-garei)

Material examined. 11 specimens. NSMT-PL 29,
35.2 mm SL, North Pacific, 43°58'N, 147°15'E, R/V *Waka-*

shio-Maru, purse seine, 1 Aug. 1989; NSMT-PL 30, 29.3–35.4 mm SL, (8 specimens), North Pacific, 44°07'N, 147°07'E, R/V *Wakashio-Maru*, purse seine, 1 Aug. 1989; NSMT-PL 31, 34.3, 35.2 mm SL, (2), off Kushiro, Hokkaido, Japan, 42°33'N, 143°40'E, *Tokukai-Maru*, beam trawl, 8 July 1990.

Morphology. Counts and measurements are shown in Table 1.

Early metamorphic larvae (30.2–35.2 mm SL): body slender, moderately compressed; mouth very large; preopercle spine present; supraorbital spine absent; body scaleless; all fin rays except pectorals complete; left eye positioned slightly dorsally following onset of eye migration (Fig. 1A, B). Late metamorphic larvae (29.3–35.4 mm SL): body depth increased slightly; left eye positioned more dorsally (Fig. 1C, D). Settled larvae (34.3–35.2 mm SL): migration of left eye completed, left (upper) eye located just below top of head (as in adults); premaxillary, dentary and palatine with teeth; body scaleless; dorsal fin origin posterior to right eye; anal fin origin located anteriorly at ca. 28% of SL (Fig. 1E).

Pigmentation. At early metamorphosis, pigmentation pattern similar on both sides of body. Melanophores present on and near border between myomeres and pterygiophores of dorsal and anal fins, and on upper and lower jaws. Patches of melanophores on dorsolateral area of head, cheek and breast, and in distinct band on caudal peduncle (Fig. 1A, B). At late metamorphosis, pigmentation pattern on each side differs. Melanophores on left side less distinct than in former stage (Fig. 1C, D); melanophores on right side increased in number, forming several weak, evenly spaced, vertical bands (retained in settled larvae) (Fig. 1E).

Osteology. At early metamorphosis, all skull elements present; lateral ethmoid, metapterygoid and quadrate still cartilaginous. About 20 spines on preopercle, two small spines on parietal. Frontals symmetrical. Coracoid with long posterior process (stained poorly with alcian blue) (Fig. 2A). Ossification of abdominal vertebrae initiated; basipterygium and caudal skeleton still cartilaginous. At late metamorphosis, posterior process of coracoid absent, preural vertebrae ossifying. At settlement, skull and vertebrae, including basipterygium, fully ossified. Frontals asymmetric, twisted to right side (Fig. 2B).

Remarks. These specimens were identified as *Atheresthes evermanni* on the basis of the number of

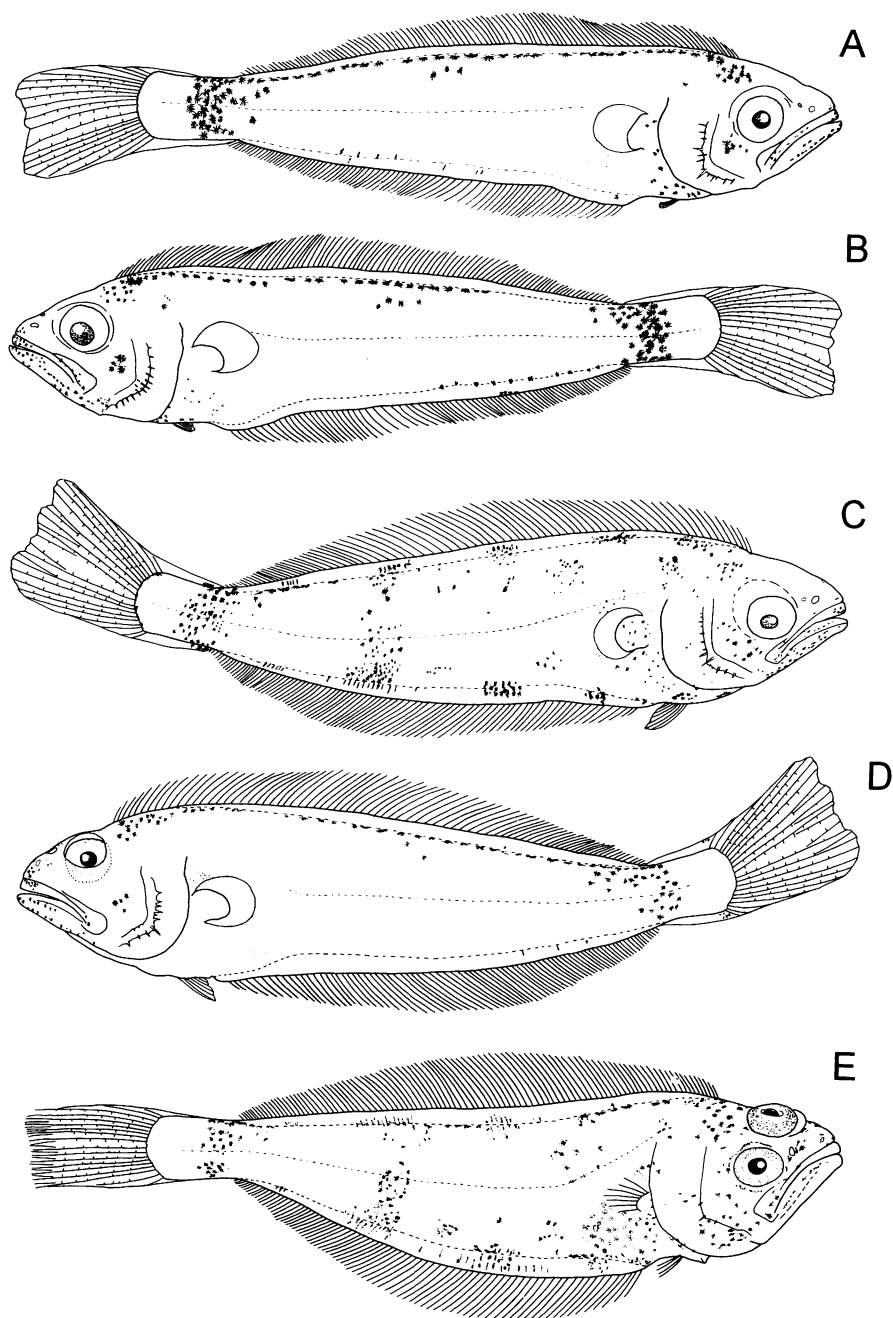


Fig. 1. Metamorphic and settled larvae of *Atheresthes evermanni*. A, B) Early metamorphic larva, NSMT-PL 30, 30.2 mm SL; C, D) late metamorphic larva, NSMT-PL 30, 35.2 mm SL; E) settled larva, NSMT-PL 31, 34.3 mm SL. A, C and E) Right-lateral view; B, D) left-lateral view.

myomeres-vertebrae, together with the extremely large mouth. Larvae of the genus *Atheresthes* are usually identifiable by their possessing supraorbital

and preopercle spines (Pertseva-Ostroumova, 1961; Minami, 1989). Although the present specimens lacked spines on the supraorbital, two weak parietal

Transforming Pleuronectid Larvae

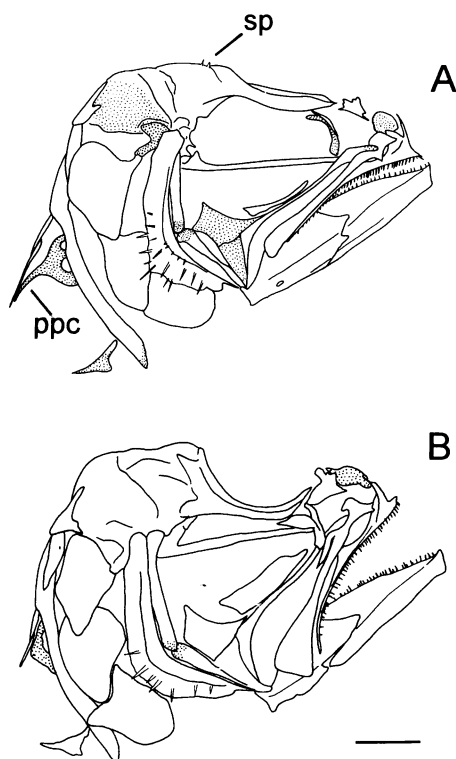


Fig. 2. Lateral view of skull, and shoulder and pelvic girdles of *Atheresthes evermanni*. A) Early metamorphic larva, NSMT-PL 30, 30.2 mm SL; B) settled larva, NSMT-PL 31, 34.3 mm SL. *ppc*—posterior process of coracoid; *sp*—spines on parietal. Dots and scale indicate cartilage and 1 mm, respectively.

Table 1. Counts and proportional measurements (range and mean) of metamorphic and settled larvae of *Atheresthes evermanni* and *Reinhardtius hippoglossoides*

	<i>A. evermanni</i>			<i>R. hippoglossoides</i>
	Early metamorphic larvae	Late metamorphic larvae	Settled larvae	
Number of specimens	4	5	2	1
Total length (mm)	35.6–41.7 (37.7)	34.3–41.6 (39.4)	40.7–41.5 (41.1)	58.0
Standard length (mm)	30.2–35.2 (32.4)	29.3–35.4 (33.2)	34.3–35.2 (34.8)	49.9
Counts				
Dorsal fin rays	104–113	101–109	104–106	97
Anal fin rays	79–90	77–80	78–84	70
Myomeres	49	49	49	63
Measurements in % of SL				
Head length	20.7–24.6 (22.6)	24.2–31.8 (26.3)	25.6–26.0 (25.8)	28.1
Preanal length	27.0–29.1 (27.2)	25.7–28.9 (27.2)	27.4–27.8 (27.6)	33.9
Body depth	18.4–22.7 (20.4)	21.8–25.2 (23.2)	23.3–24.1 (23.7)	26.1
Measurements in % of HL				
Snout length	25.7–30.7 (29.0)	26.1–29.6 (27.7)	25.8–27.3 (26.6)	31.3
Upper jaw length	51.4–56.8 (54.3)	51.1–56.3 (53.9)	53.4–56.2 (54.8)	44.6
Suborbital width (right)	2.7–7.9 (5.1)	1.1–2.6 (1.9)	1.9–5.7 (3.8)	5.9
Suborbital width (left)	3.6–7.9 (5.5)	4.2–11.3 (7.2)	—	—

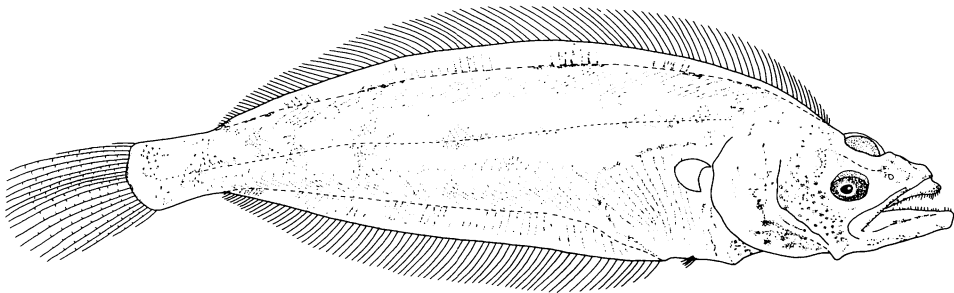


Fig. 3. Metamorphic larva of *Reinhardtius hippoglossoides*, NSMT-PL 28, 49.9 mm SL.

spines buried under the skin in the early metamorphosis stage are considered to be degenerated supra-orbital spines. These had disappeared completely by the late metamorphosis stage. Likewise, the preopercle spines had also become weak in the settled larvae and seemed destined to quickly disappear. The above head spines on head are notable morphological features, peculiar to the pelagic stages.

***Reinhardtius hippoglossoides* (Walbaum)**
(Japanese name: Karasu-garei)

Material examined. One specimen. NSMT-PL 28, 49.9 mm SL, Bering Sea, 57°11.4'N, 172°50.1'W, *Seiju-Maru*, surface trawl, 22 Aug. 1989.

Morphology. Counts and measurements are shown in Table 1. Body moderately elongate, strongly compressed; mouth very large; premaxillary, dentary and palatine with teeth; body scaleless; left eye on top of head (as in adults); all fin rays except pectorals complete; dorsal fin originating over posterior rim of right eye; anal fin origin located anteriorly at 33% of SL (Fig. 3).

Pigmentation. Melanophores variously present only on left side, including head, between pterygiophores of dorsal and anal fins, between myomeres, and caudal peduncle and interspine bases of dorsal and anal fin rays (Fig. 3).

Remarks. This specimen was identified as *Reinhardtius hippoglossoides* owing to the large mouth and number of myomeres. *R. hippoglossoides* occurs in Arctic-amphiboreal waters, having been divided into two subspecies or species (i.e. Pacific stock, *R. hippoglossoides matsuurae* or *R. matsuurae* and Atlantic stock, *R. hippoglossoides*) until Hubbs and Wilimovsky (1964) confirmed both stocks to represent a single species, *R. hippoglossoides*. Judging from the

location of the left eye, the present specimen (49.9 mm SL) seemed to be near the settlement stage, although its size was ca. 10 mm shorter than that of Atlantic specimens at the same stage (Jensen, 1935). Pertseva-Ostroumova (1961) noted that the Pacific stock was better developed than Atlantic stock of the same size, these facts suggesting that Pacific and Atlantic stocks of *R. hippoglossoides* have different growth patterns during their early life histories. Moreover, Fairbairn (1981) suggested that the genetic divergence between the two stocks was at the subspecific level. Further consideration is necessary for full clarification of these differences.

Both *Atheresthes evermanni* and *Reinhardtius hippoglossoides* spawn during Oct. to Jan. in the Pacific Ocean (Pertseva-Ostroumova, 1961; Mikawa, 1963). As these metamorphic larvae were captured in August, their pelagic life stages were estimated to extend over half a year.

Okiyama and Takahashi (1976) suggested that the vertebral number is positively correlated with metamorphic size in the Pleuronectinae. *A. evermanni* and *R. hippoglossoides* have vertebral numbers of 49–50 and 60–65, respectively (Okiyama and Takahashi, 1976; Sakamoto, 1983). Since the estimated sizes at metamorphosis of *A. evermanni* and *R. hippoglossoides* are ca. 35 mm and 50 mm SL, respectively, some support is given to the suggested relationship above.

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アブラガレイとカラスガレイの変態期仔魚

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2種のカレイ科魚類, アブラガレイ *Atheresthes evermanni* とカラスガレイ *Reinhardtius hippoglossoides* の変態期仔魚について形態的特徴を記載した。変態が完了する体長はアブラガレイが約35 mm, カラスガレイが約50 mmと推定され, いずれの種もカレイ科では最大クラスに属する。

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