

DEVELOPMENTAL CHARACTERS OF *PSETTINA IJIMAE* (JORDAN AND STARKS), BOTHID FLAT FISHES - PISCES

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ABSTRACT

Post larval stages of *Psettina ijimae* (Jordan and Starks) ranging from 1.8 mm NL to 44.6 mm SL collected during Naga Expedition and International Indian Ocean Expedition (IIOE) are described. The characteristics which help to identify larval stages of *Psettina* are the presence of pigmented urohyal appendage in early stages which gets progressively reduced during flexion stages and which disappears in later postflexion stages, the meristics, the spines on urohyal and posterior basipterygial processes and the absence of spines on cleithra. The *P.ijimae* can be distinguished in the presence of spines on the median fin rays which differentiate near the baseoste along the dorsal and ventral body wall much before the fin rays.

The larvae of *P.ijimae* were more abundant in the Gulf of Thailand compared to South China Sea and Indian Ocean.

INTRODUCTION

Even though information on systematics and distribution of adults of flat fishes from the Indo-Pacific region are well documented; the larvae of many of them still remains to be identified. Larvae of *Psettina ijimae* from Gulf of Tonkin has been reported by Pertseva - Ostoumova (1965). The present report attempts to elucidate the characteristics, developmental stages and distribution of *P. ijimae* collected from Indian Ocean, Gulf of Thailand and South China Sea.

MATERIAL AND METHODS

The larval stages of *P.ijimae* from the Indian Ocean, Gulf of Thailand and South China Sea collected during International Indian Ocean Expedition

(1960-65) and Naga Expedition (1959-61) were sorted out from the zooplankton samples and identified upto specific level. A set of larvae were used for morphometric data and another set for numerical counts. A third set was sacrificed to study the development of bone and cartilage using differential stains of Alizarine Red and Alcian Blue after clearing the flesh with Enzyme Tripsin (Dingerkus and Uhler, 1977). During IIOE most of the samples were collected in a uniform manner with the Indian Ocean Standard net (Currie, 1963) adhering to the recommendation to haul the net vertically at a winch speed of 1 m/sec from a depth of 200 m to the surface or, on the continental shelf from the bottom to the surface (IOBC, 1969). In the case of Naga Expedition different type of net was used and the volume of water filtered was obtained from the flow meter in most cases (Faughn, 1974). Statistical analyses of the data were made whenever possible. Wherever the sampling was not quantitative their presence was indicated by the sign X in the chart.

RESULTS

Larvae ranging from 1.8 mm NL to 20.2 mm SL and metamorphosed stage from 22.5 to 44.6 mm SL occur in the plankton collection of the IIOE and Naga Expedition. The larvae belonging to preflexion, flexion and postflexion and metamorphosed stages are contained in the collections. (Figs. 1 A, B, C, Tables I-IV).

Morphology IGY

The larval body is thin, transparent and symmetrical in early stages. The eyes are symmetrical and black pigments are seen only from 2.6 mm NL larvae. The right eye has started shifting from its symmetrical position preparatory to migration to the left side in 13.5 mm SL larvae and the migration is completed in larvae ranging in length from 20.2 and 22.5 mm SL (Table I). The teeth are not visible in the larvae upto 2.3 mm NL. The anterior portion of the alimentary canal runs slightly slanting downwards towards the ventral aspect and makes an elliptical coil at the posterior end of the abdominal cavity. The terminal portion lies vertically down and the anus opens at the level of tenth myotome in early stages (Fig. 1A). In advanced stages, the alimentary canal becomes compactly packed with the ventral portion being pushed forward and the anus opens at the level of the seventh vertebral segment. The antero-posterior axis of the liver is longer than the dorso-ventral axis in early stages but after metamorphosis the latter is more. The swim bladder is situated in the posterior region of the abdominal cavity and occupies the space between seventh and tenth vertebral segments.

Table I : Morphometrics, in mm, of larvae and metamorphosed stage of *P. ijimae*. (specimens between dashed lines are undergoing notochord flexion)

STN	BL	RE	NC	SA	HL	SL	EW	EH	DPB	DAN	DCP	CPL	SPF
S5-23 A	1.8 NL	SYM	STR	1.00	0.41	0.13	0.18	0.21	0.61	0.45	--	--	--
S7-13	2.1 "	"	"	1.30	0.55	0.16	0.23	0.23	0.71	0.50	--	--	--
S7-18G	2.6 "	"	"	1.50	0.74	0.16	0.23	0.26	0.97	0.61	--	--	--
S5-22A	3.2 "	"	"	1.80	1.00	0.21	0.29	0.34	1.48	1.26	--	--	--
S7-18G	3.7 "	"	"	1.70	1.00	0.31	0.29	0.32	1.50	1.30	--	--	0.70
S5-10	3.9 "	"	"	1.80	1.10	0.39	0.31	0.32	1.90	1.50	--	--	0.90
S7-8B	4.3 "	"	"	1.90	1.20	0.35	0.34	0.35	2.30	2.20	--	--	0.90
S7-18G	4.6 "	"	EP	2.30	1.40	0.42	0.34	0.36	2.10	2.00	--	--	0.90
S7-18G	4.9 "	"	"	2.40	1.55	0.50	0.34	0.35	2.40	2.00	--	--	1.30
S7-8B	5.1 "	"	MF	2.40	1.60	0.55	0.38	0.43	2.70	2.40	--	--	1.30
S5-22E	5.2 "	"	"	2.30	1.60	0.58	0.39	0.42	2.70	2.70	--	--	1.30
S7-8B	5.8 "	"	LF	2.40	1.80	0.55	0.42	0.48	3.00	2.80	--	--	1.30
S9-21	6.3 "	"	"	2.70	1.80	0.55	0.45	0.48	3.10	2.80	--	--	1.50
Ki-527	6.6 "	"	"	2.70	1.90	0.53	0.45	0.48	3.10	3.10	--	--	1.30
S9A-13A	6.5 SL	"	FLD	2.50	1.80	0.55	0.48	0.53	3.40	3.20	0.58	0.32	1.10
S9A-13A	7.0 "	"	"	2.80	2.00	0.61	0.53	0.56	3.50	3.40	0.66	0.39	1.30
S9A-13A	8.6 "	"	"	3.30	2.20	0.63	0.53	0.60	4.40	4.30	0.90	0.42	1.50
S7-8B	9.1 "	"	"	3.50	2.20	0.69	0.52	0.58	5.40	5.30	1.13	0.52	0.30
S9A-13A	10.3 "	"	"	3.60	2.40	0.64	0.52	0.58	5.50	5.40	1.32	0.64	1.70
S9A-13A	11.7 "	"	"	3.70	2.80	0.74	0.58	0.61	5.70	5.80	1.61	0.66	1.60
S9A-13A	12.7 "	"	"	4.40	3.00	0.77	0.61	0.68	5.60	6.70	1.80	0.71	2.00
S9A-13A	13.5	MIG	"	4.40	3.00	0.74	0.60	0.64	5.90	6.60	2.00	0.79	1.90
S3-29	14.7 "	"	"	4.40	3.10	0.81	0.60	0.68	6.40	7.10	2.40	0.89	1.90
S11A-12	16.2 "	"	"	4.80	3.70	1.03	0.60	0.63	7.90	8.30	2.50	0.85	1.80
S4-U24	18.5 "	"	"	4.80	4.10	1.03	0.84	0.84	8.80	8.90	2.80	1.13	1.90
S5-28A	19.7 "	"	"	5.00	4.00	1.00	0.87	0.97	9.70	9.60	2.90	1.13	2.00
S5-28A	20.2 "	"	"	5.20	4.20	1.10	0.89	0.97	8.70	9.30	2.80	1.22	2.10
S9A-10	22.5 "	OVR	MET	5.40	6.10	1.50	1.29	0.90	8.60	8.40	2.60	1.38	3.10
S9A-4A	26.4 "	"	"	7.00	7.10	1.70	1.80	1.20	8.70	8.70	3.00	1.58	4.00
S9A-4A	36.4 "	"	"	9.50	9.10	1.90	2.60	1.90	10.90	11.30	3.70	2.20	6.10
S9A-5	44.6 "	"	"	11.00	11.70	2.50	2.70	1.90	14.20	13.20	5.60	3.00	7.60

STN = Station ; BL = Body length ; RE = Right eye ; NC = Notochord ; SA = Snout to anus ; HL = Head Length ; SL = Snout length ; EW = Eye width ; EH = Eye height ; DPB = Body depth at pectoral fin base ; DAN = Body depth at anus ; DCP = Caudal peduncle depth ; CPL = Caudal peduncle length ; SPF = Snout to origin of pelvic fin ; SYM = Symmetrical ; STR = Straight ; EF = Early flexion ; MF = Midflexion ; LF = Late flexion ; FLD = Flexed ; MIG = Migrating ; OVR = Over ; MET = Metamorphosed

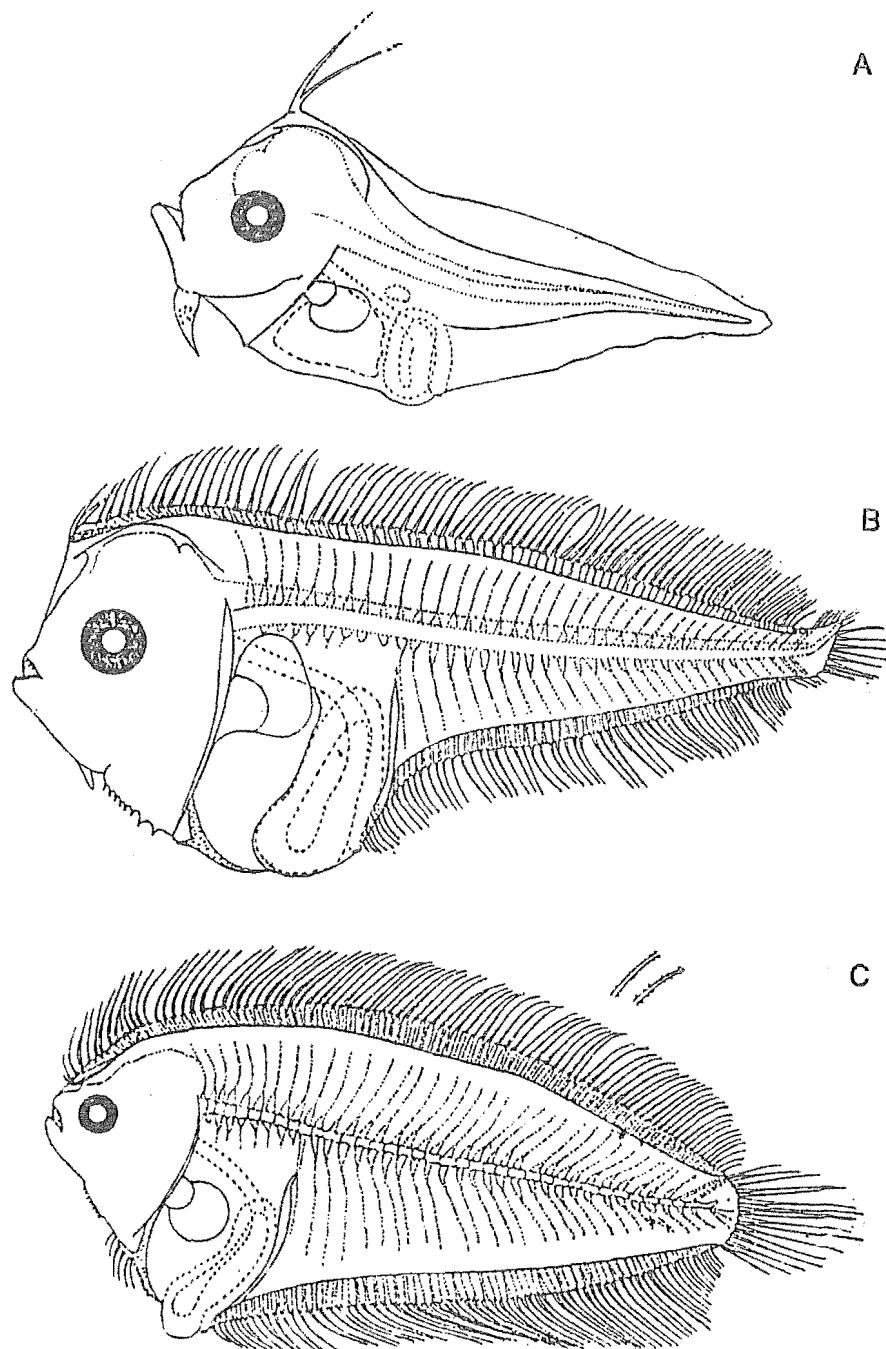


Fig. 1. A. Prolle-xion stage larva of *Psettina ijimae* 3.0 mm NL showing pigmented diverticulum.
B. Flexion stage larva of *P. ijimae* 5.7 mm NL.
C. Post flexion stage larva of *P. ijimae* 19.7 mm SL with enlarged view of spinules on rays.

A pigmented diverticulum is seen hanging down just in front of the first spine on the urohyal (Fig. 1A) in the earliest larvae of 1.8 mm NL. This urohyal appendage shrivels up as growth progresses and is traceable upto 12.7 mm SL in cleared specimens. The brownish black pigment at the base of the appendage also disappears along with the appendage (Fig. 1C). Pigments are not noticed anywhere else on the body of the larvae.

Spines are late to appear on urohyal and posterior basipterygial processes (Fig. 1B). This species differs from others in that the spinules are seen distributed near the baseosts along the dorsal and ventral body wall even before the formation of the fin rays (Devi, 1986). They are found distributed along the fin rays when the larvae attains 4.6 mm NL onwards and continue to exist even in metamorphosed stages. Spines on urohyal gets differentiated from larvae of 5.1 mm NL and posterior basipterygial from 7.0 mm SL (Table II). The spines on the posterior basipterygial processes is confined to its proximal half, the distal half being devoid of any such spines. The spines are not found on the cleithra. The spines on the posterior basipterygial processes and urohyal reduce in size and disappear as soon as metamorphosis takes place.

Table II : Meristics of larvae and juvenile of *P.ijimae* (specimens between dashed lines are undergoing notochord flexion)

STATION	SIZE STAGE (mm)	NC	RE	FIN RAYS				VERTEBRAE			SPINES		
				DL	AL	CL	LP	PCL	CL	TOTAL	UH	CR	PBP
S5 - 23A	1.8 NL PF	STR	SYM	1	0	0	0				0	0	0
S7 - 18G	2.1 NL "	"	"	1	0	0	0				0	0	0
"	3.7 NL "	"	"	1	0	0	0				0	0	0
S7 - 8B	4.3 NL "	"	"	1 + Forming	0	0	0				0	0	0
S9A - 13A	4.9 NL EF	FL	"	"	"	ca.4	0				0	0	0
S7 - 8B	5.1 NL MF	"	"	"	"	ca.8	0				6	0	0
S9A - 13A	5.5 NL "	"	"	ca.78	ca.61	8	0				8	0	0
S7 - 8B	5.8 NL LF	"	"	ca.82	ca.60	11	0				9	0	0
S9A - 13A	6.5 SL PTF	FLD	"	85	68	17	2+4	10	29	39	10	0	0
"	7.0 SL "	"	"	87	68	17	2+4	10	29	39	8	0	2
"	8.6 SL "	"	"	93	70	17	2+4	10	29	39	9	0	5
"	10.8 SL "	"	"	88	68	17	3+3	10	28	38	8	0	4
S6 - 30	11.5 SL "	"	"	86	69	17	3+3	10	29	39	8	0	7
S7 - 8B	13.5 SL "	"	MIG	86	69	17	3+3	10	28	38	9	0	10
S5 - 10	15.5 SL "	"	"	88	70	17	3+3	10	29	39	10	0	10
S3 - 32	16.9 SL "	"	"	84	69	17	3+3	10	28	38	9	0	9
S5 - 28A	20.2 SL "	"	"	91	70	17	3+3	10	30	40	5	0	11
S9A - 10	22.5 SL MET	"	OVR	82	68	17	3+3	10	29	39	0	0	0
S9A 4A	26.4 SL "	"	"	84	70	17	3+3	10	29	39	0	0	0
S9A - 5	44.6 SL "	"	"	82	68	17	3+3	10	28	38	0	0	0

* Spinules along the base of median fins

NC = Notochord; RE = Right eye; DL = Dorsal; AL = Anal; CL = Caudal; LP = Left pelvic; PCL = Precaudal; UH = Urohyal; CR = Cleithra; PBP = Posterior basipterygial processes; PF = Preflexion; STR = Straight; SYM = Symmetric; EF = Early flexion; FL = Flexing; MF = Midflexion; LF = Late flexion; PTF = Postflexion; FLD = Flexed; MIG = Migrating; MET = Metamorphosed; OVR = Over.

The relative head length and the length between snout and pelvic fin base increase from preflexion to flexion stages, decrease from flexion to postflexion stages and then show increase from postflexion to metamorphosed stages but the increment is less than the preflexion values (Table III). The relative snout to anus length, depth at pectoral fin base as well as the eye width and height gradually decrease but the eye width shows a slight increase in the metamorphosed stages. However, the increment is less than the preflexion values. The relative depth across anus decreases from preflexion to flexion stages but decreases again. The relative snout length shows slight increase during flexion stages, thereafter it decreases.

Table III : Body proportions of larvae of *P. ijilmae* (Values given for each body proportion expressed as 10^{-2} of body length or head length, mean, standard deviation and range)

Stages	Body Proportions			
	Snout to anus/Body Length	Head length/Body length	Snout length/Head length	Eye width/Head length
Preflexion	52.57 \pm 7.09 (44-62)	27.14 \pm 2.73 (22-31)	28.43 \pm 5.16 (21-35)	33.00 \pm 6.93 (28-44)
Flexion	45.00 \pm 3.70 (41-50)	30.43 \pm 3.13 (20-29)	30.57 \pm 3.46 (26-36)	23.71 \pm 0.95 (22-25)
Postflexion	32.33 \pm 5.07 (25-40)	23.25 \pm 2.45 (20-29)	27.08 \pm 2.19 (25-31)	21.33 \pm 2.81 (16-27)
Metamorphosed	25.91 \pm 4.11 (22-36)	26.27 \pm 3.44 (23-35)	24.00 \pm 2.28 (21-27)	26.55 \pm 4.41 (19-33)
	Eye Height/Head Length	Body depth at Pectoral base before development of dorsal base/Body length	body depth at Pectoral base after development of dorsal base/Body length	Body depth at anus before the formation of dorsal & anal/Body length
Preflexion	36.00 \pm 7.96 (29-51)	40.17 \pm 6.31 (34-49)	53.00	30.67 \pm 7.45 (23-39)
Flexion	25.71 \pm 1.80 (22-27)		49.71 \pm 2.69 (46-52)	
Postflexion	23.08 \pm 3.06 (17-28)		48.58 \pm 4.58 (43-59)	
Metamorphosed	17.35 \pm 3.14 (11-21)		33.36 \pm 4.20 (30-43)	
	Body depth at anus after development of Dorsal and Anal base/Body length	Caudal peduncle depth/Body length	Cadual Peduncle Length/Body length	Snout to pelvic fin base/Body length
Preflexion	51.00			21.00 \pm 2.0 (19-23)
Flexion	46.00 \pm 3.85 (41-52)			25.00 \pm 4.76 (20-34)
Postflexion	50.25 \pm 3.03 (46-58)	13.5 \pm 2.15 (9-16)	5.83 \pm 0.39 (5-6)	13.75 \pm 3.08 (10-19)
Metamorphosed	33.73 \pm 4.67 (29-45)	11.73 \pm 1.27 (10-14)	6.18 \pm 0.80 (5-7)	14.64 \pm 5.18 (10-29)

Fin and supporting structures

The elongated dorsal ray at the anterior end of the dorsal fin fold is seen in the larvae from very early stage upto 20.2 mm SL. Pterygiophers and baseosts are differentiated in 3.8 mm NL but rays are not differentiated. The first anal pterygiophore is differentiated in 3.7 mm NL and is long and stout. The fin rays and pterygiophores differentiate from anterior to posterior. The first dorsal pterygiophore extends forwards beyond the articulation of the elongated dorsal ray in 5.8 mm larvae which is indicated in 4.9 mm. The first dorsal ray is very small and is differentiated in 6.5 mm SL larvae when full complements of 85 dorsal and 68 anal rays are seen. The dorsal and anal rays range from 82-93 and 68-70 respectively.

The rudiments of the hypural elements are seen differentiating as a pack of cells at the ventral caudal extremity in 4.3 mm NL. Caudal rays are differentiated from 4.6 mm NL larvae. The inferior hypural middle and superior hypural middle are differentiated and carry four and two rays respectively in 4.6 mm NL larvae. In 5.5 mm NL larvae, inferior hypural lower is differentiated and the superior hypural upper in 6.5 mm SL. The flexion of the notochord takes place between 4.6 mm NL and 6.5 mm SL larvae. The epural component is differentiated in 4.9 mm NL larvae. The full complement of the caudal finrays are seen in 6.5 mm SL. Of the 17 caudal rays, 15 are borne by the hypural plates. The inferior hypural lower three, middle four, superior hypural middle five and upper three.

The pelvic fin complex appears as pack of cells at the ventral posterior face of the cleithra in 3.7 mm NL larvae. The pelvic fin radial rudiment (anterior basipterygial processes) is indicated in 4.3 mm NL larvae when the posterior basipterygial processes are also differentiated. The pelvic fin ray rudiments are seen in 6.3 mm NL and the rays are discernible in 6.5 mm SL. At this stage two of the left pelvic fin rays are seen in advance of the right fin rays. The left fin radial continues to grow in advance of the right and reaches the level of the cleithral tip in 6.5 mm SL and in 10.8 mm SL it reaches the level of the posterior most spine on the urohyal. In 20.2 mm SL larvae, the anterior rays of the pelvic fin super impose the urohyal and the tip of the cleithra is seen between third and fourth rays. The urohyal is differentiated in 4.3 mm NL.

Axial skeleton

The notochord remains vacuolated and segmented in larvae up to 4.9 mm NL. The segmentation commences from the anterior end. The first neural arch is differentiated as a cartilaginous loop like structure in front of the second neural arch in 4.3 mm NL larvae. It has no neural processes but there is a lancet shaped portion which is short and never reaches the body wall like other neural spines. It gets ossified in 10.8 mm SL, while the other processes get ossified much earlier (6.5 mm SL). The first dorsal pterygiophore carries the elongated dorsal ray and is seen in the earliest larvae 1.8 mm NL. The first dorsal pterygiophore remain ossified from the earliest larvae. It grows over the skull. The precaudal neural processes are seen in 3.7 mm NL except the first. In caudal region, the neural and haemal processes are also differentiated in 3.7 mm NL and are completed in 5.8 mm NL (Table IV). The haemal arches of the precaudal region have started differentiating in 3.7 mm NL and the tiny processes have started differentiating from 5.8 mm NL but completed only in 8.6 mm SL when six processes are discernible. The precaudal centra start differentiating from 5.5 mm NL and the caudal centra are only faintly marked which is clearly seen from 6.5 mm SL. The vertebrae start ossification from 10.8 mm SL. There are 10 + 28 - 39 vertebrae including urostyle.

Table IV : Development of vertebral column, caudal fin rays and caudal fin supporting bones in larvae of *P. iijimae*

Station	BL	ST	NC	RE	Precaudal Vertebrae					Caudal Vertebrae					UC	TV	CFR	Ural Bones				
					NPR	NAR	HPR	HAR	CEN	NPR	NAR	HPR	HAR	CEN				SHU	SHM	IBM	IHL	EP
S5-23A	1.8 NL	PF	STR	SYM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S7-18G	2.1 "	"	"	"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
"	2.3 "	"	"	"	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
"	2.6 "	"	"	"	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
"	3.0 "	"	"	"	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S5-22A	3.2 "	"	"	"	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S7-18G	3.7 "	"	"	"	9	0	0	3	0	7	10	11	10	0	0	30	0	0	0	0	0	0
S7-8B	4.3 "	"	"	"	9	1	0	6	0	24	3	25	3	0	0	38	0	0	0	0	0	0
S7-18G	4.6 "	EF	FL	"	9	1	0	8	0	24	3	24	3	0	0	37	6	0	x	x	0	0
S9A-13A	4.9 "	"	"	"	9	1	0	8	0	24	3	24	3	0	0	37	6	0	x	x	0	x
"	5.5 "	MF	"	"	9	1	0	8	10	26	3	26	3	+	0	39	8	0	x	x	x	x
S7-8B	5.8 "	LF	"	"	9	1	4	4	10	26	2	26	2	+	0	38	11	0	x	x	x	x
S9-13A	6.5 SL	PTF	FLD	"	9	1	4	5	10	26	2	26	2	26	1	39	17	x	x	x	x	x
"	7.6 "	"	"	"	9	1	4	5	10	26	2	26	2	28	1	39	17	x	x	x	x	x
"	8.6 "	"	"	"	9	1	6	3	10	26	2	26	2	28	1	39	17	x	x	x	x	x
"	10.8 "	"	"	"	9	1	6	3	10	25	2	25	2	27	1	38	17	x	x	x	x	x
"	11.7 "	"	"	"	9	1	6	3	10	26	2	26	2	28	1	39	17	x	x	x	x	x
"	12.7 "	"	"	"	9	1	6	3	10	26	2	25	2	28	1	39	17	x	x	x	x	x
"	13.5 "	"	"	MIG	9	1	6	3	10	25	2	26	2	27	1	38	17	x	x	x	x	x
S5-10	15.5 SL	PTF	FLD	MIG	9	1	6	3	10	26	2	25	2	28	1	39	17	x	x	x	x	x
S3-32	16.9 "	"	"	"	9	1	6	3	10	25	2	26	2	27	1	38	7	x	x	x	x	x
S4-U24	16.3 "	"	"	"	9	1	6	3	10	26	2	25	2	28	1	38	17	x	x	x	x	x
S5-28A	20.2 "	"	"	"	9	1	6	3	10	27	2	26	2	29	1	40	17	x	x	x	x	x
S9A-10	22.5 "	JUV	"	OVR	9	1	6	3	10	26	2	27	2	28	1	39	17	x	x	x	x	x
S9A-4A	26.4 "	"	"	"	9	1	6	3	10	26	2	26	2	28	1	39	17	x	x	x	x	x
S9A-5	44.6 "	"	"	"	9	1	6	3	10	25	2	25	2	27	1	38	17	x	x	x	x	x

BL = Body length; St = Stage; NC = Notochord; RE = Right eye; NPR = Neural processes; NAR = Neural arches; HPR = Haemal processes; HAR = Haemal arches; CEN = Centra; UC = Ural centrum; TV = Total vertebrae; CFR = Caudal fin rays; SHU = Superior hypural upper; SHM = Superior hypural middle; IHM = Inferior hypural middle; IHL = Inferior hypural lower; EP = Epural; PF = Preflexion; STR = Straight; SYM = Symmetrical EF = Early flexion; FL = Flexing; MF = Midflexion; LF = Late flexion; PTF = Preflexion; FLD = Flexed; MIG = Migrating; JUV = Juvenile; OVR = Over.

Distribution

Larvae of *P. ijimae* were very rare in the IIOE samples, being represented at two stations, one in the Strait of Malacca and the other near the northwest coast of Sumatra (Indonesia) (Fig. 2). The salinity of these stations ranged between 32.40 and 35.03‰. The sounding of these stations were 60 and 2000 m. They were found in the months of September and November. Only postflexion stages were found in the collections.

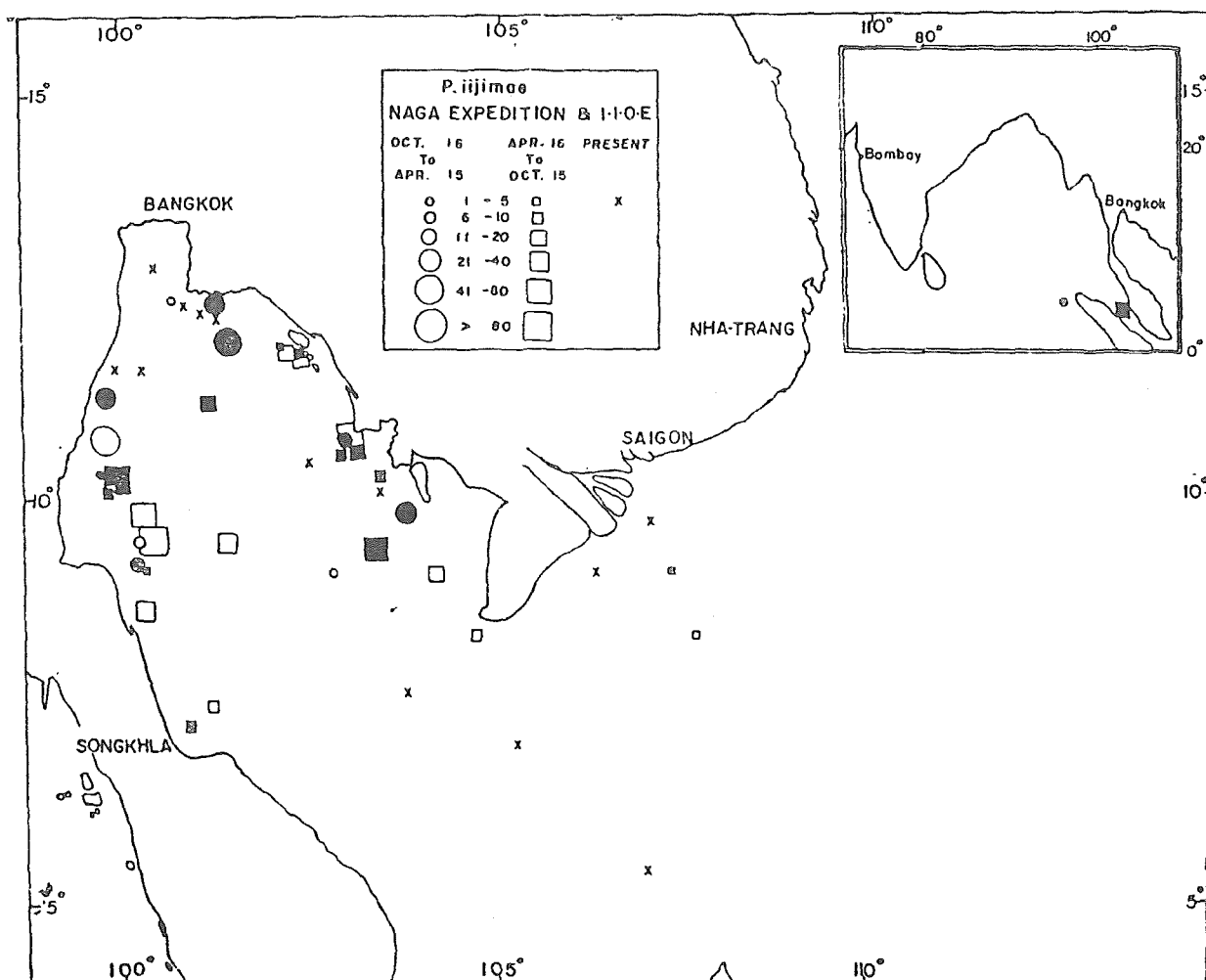


Fig. 2. Distribution of larvae of *P. ijimae* in the Indian Ocean (in set), Gulf of Thailand and South China Sea. Closed sign = night, open sign = day; x - presence

In the Naga Expedition samples they were present in the collections taken from the Gulf of Thailand. They were found throughout the Gulf waters occurring more frequently in station near the shore (Fig. 2). Preflexion to metamorphosed stages were found in the collections. The larvae of *P. ijimae* were also found in

the South China Sea also but not far away from the Gulf region. The larvae were mostly contained in the collection taken during night (37/55). Another peculiarity was the larvae of this species were found almost throughout the year except in May and July. Preflexion stages were found in the months of January, April, June, August, September, October and November. All stages were found in the same collection taken from certain stations. The salinity ranged between 30.23 and 34.50‰. The depth of the stations from where the larvae were collected varied from 18 to 67 m.

DISCUSSION

The larvae of *P. iijimae* can be distinguished from those of other bothid larvae in the presence of spines on the median fin rays in the former which differentiated as soon as the fin rays are formed (Devi, 1986). It may be noted that the spines are present near to the baseosts along the dorsal and ventral body even before the fin rays are differentiated. The range in meristic counts of the larval forms agree with those of the adults.

Uchida (1936) has described post larval stages with a greatly elongated branched dorsal ray and identified them as *P. iijimae*. The diagnostic features such as urohyal appendage, spines on urohyal and posterior basipterygial processes present in the larval forms of *P. iijimae*, being absent in the larval forms described by Uchida (1936) they cannot be placed under *P. iijimae*. The presence of elongated and branched dorsal ray together with the slender body of the larval forms described as *Arnoglossus japonicus* by Amaoka (1973). The larvae described by Amaoka (1976) as *P. iijimae* reported in detail by Pertseva-Ostroumova (1965) from Gulf of Tonkin as well as the present series from the Indian Ocean, Gulf of Thailand and South China Sea in the absence of urohyal appendage and spines on urohyal and posterior basipterygial processes structures characteristic of *P. iijimae*. Hence in all probability, the specimens described by Amaoka as *P. iijimae* may be referable to *Bothus* species.

Larval characteristics of *P. iijimae* reported and described by Pertseva-Ostroumova (1965) from Gulf of Tonkin agree with those from the Indian Ocean, Gulf of Thailand and South China Sea. The presence of larvae ranging from early stages of metamorphosing, and metamorphosed stages in the present series confirm the identification of Pertseva-Ostroumova (1965). The meristic counts agree with those of the adults. However, it is not clear whether the spines on fin rays, a characteristic feature of *P. iijimae* have been noted by Pertseva-Ostroumova (1965).

The presence of larvae mostly in the night collections show their preference to darkness. They show protracted breeding by their presence in most of the months.

Larve of *P.ijimae* is reported from the Gulf of Thailand and South China Sea as well as from Indian Ocean for the first time.

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