the fishery based on observations of field of atmospheric pressure over the Peninsular region of India.

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NOTES ON THE BIOLOGY AND FISHERY OF THE BUTTERFLY RAY, *GYMNURA POECILURA* (SHAW) FROM THE PALK BAY AND GULF OF MANNAR

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INTRODUCTION

A NUMBER of species of rays are of commercial importance at several places along the Indian Coast, forming popular food of the common man. They are consumed both in the fresh and cured states. Although the meat is generally considered to be of a low quality, for which reason it is sold very cheap, the flesh of certain species (*e.g.*, *Aetobatus narinari*) is esteemed as a delicacy.

To the fishery resources of the Palk Bay and Gulf of Mannar in the vicinity of Mandapam, the rays contribute a sizeable portion almost round the year. They are caught in a variety of nets in the area, *viz.*, shore seines, gill nets (drift and fixed) and otter trawl nets at depths varying from 10 to 30 metres. Of these, the most important gear for these fishes are the trawl nets and bottom set gill nets (especially employed for fishing the rays and called *Thirukai valai* or *Pachu valai* in Tamil), although the shore seines occasionally account for the capture of large shoals of rays that enter the inshore waters (James, 1962). In a recent study of trawl fishing in the Palk Bay and Gulf of Mannar (James and Clement Adolf, M S) it was pointed out that the resources of rays are comparatively better in Palk Bay than in the Gulf of Mannar, while shoaling species like *Rhinoptera javanica* appear to be common in the Gulf of Mannar. Of the species of rays of commercial importance in this area, namely, *Himantura bleekeri*, *H. uarnak*, *Pastinachus sephen*, *Gymnura poecilura*, *Amphotistius zugei* and *Rhinoptera javanica*, *G. poecilura* (called *Advani thirukai* in Tamil) was found to be fairly abundant, forming a greater part of the catches of rays at many places in this region. As there is no information on the biology and fishery of this important species, some general observations made by the author during the years 1964 to 1967 are given in this paper. Since the available descriptions including the proportional measurements of the species are inadequate, details of these are also given.

OBSERVATIONS

Material

In addition to a number of specimens examined in the field, detailed measurements of 49 specimens including 20 intra-uterine embryos were taken. The size range examined was 81–230 mm. for the intra-uterine embryos and 325–915 mm. disc width for others. This size, wherever mentioned in this paper, refers to disc width.

Description

The disc is typically lozenge-shaped (Pl. II, Fig. 1), the contour of the anterior margins of which on either side of the tip of snout is variable. The tip of the snout usually projects slightly in front and the concavities on either side of the snout may or may not be present. The tail which is 1·0 to 1·6 in length of disc usually bears one not very strong spine, sometimes none and very rarely two (observed only in one case in the present study, the specimen measuring 614 mm. and the spines 12 and 15 mm. in length). In the spineless individuals, a flattened, broad area may be seen in the position of the spine. A low median ridge is present on both sides of tail, but comparatively, it is more prominent on the dorsal side. Specimens were often found with a number of healed injuries on the margins of disc, a maximum of three on one side observed in the present study.

In the adults, considerable variation in the colour of the dorsal side of disc was observed, generally various shades of grey with light greenish-yellow reflections. Circular creamy-yellow spots of various sizes (3 to 8 mm. in diameter) surrounded by dark circles are present scattered all over the dorsal surface. Smaller individuals (below 600 mm.) are lighter in colour than the larger ones. The ventral surface (Pl. II, Fig. 2) is white mid-ventrally, and yellowish laterally. Ventrals show a similar colour as the disc. Tail light yellow, with a varying number of 6 to 10 dark bands.

In the embryos, the dorsal surface of disc is pale or dark brown with small and large pale or dark spots scattered all over. The large spots appear to be formed by the union of smaller spots which first appear as semicircles, then circles, ultimately becoming solid spots. Ventral side is white centrally, with pale grey margins. Inner margins of ventrals have grey patches. Tail light yellow, banded with black but ventrally on the anterior two-thirds length of tail the bands are not ring-like (do not encircle the tail) while the posterior ones are ring-like. Embryos from the same parent have been observed to differ in colour,

Proportional Measurements

The measurements, as per cent of extreme breadth of disc are as below:

Disc.—Length, males 51·08–55·41, females 47·84–57·33.

Snout length : in front of orbits, males 8·06–9·33, females 6·28–9·61; in front of mouth, males 8·61–11·01, females 7·20–9·07.

Orbits.—Horizontal diameter, males 1·85–1·86, females 1·20–1·95; distance between, males 10·46–11·38, females 9·43–11·33.

Spiracles.—Length, males 2·46–3·36, females 2·03–4·49; distance between, males 9·85–10·07, females 8·16–10·23.

Mouth.—Breadth, males 9·23–9·33, females 7·86–9·70.

Exposed nostrils.—Distance between inner ends, males 6·46–7·09, females 6·05–6·75.

Gill openings.—Lengths, 1st, males 1·85–2·98, females 1·73–2·67; 3rd, males 1·85–2·80, females 1·74–2·69; 5th, males 1·23–1·49, females 1·09–1·39; distance between inner ends, 1st, males 16·00–16·04, females 15·56–17·47; 5th, males 11·19–11·69, females 10·43–12·67.

Pelvics.—Outer margin, males 6·15–8·02, females 6·69–8·87.

Distance from tip of snout to center of cloaca.—Males 45·23–49·63, females 44·09–50·67; from center of cloaca to tip of tail, males 31·04–46·95, females 36·54–54.67.

Size

During the present study, the largest intra-uterine embryo with umbilical cord and yolk sac still present measured 182 mm.; those without umbilical cord and yolk sac but still within the uterus measured a minimum of 175 and maximum of 237 mm. The minimum size of fully formed young one that is definitely known to be free living was 256 mm. From the above information, it is possible to state that the minimum disc width at birth would be between 237 and 256 mm. Females appear to produce young when about 410 mm. The largest specimen recorded in the present study was 915 mm. Males and females do not show any significant differences in body proportions (*see* proportional measurements).

Developmental Stages

The maximum size of embryo with umbilical cord was 182 mm. but some were fully formed and still born at 175 mm. The spine on the tail is absent

in all the embryos irrespective of the adult having a spine or not. It has been observed to be present in individuals above 374 mm. However, in the embryos from fish possessing a spine, a flattened, broad area is present at the position of the spine. Therefore, it appears that the spine develops with age.

While it may not be possible to state with certainty the actual number of young ones produced by an individual (as also the case in many rays which are known to eject out the embryos on capture), the relation between the size of the adult and number of embryos as revealed from an examination of two random samples is given in Table I.

TABLE I

Relation between size of the adult and number of young ones in G. poecilura

Sl. No.	Width of disc (mm.)	Total No. of young ones	No. of young ones with umbilical cord	No. of young ones without umbilical cord
1	851	2	2	..
2	825	5	...	5
3	914	7	7	...
4	698	2	...	2
5	813	3	3	...
6	813	1	...	1
7	863	2	2	...
8	800	3	...	3
9	736	3	3	...
10	787	3	3	...
11	787	2	2	...
12	762	3	3	...
13	838	2	2	...
14	795	1	1	..
15	867	5	5	..
16	660	2	..	2
17	985	3	...	3

It may be seen from Table I that while the maximum number of young ones observed is seven, there is apparently no relation between the size of the adult and number of young ones produced. All the young ones in any adult were in the same stage of development (with umbilical cord or without). Since a varying number of young ones from 1–7 were observed in the adult fish, it is likely that all of them are not released at the same time. Depending on the time of capture and observation, the number of embryos within an adult fish may vary on its left and right sides. For the same reason, embryos of both sexes or of only one sex may be found in an adult.

The females with advanced embryos (without umbilical cord and with pigmentation almost resembling that of adult) have the cloacal region bulged which is clearly seen externally and on application of pressure from before backwards, the embryos slip out of the adult one after another. Where females carry less advanced embryos (with umbilical cord and appearing almost white), such external indications are not seen. When the embryos are more than one inside the adult, they are stacked or rolled one over the other. They lie in the uterus with the left fin curving to the right below the abdomen and the right fin curving round the abdomen to the left side external to the left fin and reaching upto mid-dorsal region. The tail of each embryo thus folded is bent inwards to the left side and the tip of the snout folded backwards below the head. The orientation of the embryos within the adult is head to head both between themselves and with the adult. Consequently, when the adults are captured and landed, the tails of embryos often project out through the cloacal opening (Pl. II, Fig. 2), as commonly found in other species of rays also. However, a great amount of variation in the nature of the folding of fins of embryos while inside the uterus and also in their orientation between themselves and with the adult has been noticed. In some, both the fins form independent scrolls ventrally, one of them being external to the other (Pl. III, Figs. 1 and 2). Sometimes, either the left or the right fin first forms a ventral scroll by itself which is wrapped around by the other fin curving below the abdomen and reaching the mid-dorsal region (Pl. II, Figs. 3 and 4). Usually, the ventral side of the embryos face the ventral side of adult but they may lie slightly laterally also. Sometimes, an embryo may have its head directed towards the cloaca of the adult while others in the same parent may have head-to-head orientation between themselves and with the adult. These observations therefore indicate that several changes in the type of folding of fins and in the orientation of embryos within the adult take place till they are released from the parent. Such changes may also be dependent on the number of embryos and the availability of space within the uterus.

Habits

The species is mostly caught from sandy or muddy bottom, in comparatively shallow water, ranging in depth from 10 to 30 metres in this area. It has not been encountered in large shoals; few specimens are commonly caught in trawal nets or bottom set gill nets. The species occurs in the fish catches in this region almost round the year, particularly abundant between January and May. The dominant size range in the fishery is from 350 to 700 mm. It appears to breed almost throughout the year, the peak period being April to October. In the commercial catches, females have been found to be in greater numbers than the males. Many of the specimens examined had their stomachs empty. A few of them showed remains of fish (*Leiognathus* sp. which forms the major catch in trawl nets), broken shells of molluscs and crustacean appendages.

Numerical Abundance

The species is quite common along the south-east coast of India. It is more abundant in the Palk Bay than in the Gulf of Mannar. A greater percentage of catches of rays in trawl nets is contributed to by this species. Although separate catch particulars for this species are not available, the catch particulars of rays in relation to total catch at Mandapam (trawl fishing) for the period March 1966 to May 1967 are given in Table II to indicate the proportion of rays in the commercial catches.

Remarks

In this connection it should be mentioned that Day (1878) described only one species, *Pteroplatea micrura*, synonymising with it *Raja poecilura* of Shaw and *R. micrura* of Bloch and Schneider. From the description and figure of *P. micrura* given by Day, it is clear that *P. micrura* of Day should be relegated to the synonymy of *Gymnura poecilura* (Shaw), which is distinct from *G. micrura* (Bloch and Schneider). Further, *G. micrura* is known to differ from *G. poecilura* in its comparatively very short tail and lack of spine on tail at any age. It may also be pertinent to state here that the exact relationship between the spineless, short-tailed individuals often described as *G. micrura* from the Indo-Pacific and *G. micrura* from the Atlantic still remains to be established (Bigelow and Schroeder, 1953, p. 412). The distribution of *G. poecilura* includes the seas of India to the Malay Archipelago, and beyond (Day, *op. cit.*).

Wood-Mason and Alcock (1891) and Alcock (1892) described the uterine villiform papillae and their relation to the embryo and the embryonic history

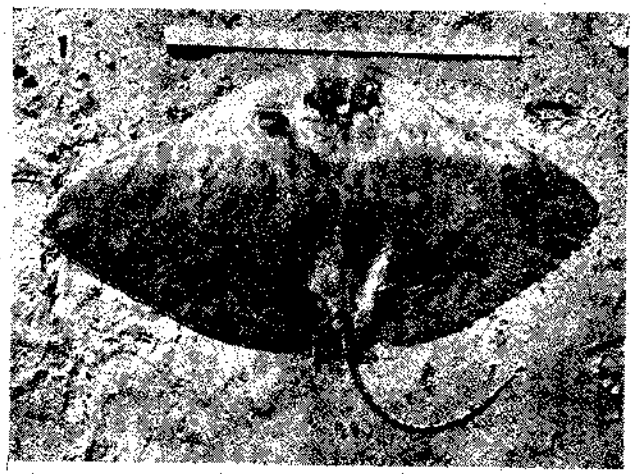
TABLE II

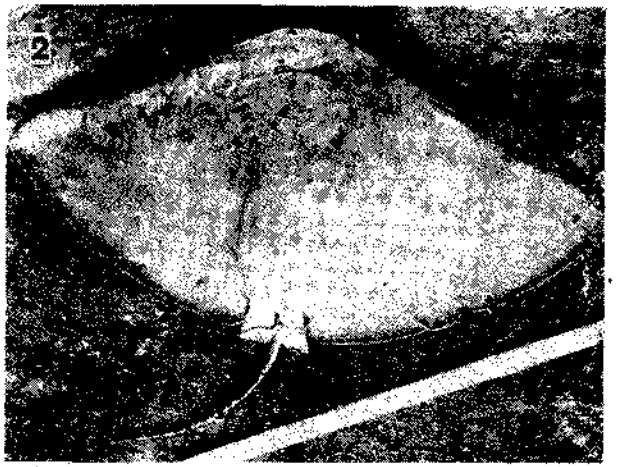
Average total catch, catch of rays and number of boats operated per day in trawl fishing in Palk Bay off Mandapam*

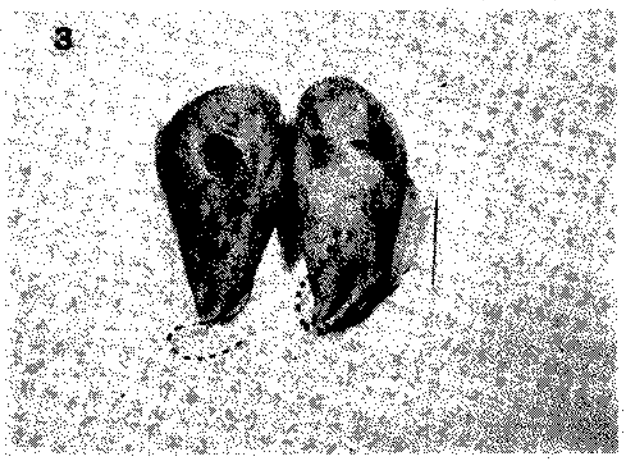
Month	No. of boats operated	Total catch (m. tons)	Total catch of rays (m. tons)
1966—			
March ..	26	32·78	1·10 (0·66)
April ..	23	28·47	0·46 (0·19)
May ..	34	59·57	0·64 (0·38)
June ..	28	38·96	0·77 (0·39)
July ..	34	50·19	0·99 (0·73)
August ..	38	56·50	0·53
September ..	23	40·72	0·36
October ..	12	14·15	0·20
November ..	8	9·13	0·12
December ..	6	12·64	0·08
1967—			
January ..	4	4·29	0·10
February ..	8	8·03	0·16
March ..	16	20·24	0·19
April ..	14	17·88	0·17
May ..	20	29·95	0·38 (0·33)

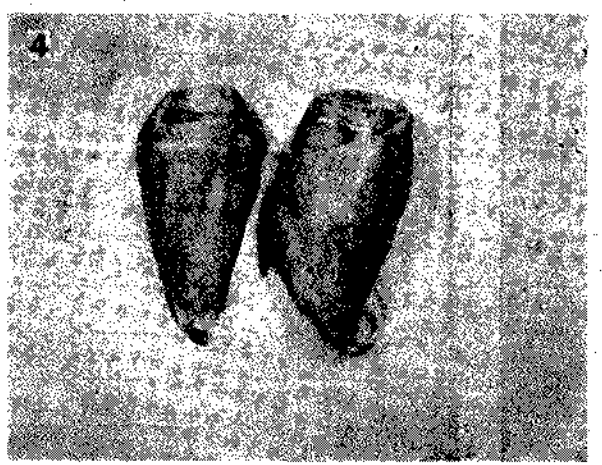
* Proportion of *G. poecilura* in total catch of rays where available separately is given in parentheses.

of *Pteroplataea micrura* (emended spelling for *Pteroplatea*) respectively but the text and figures 1 and 2 in Plate VII of the former account indicate that

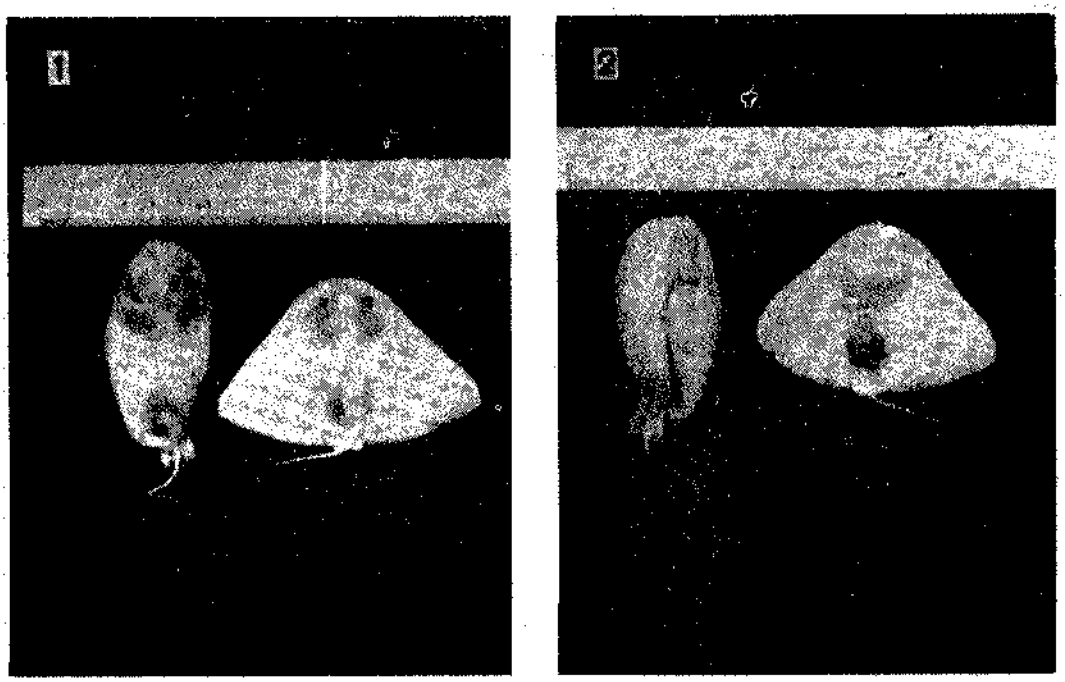








Gymnura poecilura (Shaw). Fig. 1 Dorsal view, female, 795 mm. wide. 2. Ventral view, female 660 mm. wide, showing the tails of two of the embroys projecting out through the cloacal opening. 3. Dorsal view of two pigmented intra-uterine embryos from adult 660 mm. 4. Ventral view of the same (Photographs by Mr. S. P. D. Ghanshani).



Gymnura poecilura (Shaw). Fig. 1. Dorsal view of unpigmented, intra-uterine embryos (folded, female with rudimentary yolk sac, from adult 795 mm. wide stretched, male with large yolk sac, from adult 862 mm wide). 2. Ventral view of the same. (Photographs by Mr. S. P. D. Ghanshani).

the species involved is actually *Gymnura poecilura* (Shaw) as revealed by the embryo with its characteristically long tail (more than half length of disc) bearing 11 dark spots from base to tip with wider white interspaces. It is of interest to note that gravid females have been examined by them in February and April, the maximum number of embryos being five from one individual.

Although *G. micrura* has been reported from several areas in the Indo-Pacific, no biological information is yet available for comparison with *G. poecilura*. Some observations on the biology of *G. micrura* were given by Bigelow and Schroeder (*op. cit.*) from the Atlantic. According to these, while the largest size (34″ = 863 mm.) and the size at birth (6–9″ = 152–228 mm.) reported for this species are quite comparable with those for *G. poecilura* (914 and 237–256 mm. respectively), the size at which young are produced is much larger (25–26″ = 635–660 mm) in *G. micrura* than in *G. poecilura* (410 mm).

Summary

Observations on the biology and fishery of the butterfly ray, *Gymnura poecilura* (Shaw) from the Palk Bay and Gulf of Mannar including details of description, size, proportional measurements, developmental stages, habits, colour and numerical abundance are given.

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