

ENTEROPNEUSTA FROM THE EAST COAST OF
INDIA, WITH A NOTE ON THE PROBABLE
COURSE OF DISTRIBUTION OF
PTYCHODERA FLAVA

BY KANDULA PAMPAPATHI RAO

(Department of Zoology, Sri Venkateswara University, Tirupati, A.P.)

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Ptychodera flava was first noticed by Eschscholtz (1825) and in 1893, Spengel included it in his classical monograph on the Enteropneusta (1893). But it was Willey (1899) who gave a detailed description and distinguished two different forms, on the basis of the length of the pharynx and called them *P. flava brachybranchiate* form having a short pharynx and *P. flava macrobranchiate* form with a considerably longer pharynx. In 1903, Punnett listed seven varieties of *P. flava* and two new species under the genus *Ptychodera* (*P. viridis* and *P. asymmetrica*). Three subspecies were defined by Spengel (1903 and 1904), namely, *P. flava funafutica*, *P. flava laysanica* and *P. flava caledoniensis*. *P. flava* was recorded from the Australian waters by Hill (1897), Dakin (1916) and Trewavas (1931), while *P. erythraea* was recorded from the red-sea by Spengel (1893), Klunzinger (1902) and Gravier (1905). Although different specific names were given to the types of *P. flava* occurring in the Indo-Pacific area, Horst (1927-39 and 1932) has shown that these belong to a single species, *Ptychodera flava* Eschscholtz.

In the Madras coast species of four genera are known to occur. Menon (1904) recorded three species, namely, *Saccoglossus bournei*, *Glandiceps coramandelicus* and *Glossobalanus minuta*. *Glossobalanus minuta* recorded by him was considered to be *P. flava* (Horst, 1932, 1927-39). *Saccoglossus madrasensis* was collected by the author from the Madras area. *Glossobalanus elongatus* was dredged by the author in the inshore area of the Madras coast. Though repeated dredging failed to yield any form belonging to the genus *Glandiceps* and *Ptychodera*, it is probable that *Ptychodera flava* as well as other enteropneusts may be found.

The occurrence of enteropneusts in the Krusadai waters was first reported by Gravelly (1932), who found them on the northern shores of the island. Narayanarao (1934) distinguished four forms, namely, *Chlamydothorax*

(*Ptychodera*) *Krusadiensis*, *C. ceylonensis* Spengel, *Ptychodera* (*Balanoglossus*) *minuta* and *Glandiceps hacksii*, the latter two having been obtained from a tangled mass accidentally washed ashore and not collected from any natural habitat (Ramanujam, 1951). Since the last two species were collected under conditions not quite natural, it appears likely that they had been taken up from their native habitat elsewhere, carried along by the current and thrown up on the northern shore of the island. As these two species have not been recorded since by several collection parties, the staff of the Biological Station as well by the author, it confirms the probability that these two forms do not really belong to the area under consideration. Ramanujam (1955) reported the occurrence of balanoglossids on the southern shore of the island and suggested that the first two species referred to by Narayanarao (1934) might have been obtained from this area. As Narayanarao's *Chlamydotorax ceylonensis* (*Ptychodera ceylonica*) is *P. flava* (Horst, 1932) and even *Chlamydotorax krusadiensis* differs only in relative measurements of the various body regions it is by no means certain that Narayanarao's collection consisted of the two distinct species, *P. ceylonica* and *P. krusadiensis*, and it is unfortunate that the collection is now untraceable in his laboratory.

The collections made by the author and others from the Krusadai and neighbouring islands are composed of five varieties of *Ptychodera flava* Eschscholtz. The balanoglossids collected at Madras and the Krusadai area are listed below on the basis of the classification given by Horst (1927-39).

SYSTEMATIC ACCOUNT

1. FAMILY .. Harrimanidæ Spengel, 1901.
GENUS .. *Saccoglossus* Schimkewitsch, 1892.
SPECIES.. *S. bournei* (Menon), 1904.

Collected and recorded by Menon (1904) from off the coast of Madras.
Not collected by the author.

2. FAMILY .. Harrimanidæ Spengel, 1901.
GENUS .. *Saccoglossus* Schimkewitsch, 1892.
SPECIES .. *S. madrasensis* sp. Nov.

Collected from off the coast of Madras by the author and only the proboscis, collar and part of the branchial region were obtained.

3. FAMILY .. Spengelidæ Willey, 1899.
GENUS .. *Glandiceps* Spengel, 1893.
SPECIES .. *G. coramandelicus* Spengel, 1907.

(*G. Hacksi* Menon, 1904)

This was collected and recorded by Menon (1904) from off the coast of Madras and was not obtained by the author.

4. FAMILY .. Ptychoderidæ Spengel, 1893.
 GENUS .. *Glossobalanus* Spengel, 1901.
 SPECIES .. *G. minutus* (Kowalvesky) 1866.

This was collected and identified by Menon (1904) from off the coast of Madras. Although Horst (1927-39) is inclined to consider it as *Ptychodera flava*, if it does possess a triangular 'Kiemenfeld' which Menon (1904) mentions, it may prove to be really *Glossobalanus minutus*. The author could not obtain it.

5. FAMILY .. Ptychoderidæ Spengel, 1893.
 GENUS .. *Glossobalanus* Spengel, 1901.
 SPECIES .. *G. elongatus* Spengel ?

Only a single specimen consisting of the proboscis, collar and branchia region was obtained by the author from off the coast of Madras.

6. FAMILY .. Ptychoderidæ Spengel, 1893.
 GENUS .. *Ptychodera* Eschscholtz, 1825.
 SPECIES .. *P. flava* Eschscholtz, 1825.

From the collections made by the author and various collection parties in the Krusadai and neighbouring islands (Shingle and Pallivausal islands), in the Gulf of Mannar, five varieties of *P. flava* were distinguished, all of which have the following specific characters. The characters by which the different varieties are distinguished are mostly external and phenotypic.

Specific characters common to all varieties of P. flava:

Total length varies from about 5 to 35 cm. Collar narrowest at its middle, with posterior annulus. The genital pleuræ are joined to the collar at their anterior end, and are broadest in the branchial region, extending posteriorly into the hepatic region. The pleuræ are ventral in origin. The hepatic cæca which have transverse folds on their anterior and posterior faces are arranged in two rows dorso-laterally. The abdominal region with irregular annulations and the rectal part is swollen. 'Cauliflower organ' (Blumenkohlahnlische organ) present on the ventral side of the base of the proboscis. Keel of the proboscis skeleton poorly developed. Collar cord with a continuous lumen which is open at both ends. Both the collar canals and collar pores present. Branchial pores are extremely large, so that almost

the entire outer part of the gill-pouch is absent and the tongues with the U-shaped gill-slits are externally visible. Hence the branchial basket projects out between the genital pleuræ. Lateral septa and the gonads extend up to the hind end of the collar. No primary gonads. The numerous small roundish secondary gonads confined to the ventral coelomic space. Two dorso-lateral ciliated grooves in the abdominal region of the gut.

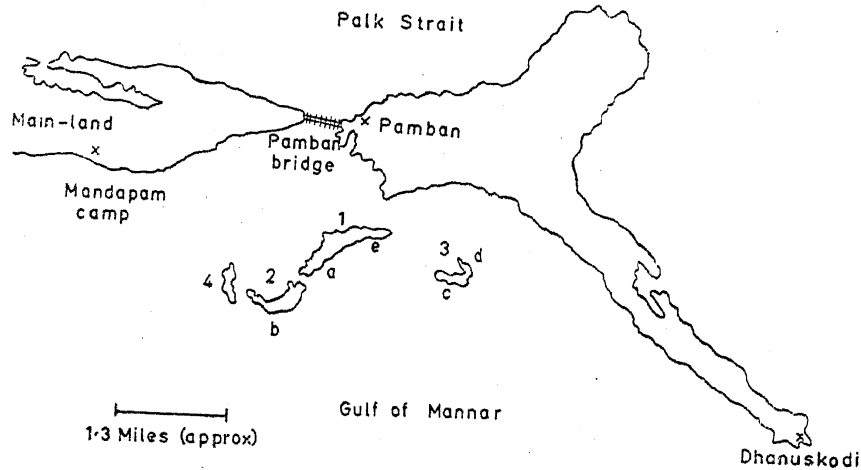
Description of the different varieties

6. (a) *P. flava* var. *krusadiensis*.—Varies from 12 to 25 cm. in length and is of a delicate build. This variety corresponds in most of the features like colour and relative length of the various body regions to *P. krusadiensis* (Narayanarao, 1934). Only the left ventro-lateral blind sac of the buccal-diverticulum (stomochord) opens into the primary lumen. Only the left proboscis pore and the two collar pores present. Of the four dorsal roots present in the collar, only two are complete. The ventral septum of the proboscis barely extends anteriorly beyond the ventro-lateral blind pouches of the buccal diverticulum. This variety does not resemble any of the forms described by Punnett (1903).

6. (b) *P. flava pallivausalensis* var. nov.—These forms are larger in size compared to those of the previous variety and range from 15 to 35 cm. in length. The general body colour is of a duller hue in the present form, being a brownish-yellow, while the Krusadai variety is of a brilliant-yellow. The anterior margin of the collar in the present variety is frilled. The most important anatomical feature of this variety is the possession of a single collar canal and pore. Both the proboscis pores are in functional communication with the dorsal proboscis cœlom. The possession of a single collar pore is unique in the Enteropneusta. Further, it differs from the previous form in the possession of five dorsal roots of which four are complete and in the fact that the ventro-lateral pouches of the buccal diverticulum open together into the primary lumen. In the possession of 5 dorsal roots it resembles *P. flava laccadivensis* (Punnett, 1903), but in the possession of a single collar pore it differs from all the varieties hitherto described. This form was collected from a protected lagoon in the north-eastern shore of the Pallivausal (Map I) island in the Gulf of Mannar. It occurs in loose, dirty greyish mud mixed with coral detritus.

6. (c) *P. flava shinglensis* var. nov.—These are smaller than the previous forms and vary from 7 to about 12 cm. in length and appear stumpy in their build. In its external features this variety closely resembles var. *Pallivausalensis*, but in its internal anatomy it is similar to var. *krusadiensis*, and

inhabits the rough coral detritus on the southern shore of the Shingle Island (Map I), which is exposed at high tide to the action of the breakers. Probably this explains their stumpy build.



MAP I. Map of the Krusadai Island and environs, showing the distribution of the five varieties of *Ptychodera flava*.

- | | |
|------------------------------|----------------------------------|
| 1. Krusadai Island | 2. Pallivausal Island |
| 3. Shingle Island | 4. Pulli Island |
| (a) var. <i>krusadiensis</i> | (b) var. <i>pallivausalensis</i> |
| (c) var. <i>shinglensis</i> | (d) var. <i>coralliformia</i> |
| (e) var. <i>gigantica</i> | |

6. (d) *P. flava coralliformia* var. nov.—Although the normal habitat of *Ptychodera flava* is a sandy substratum mixed with coral detritus, the present variety occurs in the rocky beach exposed at low tide. They inhabit crevices in the dead coral rocks between tide marks on the northern reef of the Shingle Island (Map I). The environment is such that no sandy element is obtained. Since normally *Ptychodera flava* depend on sandy substratum for their food the occurrence of this variety in an environment devoid of sand is of interest. The fact that these creatures can ingest solid food particles, unmixed with sand or mud, was proved by observing one of them feed on broken bits of their fellows in the laboratory aquaria. Collection of these forms proved to be difficult, since they withdrew into the coral crevices on slight disturbance and the coral rock had to be broken before the organism could be secured.

They are very small in size, measuring only from 2.25 cm. to 4.5 cm. in length. The collar is prominent and is as broad as long, the anterior margin being smooth, thus resembling var. *krusadiensis*. The branchial region is short and is about the length of the collar, whereas normally in other varieties the branchial region measures from 2 to 4 times the length

of the collar. The general body colour is brilliant brownish-green or sometimes bright green. Both the proboscis pores and collar pores are present. The ventro-lateral blind pouches of the buccal diverticulum open together into the primary lumen thus resembling the condition obtaining in var. *pallivausalensis*. Only three dorsal roots are present of which the first two are complete.

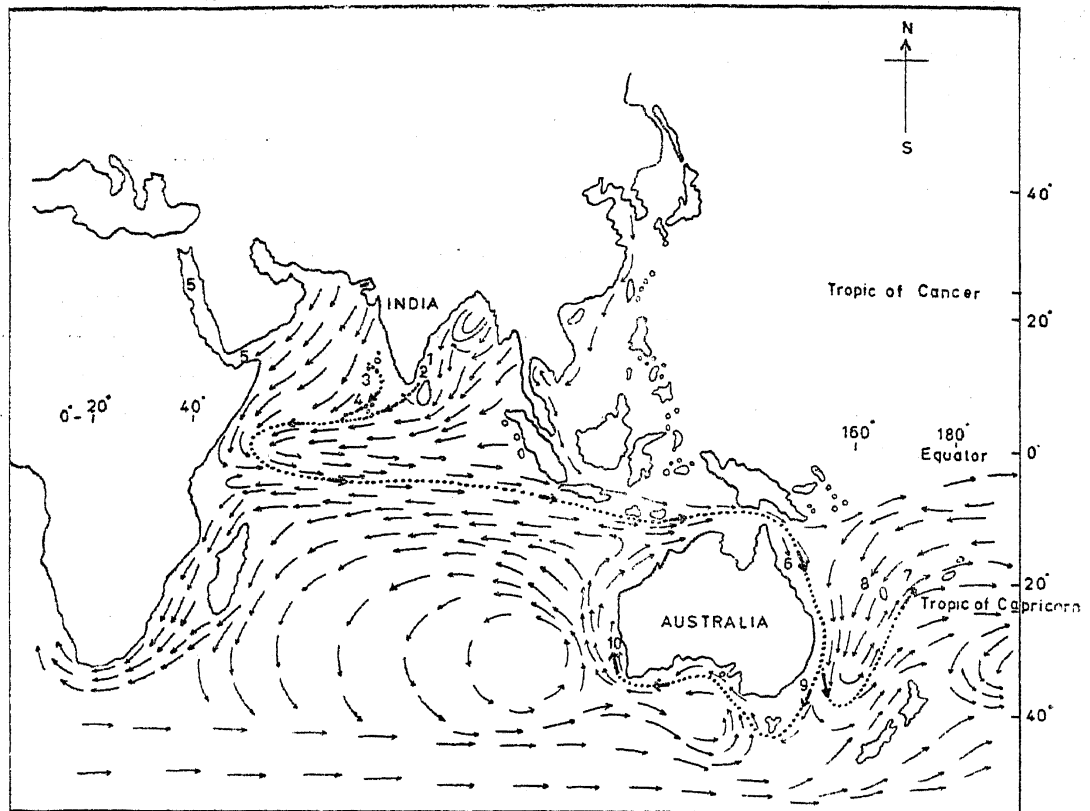
6. (e) *P. flava gigantea* var. nov.—Only a single specimen of this variety was available for examination and the following measurements were made of the fixed animal. Total length 46 cm.; proboscis length 1 cm. (strongly contracted); collar length 1.3 cm.; length of the branchial region 8.5 cm., with about 250 gill-slits; length of the genital pleuræ 17 cm.; greatest breadth of the genital pleuræ (about 2.25 cm. behind the collar) 4.0 cm. Excepting for the great size, this variety resembles in all other external features the macro-branchiate variety described by Willey (1899). The internal structure could not be studied as the single specimen collected by Messrs. Sundara Rao and Ranga Rao from the sandy patches in the Galaxea reef, Krusadai, was deposited in their museum, at the Presidency College, Madras.

Variable characters

From the above it is seen that the colour of the body and the hepatic cæca, the size of the animal and the relative length of the branchial region are highly variable. The significance of this variation is discussed elsewhere (Pampapathi Rao, 1952).

The probable course of distribution of P. flava:

The great plasticity and considerably extended free-swimming larval life of the organism make the dispersal of species like *P. flava* over wide areas by tidal and surface currents possible. The occurrence of such a species over the whole Indo-Pacific area, showing local variations, indicates that these different varieties must have originated from one or more centres. An examination of the distribution of the different varieties of *P. flava* over the Indo-Pacific area, along with the prevailing oceanic surface currents shows that the probable centre of distribution could be the area marked by the Laccadive and Maldivé archipelagoes along with the Gulf of Mannar (*vide* Map II). The occurrence of *Tornaria* belonging to *P. flava* at Madras (Pampapathi Rao, 1955), suggests the occurrence of *Ptychodera flava* off the coast of Madras. The breeding period of *P. flava* occurring at Krusadai is in March (Pampapathi Rao, 1954, *a, b*). An examination of the surface currents along the east coast during this period (Map III) shows that there

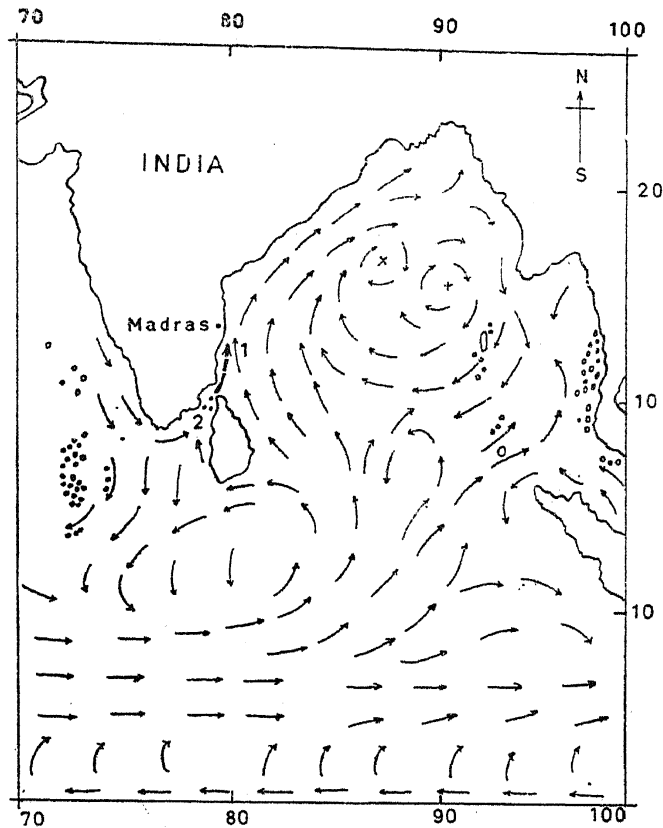


MAP II. Surface currents of the Indo-Pacific area indicating the probable course of distribution of *P. flava* in the Indo-Pacific area. The dotted line indicates the probable routes of dispersal of *P. flava*.

1. *P. flava* (Madras).
2. The five varieties of *P. flava* indicated in Map I from the Gulf of Mannar.
- 3 & 4. The different varieties listed by Punnett (1903) from Maldive and Laccadive archipelagoes.
5. *P. erythræa* from the Red Sea.
6. *P. flava* (Eas coast of Australia).
7. *P. flava*.
8. *P. flava* (from the Great Barrier reef).
9. *P. flava* (South-east coast of Australia).
10. *P. pelsartii* (West coast of Australia).

is a northerly current starting from about the Gulf of Mannar and flowing along the coast. It is likely that the larval forms from the Krusadai area are carried northwards along this current, thus explaining the probable occurrence of *P. flava* at Madras. From the Laccadive and Maldive archipelagoes the larval forms can be carried along the westerly flowing current (Map II) which bends sharply eastwards at about the northern shores of Madagascar

(i.e., at about Lat. 5 s.), and continues across the Indian ocean as the equatorial current. The latter continues eastwards along the northern shores and along the eastern shores of the Australian continent (Map II). This explains the dispersal of forms from the Laccadive and Maldive archipelagoes into the eastern Australian waters (Great Barrier Reef and neighbouring islands).



MAP III. Surface currents in the Bay of Bengal, to show the probable course of distribution of *P. flava* from the Gulf of Mannar to the Madras Coast.

1 & 2 same as in Map II.

SUMMARY

The distribution of the different varieties of *Ptychodera flava* on the east coast of South India is described, along with an account of the five varieties of this species occurring in the different regions of the Krusadai group of Islands in the Gulf of Mannar.

An examination of the surface currents in the Bay of Bengal and the Indo-Pacific region of the Indian Ocean, during the breeding season of *Ptychodera flava* (when its larvæ are in the plankton) suggests the probable course of distribution of the species, from a starting point near about the Maldive and Laccadive archipelago.

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