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STILIGER NIGROVITTATUS SP. NOV., A SACOGLOSSAN MOLLUSC FROM THE GULF OF MANNAR*

By K. VlRABHADRA RAO & K. PRABHAKARA RAO
Central Marine Fisheries Research Institute, Mandapam Camp

THE species under the genus *Stiliger* Ehrenberg 1831 known hitherto from the coastal waters or backwaters and estuaries of India are very few. *S. pica* Annandale and Prashad (Sewell & Annandale, 1922) from Chilka Lake and *S. gopalai* Rao (1937) from Madras backwaters are the only species on record. *Stiliger viridis* (Kelaart) as described by Eliot (1906a) from the Ceylon coast of Gulf of Mannar and 5". *tentaculatus* Eliot (1916) from Siam are two other species known from regions very close to Indian coasts. *S. nigrovittatus* described here is one of the few species collected by the present writers from the Palk Bay and the Gulf of Mannar in the vicinity of Mandapam. It has been experienced that a careful search among the members of filamentous algae like *Chaetamorpha* revealed one or the other species of the sacoglossan Opisthobranchs which feed on those algae. A few individuals of *S. nigrovittatus* were obtained from the Gulf of Mannar close to the Central Marine Fisheries Research Institute, Mandapam Camp, on November 29, 1962, for the first time. Subsequently they were collected from the same locality and also from Kundagal Point near Pamban in all months upto March 1963. They were observed on algal growths of *Cladophoropsis zoolingeri* (Kuetz.) Boergs., covering the rocks in the intertidal region. In captivity they were found feeding on this alga as also on *Chaetomorpha* sp.

EXTERNAL FEATURES

The largest of the individuals measured about 7 mm. long (Fig. 1). The tentacles or rhinophores are in single pair arising from the head. They are smooth, moderately long, broad at the base and narrow at their distal ends. The head region in front of the tentacles, slopes down obliquely towards the mouth which is anterior and median and a little ventralwards in the head. The head region, close to the mouth bears a pair of labial thickenings, one on each side. A shallow depression extends medianally from the mouth over the head region. At the basal region of the tentacles is seen a pair of dark pigmented eyes. The region immediately behind the tentacles is to some distance free from cerata which are arranged in two lateral rows upto the root of the tail. The foot is a little broad in the region of the head with a median depression and two round lateral prominences (Fig. 3). It is about the same width as the back in the middle region of the body but posteriorly tapers into a moderately long tail.

The anal opening (Fig. 1, *an.)* is dorsal and a little to the right side of the median line. It lies in a line with the origin of the third by fourth cerata of the right side. The excretory pore is close to the anal opening. The male genital aperture (Fig. 2,

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p. op.) is beneath the right eye. The oviducal aperture (Fig. *2, ov. op.)* is close behind it. The vaginal opening (Fig. *2, va. op.)* is a little behind the oviducal aperture. The pericardial prominence is beneath the dorsal integument from the anus to about a third of the length of the animal from its anterior end. In a lateral view of the head, labial thickenings are a little behind the anterior margin of the foot.

Dorsally on each tentacle there is a distinct dark gray almost blackish stripe which meets a triangular patch of the same colouration present on the head. The apex of this patch runs forwards in the median depression of the head up to very nearly the mouth ; at the base it is continued to some distance behind the region of the tentacles and later spreads over the rest of the back where it presents a mottled appearance of gray and yellow. Dorsally in the middle region at the base of the head there is a clear patch which in some individuals presented a pale pink colouration. A dark gray stripe is also present laterally commencing from below the level of the third or the fourth cerata on each side and extending very nearly up to the mouth. The prominent dark gray almost black bands on the tentacles and the sides of the body being very characteristic of the form, the species is named *S. nigrovittatus.*

The cerata are moderately inflated (Fig. 4). They are greenish because of the diverticula of the same colouration. The tips of the cerata are distinctly white. The epithelium of the cerata reveals a large number of whitish-looking glands which exude an odoriferous oily secretion on irritation. The surface is faintly speckled gray over a faint orange background colouration. The hepatic diverticulum in each (Fig. 4, *d.g.)* gives off numerous short lateral branches. The foot is pale yellow. The tentacles and the sides of the body are also pale yellow except in the regions where the gray stripes are present.

INTERNAL ANATOMY

The senior author (Rao, 1937) in *S.gopalai* described in detail the internal organisation of that species. The internal structure of *S. nigrovittatus* is in general, very much similar to that of *S. gopalai.* Opening into the channel of the mouth are numerous buccal glands (Fig. 6, *b.g*/.). The buccopharynx or pharyngeal bulb (Fig. 6, *b.ph.)* is highly muscular and is continued by the oesophagus *(oe.),* which in its turn leads into a triangular stomach. From the posterior region of the latter arises a pair of diverticula one on each side. Each diverticulum is in communication with one anterior and one posterior caecal prolongations with which the hepatic glands in the cerata are in communication. The intestine arises on the dorsal region of the stomach a little to the right of the median line and passes upwards and a little forwards to be continued by a short rectum opening out by the anus. The radular structure of *S. nigrovittatus* conforms to the typical sacoglossan radula. In this form (Fig. 6) three to four teeth are found in the ascending axis, of which onels under formation in the radular sac *(r.s.),* five in the descending axis and about fifteen worn-out ones in the sac or ascus *(as).* Opening into the buccopharynx, by their slender ducts is a pair of salivary glands *(s.g*/.).

In the central nervous system (Figs. 8 & 9) there are a pair of large cerebropleural ganglia *(c.pl.g.),* a pair of equally large pedal ganglia *(p.g.),* a pair of unequal visceral ganglia (consisting of a big abdominal ganglion, *ab.g.* and a small supraintestinal ganglion, *s.int.g.)* and a pair of very small buccal ganglia (Fig. 6, *b.ga.).* Of the sense organs there are a pair of eyes and a pair of statocysts closely asso-

ciated with the central nervous system. The statocysts which are clearly visible from the ventral aspect have each a single statolith.

The general arrangement of the reproductive organs of *S. nigrovittatus* is as in *S. gopalai*. The penial organ is provided with a short slightly recurved penial stylet (Fig. 10).

SPAWN AND DEVELOPMENTAL STAGES

In captivity the animals were observed to pair often and deposit spawn attached either to the algae or to the surface of the glass vessels. The smaller individuals had tiny spawn (Fig. 11) in the form of oval masses of about 2 mm. and the larger ones in the form of elongated cylindrical strings of 6 to 7 mm. in length. Each spawn had about eighty or even several times more of the eggs depending upon its length and they were enveloped in a mass of transparent mucous substance. Each capsule (Fig. 12) in its long axis measured about 145 /i and in its short axis about 120 *p.* The eggs within the capsule were perfectly spherical containing yellow granular yolk and measuring about 70 /t in diameter. In a small bit of spawn deposited on December 6, 1962 at 9 a.m. the progress of development was followed up to the liberation of all veligers from it (Figs. 13 to 17). The details of development at various stages are given below :

Date	*Time*	*Development Stages*	*Duration of development*
6-12-62	9.30 A.M.	Egg before cleavage with two polar bodies	30 minutes old.
	10.00 „	First cleavage started	1 hour old.
	10.30 „	First cleavage completed	1 hour 30 minutes old.
	10.35 „	Second cleavage started	1 hour 35 minutes old.
	12.00 Noon	Third cleavage started	3 hours old.
	7.30 P.M.	Blastula formation started	10 hours old.
7-12-62	9.50 A.M.	Gastrula formed	24 hours 50 minutes old.
»	2.30 P.M.	Shell gland formation started	29 hours 30 minutes old.
8-12-62	2.35 P.M.	Veliger fully formed but not liberated	53 hours 35 minutes old.
10-12-62	10.00 A.M.	All veligers liberated	By 97 Hours after deposition of spawn.

Of the water in the glass vessels where the development took place the salinity was $27.99°/_{00}$ and the temperature ranged from 25.5. to 27°C. The fully developed veliger (Fig. 15) has a short spiral shell about 135 *fi* in its long axis and 95 /t in its short axis (Figs. 16 & 17). The shell is transparent, colourless and slightly pitted, particularly in the region of the spire. The fully expanded veliger with the velar lobes (Fig. 15, v) is about 143 /t long. The velar cilia are large. There is a subvelum showing smaller cilia. The foot *(ft.)* is rather broad and flattened. Corresponding to the large, wide more or less oblong aperture there is a large operculum *(op.)*. Between foot and velar lobes is the mouth leading to a moderately long oesophagus, which communicates with a spacious stomach *(st.)*. A large left lobe *(It.l.)* and a small right lobe *(rt.l.)* of the greenish liver lie on either side of the stomach. The intestine is moderately long and coiled; it is followed by a short rectum which opens by an anus into the mantle space close to which there is a dark pigmented excretory organ *(ex.o)* as in the larvae of *S. gopalai* (Rao, 1937) and *S. niger* (Rasmussen, 1951). On the right side of the animal below the level of the velar lobe there is a small pigmented area *(p.a.)*. The statocysts *(st.c.)* are large each containing a statolith. The early hatched veligers did not possess eyes. After

liberation the veligers survived for a few days in the fingerbowls but they did not show any signs of metamorphosis.

SYSTEMATIC POSITION

The genus *Stiliger* belongs to the family Stiligeridae under sacoglossan opisthobranchiate molluscs. The family Stiligridae is synonymous with the more commonly known family Hermaediae. The oldest member of the group is *Stiliger* Ehrenberg 1831 and not *Hermaea* Loven 1844 *(vide* O'Donoghue 1928, Theile 1931, Rao 1937, Taylor and Sohl 1962).

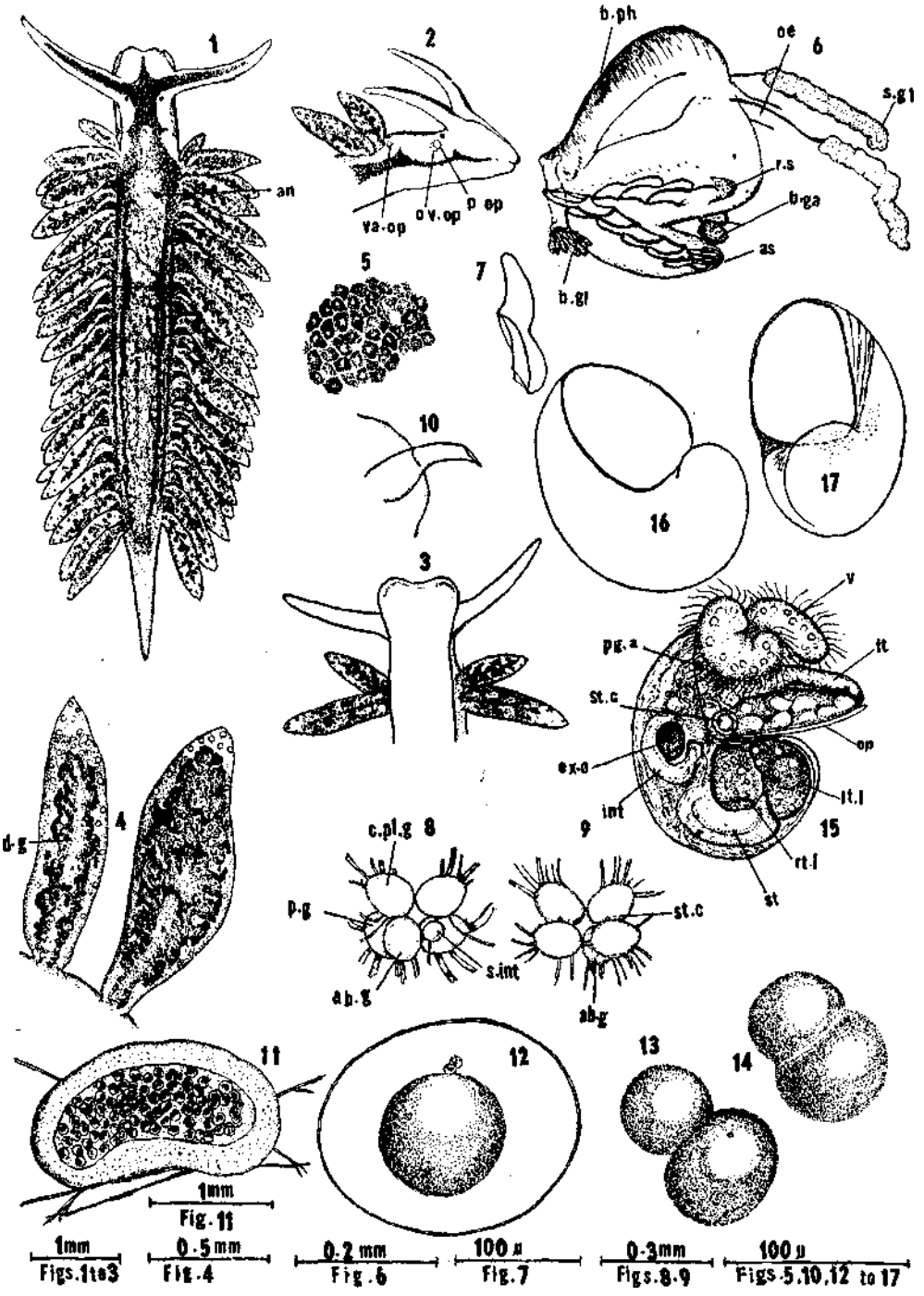
The specific characters of *S. nigrovittatus* are as follows : Aeolid-like in appearance ; head with moderately long tentacles in a single pair; cerata in two lateral rows upto the root of the tail, a little inflated, with hepatic diverticula in each bearing short lateral branches ; foot anteriorly a little broad with two lateral rounded prominences and tapering posteriorly into a fairly long tail; the anal opening a little to the right of the median line at about the level of the 3rd by 4th cerata of the right side ; male genital aperture and oviducal opening close beneath the level of the eye on the right side and the vaginal aperture behind the oviducal opening.

Tentacles with a distinct dark gray stripe meeting a patch of the same colour on the head ; a dark gray stripe laterally in the anterior part of the head and sides ; cerata greenish because of hepatic diverticula, tips white, surface speckled gray on a faint orange background colour.

Radula with three to four teeth in the ascending axis, 5 in the descending axis and about 15 in the ascus, both axes straight and not spiral; penis with a short recurved penial stylet.

Affinities. There is some resemblance between *S. gopalai* and *S. nigrovittatus.* In the general contour of their bodies, in possessing single main stems of the digestive gland with minute lateral branches in their cerata, in the presence of the anterior lobes of the foot being rounded and the tail region filamentous, in the axes of the radula being straight and not spiral and also in having short recurved penial armature the two species are similar. However, *S. nigrovittatus* differs from *S. gopalai* in the presence of its characteristic colouration described earlier and also in possessing a smaller number of teeth in both the axes of the radula of the former. The presence of oral tentacles and tentacle-like processes at the anterodorsal angles of the foot in *S. tentaculatus* is very distinctive of the species. The colouration in *S. pica* is different from that of *S. nigrovittatus.* In the former the dorsum and the sides are dull olive green tinged with black between the rhinophores and obscurely vermiculated on the anterolateral regions, but the dark stripes on rhinophores and on the anterolateral regions of the body characteristic of the latter species are absent. Kelaart's (1858) *Pterochilus viridis* from the Gulf of Mannar on the Ceylon coast is not easily distinguishable from the meagre description given by the author, but the species has subsequently been referred by Eliot (1906a) to *Stiliger* ? *viridis.* It has a light green colouration on the body and the branchiae are green, spotted with darker green and gray by which characters it is distinguishable from the present form.

S". *varians* (Eliot, 1904) from Prison Island near Zanzibar Harbour has a brilliant green colouration as a rule, but some of the specimens are dark brown to white, sometimes with patches of crimson lake ; the cerata contain ramifications of the liver



FIGS. 1-17 *Stiliger nigrovittatus* sp. nov.—1. Dorsal view of entire animal; 2. Lateral view of anterior region ; 3. Ventral view of anterior region ; 4. Cerata; 5. Pigmented flecks in integument; 6. Buccopharynx, and radula ; 7. Single tooth ; 8 and 9. Dorsal and ventral aspects of central nervous system; 10. Penial armature; 11. Spawn; 12. Egg before cleavage; 13 and 14. Egg at first cleavage; 15. Veliger; 16 and 17. Empty shells of larvae.

ab.g. abdominal ganglion ; *an.* anus ; *as.* ascus ; *b.ga.* buccal ganglion ; *b.gl.* buccal glands ; *b.ph.* buccopharynx ; *c.pl.g.* cerebropleural ganglion ; *d.g.* digestive glands; *ex.o.* excretory organ ; *ft.* foot; *int.* intestine ; *lt.l.* left liver lobe ; *oe.* oesophagus ; *op.* operculum ; *ob.op.* oviducal opening ; *p.g.* pedal ganglion ; *pg.a.* pigmented area ; *p.op.* penial opening ; *r.s.* radular sac ; *rt.l.* right liver lobe; *s.gl.* salivary glands; *s.int.* supra intestinal ganglion ; *st.c.* statocyst; v. velum ; *va.op.* vaginal opening.

with one large main stem which gives off three to four branches; the radula has four to five teeth in the ascending axis, six in the descending axis and eight in the ascus. As pointed out by Eliot (1904 on p. 290) this species has been erroneously figured as *Hermaeal minor* in another paper of his in the *Fauna and Geography of the Maldives and Laccadive Archipelagoes,* Vol. II, PL 32, figs. 9 and 10. The bright green colouration of the body sometimes with crimson lake patches, fairly prominent lateral branches of the main stems of the hepatic diverticula in the cerata and a large number of teeth in the radula of *S. varians* make it distinguishable from *S. nigrovittatus. S. irregularis* (Eliot 1904) also from Zanzibar being translucent white, with the green liver branches in the body and cerata, with reddish green pigment in the integuments, with hinder cerata being twice as long as those in the front and spread out in a fan-like manner, is distinct from the present species.

In *S. fuscovittata* (Lance, 1962) and the present species the rhinophores bear each a distinct stripe, but the basic colour of pigmentation in the former is reddish brown whereas in the latter it is dark gray almost black. There is some difference in the microscopic structure of the pigmented region of the epidermis although the flecks are gathered into a mosaic pattern in both. The pigment in *S. fuscovittata* is scattered irregularly in the flecks whereas it is concentrated in each of them in an area surrounding a central hyaline region in the present species (Fig. 5). Further in *S. fuscovittata* the anal opening is far more anterior in its location than in any other species hitherto known. The position of anal opening in *S. nigrovittatus* is more like that of *S. gopalai.* As shown by Lance *(Joe, cit.)* on p. 54, fig. 3 the basal regions of the teeth in the radula of *S. fuscovittata* are short and the apical regions much produced, unlike those of the present form. Further in both axes of the radula the number of teeth in *S. fuscovittata* is much greater than in *S. nigrovittatus.* In the former the descending axis is spiral as compared with almost straight axis of the latter.

SUMMARY

A sacoglossan Opisthobranch obtained from the Palk Bay and the Gulf of Mannar in the vicinity of Mandapam Camp has been ascribed to a new species of *Stiliger* Ehrenberg and named *S. nigrovittatus* because of the characteristic dark stripes present on the dorsal region of the rhinophores and the anterolateral regions of the body. Its external morphology and some aspects of internal anatomy have been described along with notes on its early development. Its systematic position and similarity or divergence with other species of *Stiliger* have been discussed.

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