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TWO NEW SACOGLOSSANS (GASTROPODA: OPISTHOBRANCHIA) FROM THAILAND

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ABSTRACT

Two new sacoglossans were found in brackish mangrove habitats near Pattani in the southern part of the Gulf of Thailand. Both are small species (< 10 mm) living hidden in clay with small green algae high in the intertidal zone becoming not submerged for days. They have black pigment on the dorsal side and their bodies clearly consist of two parts. One is named *Gascoignella nukuli* n. sp., which looks similar to *G. aprica* Jensen, 1985 from Hong Kong, but differs in radula, penial spine, body proportions and habitat. The other is *G. jabae* n. sp., which has two parallel cerata instead of a visceral sack on the posterior side of the body.

INTRODUCTION

While studying the molluscs in the southern part of the Gulf of Thailand in the surroundings of Pattani, the author accidentally found a few live specimens, which were not recognized as molluscs in the beginning. They came out of a piece of rather dry mud with a small green alga (cf. *Derbesia marina*) on and in it, which was collected in a mangrove forest near the village Bang Tawa in June 1998. Mud with algae was taken to my house in The Netherlands, placed in a jar with seawater, closed and put on my desk. The tiny alga grew slowly up to 10 mm above the mud. No visible animals were seen in the jar until five months later. In the second half of October it

was discovered that sometimes one or two very slow and small 'planarians' came out of the mud and climbed against the glass wall or through the algae. They often disappeared again in the mud for several days. In the course of November a small egg-string with a jelly-like cover was seen in the jar. The string was totally different of what was expected of a planarian and under the microscope, it appeared to contain veliger larvae. Once the molluscan nature of the slow 'planarians' was known, they were observed more closely by which it was discovered that their bodies consisted of two parts: a small anterior body with a head and foot, and a longer visceral sack not supported by the foot. It was first tried if the slugs agreed with one of the known interstitial opistho-

branches, but when the radula was checked, it appeared to be uniseriate ones with the old teeth stored in an ascus. In the beginning a search through the literature did not give much support for a sacoglossan without rhinophores and tentacles plus having the body in two parts as in the Acochlidae. However, the paper of Jensen (1985) gave the solution, her new genus *Gascoignella* (fam. Platyhedylidae) appeared perfectly to fit in with the animals of Thailand.

It was in a similar accidental way that the second species was discovered at home from a piece of clay and tiny algae, which was collected near the village Di in October 1999. The clay came from the wall of a ditch in a remnant of a mangrove area, which is connected via a tidal channel with the inner part of Pattani Bay. This slug came out the mud in a jar with seawater three months after the mud was collected. Habitat, colour and behaviour are the same as in the first species, but it has a pair of cerata implanted at the dorso-posterior border of the body and not a single visceral sack.

As both species do not seem to match existing descriptions they are described as new species.

***Gascoignella nukuli* n. sp.**

Figs. 1A-J

MATERIAL. - On 12 June 1998, two very dark specimens were collected at 06°51'26"N, 101°09'30" E in *Derbesia* clay from the mangrove forest of Ban Bang Tawa. The animals came out the clay in October, laid an egg string of which the veligers hatched in November 1998.

On 4 June 2000, three pale, two intermediate and two dark specimens were collected in *Derbesia* clay from the same site. The animals successively emerged from the clay during the following two months and laid a few egg strings. The salinity of the nearby water was 11‰ at the time of collecting.

One pale specimen has been selected as holotype and is deposited in the Zoological Museum Amsterdam (ZMA Moll. 400 006), together with three paratypes, one is a black one of October 1998, the others are intermediate in colour of June 2000 (ZMA Moll. 400 007).

The holotype has a length and width of 5.06 and 1.33 mm, the paratypes 4.06 and 1.27 mm, 3.86 and 1.26 mm, respectively. The visceral sack is respectively 3.2, 3.6 and 4.8 times as long as the anterior body when measured from the dorsal commissure.

ETYMOLOGY. - The species is named after Mr. Nukul Ruttanadukul, who discreetly attracted my

interest to the golden borders of the Gulf of Thailand, which are becoming ruined in a mega-scale under the veil of development of wasteland.

EXTERNAL APPEARANCE. - It is a small, smooth slug without signs of rhinophores, cerata, or papillae. The total length of the live specimens was up to 5.5 mm with a width of 1.5 mm.

The body is clearly divided into two parts of which only the anterior part is supported by the foot (Fig. 1A). The connection of the anterior body part with the posterior visceral sack is on the dorso-posterior side of the frontal body part. Measured from the dorsal commissure, the posterior part is 2.8 to 4.8 times as long as the anterior. The mouth is surrounded by a wide, smooth velum (Figs. 1C, D). On the longitudinal body axis is a slight mark on the frontal side of the velum, which looks as a depression. It may be a sensory spot, but its nature could not be clarified. The foot is as wide or slightly wider than the body, and rounded without any distinct corner or notch (Fig. 1D).

The colour of the ventral side is pale yellow with the internal organs showing through. The colour on the dorsal side varies between the specimens; some are black with pale yellowish ovals in which the black eyes are visible (Figs. 1B, J). They have the dark pigment concentrated in transversal rows. Other specimens are pale and the internal organs are visible from all sides (Fig. 1E). There are specimens with intermediate amounts of black on the dorsal side. The eyes are in the posterior sides of the not pigmented ovals. The skin is studded with transparent glandular cells, which secretes a milky slime when the animal is strongly touched or irritated. Two dark green branches of the digestive gland are visible in the visceral sack, in the dark form only from the ventral side, in the light form also from the dorsal side.

INTERNAL FEATURES. - The left branch of the digestive gland in the posterior sack extends anteriorly further than the right one. Both stems are posteriorly united. The heart is beating just in the central anterior part of the visceral sack; there is not a clear pericardial bulb, only a vaguely visible swell in the dorsal skin. The heartbeat is remarkably slow when compared with the local *Elysia*

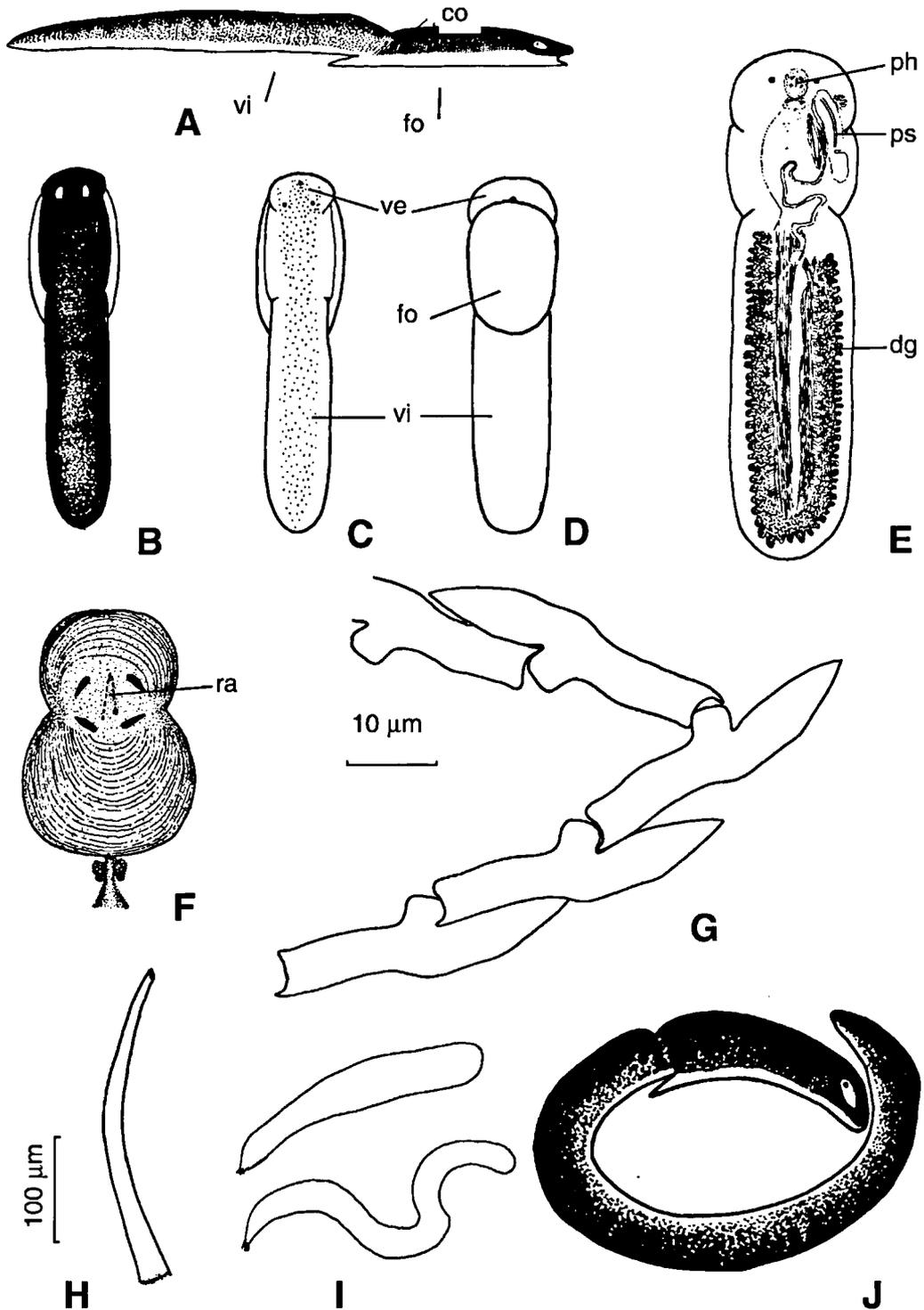


Fig. 1. *Gascoignella nukuli* n. sp. A, side view of dark specimen. B, dorsal view of a resting dark specimen. C, dorsal view of a pale-intermediate specimen (only external details are shown). D, ventral view (only external details are shown). E, dorsal view of a pale specimen showing internal organs. F, dorsal view of pharynx. G, side view of radula teeth. H, penial style. I, egg strings. J, curled specimen (scale bars are only given for radular teeth and penis spine). co = commissure; dg = digestive gland; fo = foot; ph = pharynx; ps = penial style; ra = radula; vi = visceral sack; ve = velum.

and *Ercolania* species.

The pharynx is wide and bulbous. Seen from the dorsal side there are four dark pigmented lines in a quadrate in the central part, and a dense pattern of parallel, semi-circular lines over the outside, most obvious over the posterior part (Fig. 1F). It seems to be wider than high as it turned always so that they only could be seen from above. The radula has about (six) seven (eight) teeth in the ascending limb, seven teeth in the descending, and about 10-19 teeth in the ascus. In one specimen the teeth in the ascus seemed grouped as a bundle with the tips directed to the same point, in some others they looked loose and not ordered. The length of the functional tooth was 16 μm in the smallest specimen and 34 μm in the largest. The teeth have a smooth blade, a large articulation branch at the inside, and a short extension on the outside of the base (Fig. 1G). The penial armature is a curved rather narrow, hollow needle with a length of 285–310 μm (Fig. 1H). No difference was observed in length and shape of the penial style or in the shape of the teeth between dark and light pigmented specimens. The albumen gland and gonad are along the inside of the loop of the digestive gland in the visceral sack (Fig. 1E).

REPRODUCTION. - Copulations were not observed. The egg strings (Fig. 1I) had a length of 6-8 mm and were deposited with one end adhered to the substrate, but algal threads quickly grew or adhered along the other parts. There were 580–702 eggs in a string. The fresh eggs are yellow; the surrounding fluid within the egg-shell is clear and colourless, as is the thin mucous cover of the string. The egg capsules are slightly oval, the mean length (± 1 S.D.) of fresh egg capsules is 118 μm (± 10 μm), $n = 15$.

HABITAT AND BEHAVIOUR. - The animals are slow, staying in captivity sometimes for days on the same place in algae or on the glass wall. They seem to move via cilia and excrete abundant mucus when in the mud. *Gascoignella nukuli* n. sp. seems to be a mud digger, probably feeding on the subterranean branches of *Derbesia marina* or on green micro-algae in the same mud. They rarely came out from the mud when underwater in the jars. When the slugs are freed from the

algae, they curl up with the head in the inside and the visceral sack on the outside (Fig. 1J). No specimens could be found on the surface of the substrate in the field. The studied specimens were collected in pieces of clay, which had been cut out with a knife around the high-high water level in the deep shadow of a mangrove forest. The clay with the barely visible algae becomes hard and nearly dry during periods of lower sea level and limited rain. The material could be transported as stones, and initially seemed water-repellent when placed in seawater. The specimens came on the clay surface after the materials had been underwater for days to months.

Two other, larger sacoglossans, *Elysia bangta-waensis* Swennen, 1998 and *Ercolania tentaculata* (Eliot, 1917) occur at the same site, but these stay submerged at a lower intertidal level at least during low tide.

DISCUSSION. - Only few shell-less Sacoglossans lack rhinophores and papillae, and among them besides *G. aprica* Jensen, 1985, only *Platyhedyle denudata* Salvini-Plawen, 1973 bears a visceral sack sharply set off from the rest of the body. The species was initially placed in the Acochlidae, but Wawra (1979) has shown that its position is in the Sacoglossa. *Platyhedyle*, which lives interstitially in coarse sublittoral sands, differs from *Gascognella* by having spicula but no pigment in the skin, and by some anatomical details summarized by Jensen (1996). When disturbed, *P. denudata* curls up (Salvini-Plawen, 1973) in a similar way as *G. nukuli* n. sp. (Fig. 1J) and this behaviour may be characteristic for the family Platyhedylidae. Up to now, only *G. aprica* Jensen, 1985, described from Hong Kong, was known in this genus. Dark specimens of *G. nukuli* n. sp. look rather similar to *G. aprica*. However, both species differ in several aspects, which are summarized in Table 1.

***Gascoignella jabae* n. sp.**

Figs. 2A-E

MATERIAL. - In October 1999, one specimen (holotype) was collected from the wall of a shadowed ditch in a remnant of a mangrove area near Ban Di, southern Thailand (06°52'17"N, 101°18'48"E). The holotype is deposited in the collection of the Zoological Museum Amsterdam (ZMA Moll. 400 008).

Table 1. Differences between *Gascoignella aprica* (based on description and drawings in Jensen, 1985) and *G. nukuli* n. sp. (based on this paper).

Character	<i>Gascoignella aprica</i>	<i>Gascoignella nukuli</i> n. sp.
Colour	Ventral parts pale yellowish, black on dorsal surface	Ventral parts pale yellowish; dorsal surface variable, some are black, some nearly not pigmented, others are intermediate
Position of the eyes in not pigmented area	In anterior part	In posterior part
Ratio of the length of anterior and posterior body measured from the dorsal commissure	< 2*	> 2
Shape of penial style	Nearly straight with a bulbous base	Curved, not swollen at the base
Length of the penial style	About 140 μm	About 350 μm
Number of radular teeth	8-9 in ascending limb, 12 in the descending limb	About 7 in the ascending limb and 7 in the descending limb
Shape of radular tooth	An extensive articulation knob	An articulation 'branch'
Length of radular tooth	62 μm	16-34 μm
Habitat	Intertidal, on mat of <i>Chaetomorpha</i> , creeping in open sunlight during low-tide	Supratidal, subterranean in or under <i>Derbesia</i> in deep shadow of mangroves

*According to Dr K.R. Jensen (in lit.) the relative shortness may have been caused by the use of a narcotizing agent during drawing.

ETYMOLOGY. - The species is named after its 'forked tail', which is called 'jabae' in local Jawi, a Malay language.

EXTERNAL APPEARANCE. - Total length of the creeping specimen was up to 9 mm, of which the body took 5 mm. The preserved slug has a total length of about 5 mm in total, body 3 mm, cerata about 2 mm. The height and width of the live slug could not be measured, but alive it was much flatter than in the preserved condition.

Rather flat, elongate, smooth slug with the body clearly divided into two parts (Figs. 2A, B, C). The foot is as wide and as long as frontal body; the corners are not expanded but just rounded and there is no notch in the frontal border (Fig. 2C). The head bears a semi-oval velum and two black eyes. There are no rhinophores or tentacles. The presence of a heart in the central

part of the body is somewhat doubtful, because heartbeats were seen, but not continuously and the organ could not be seen through the dark pigment. Attached to the dorso-posterior side are two, pointed cerata, which contain a continuation of the branches of the digestive gland. They are accurately paired, and kept in posterior direction.

The male gonopore is situated on the right side in the dark area just behind and under the right eye (Fig. 2B). There are two more openings on the same side: one below and slightly posterior of the male pore, the other is more posterior. They are supposed to be of the oviduct and the vagina or anus. However, there is a light coloured spot on the posterior part of the back right of the median, which may be the anal opening, but it may also be a skin damage. A few times faeces were observed in the shape of short, thin, blackish threads near the right ceras, but their origin

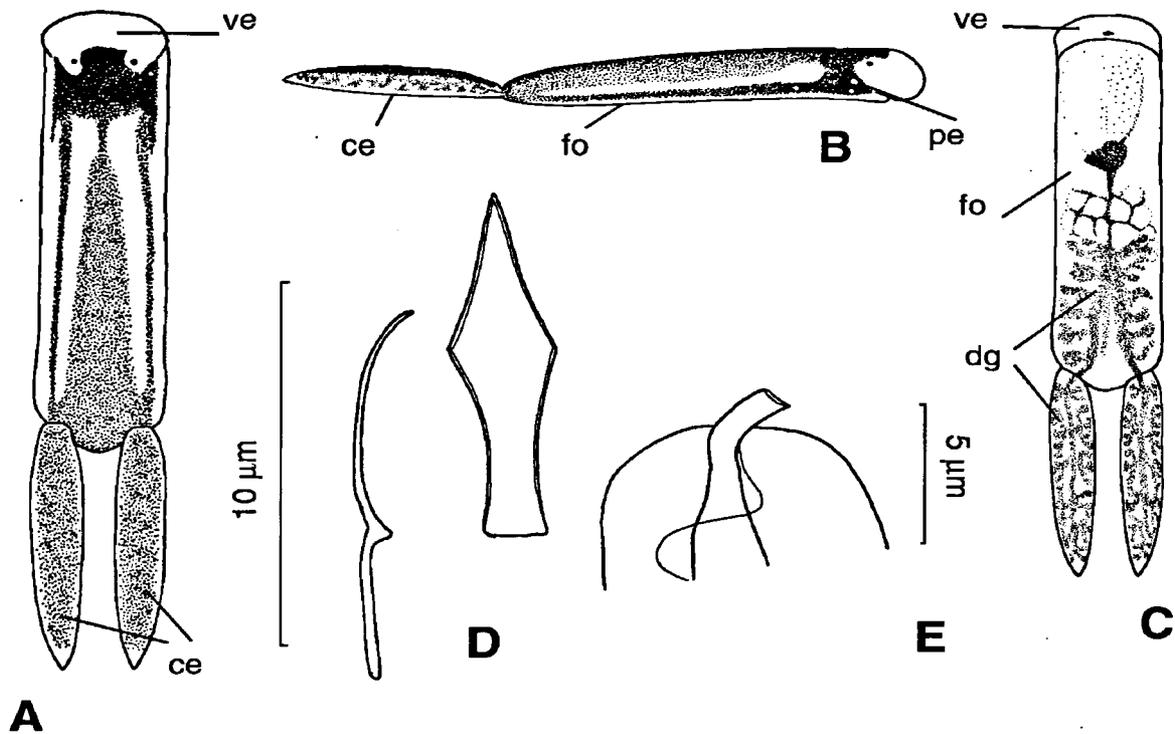


Fig. 2. *Gascoignella jabae* n. sp. A, dorsal view. B, right side view. C, ventral view. D, dorsal en side view of radular teeth. E, tip of penis with penial style (scale bars are only given for radular teeth and penis spine). ce = cerata; dg = digestive gland; fo = foot; pe = male gonopore; ve = velum.

remained unknown.

The colour of the animal is transparent pale yellow with dark longitudinal stripes and marks on the dorsal side. The colour of the markings is black on the head area and brownish black on the other parts (Fig. 2A, B). Closer inspection shows dispersed white gland cells in the skin, which are most dense along the sides and on the tip of the cerata. Through the transparent parts of the skin several yellowish balls of the reproductive organs are visible in the body. The two main stems with side branches of the digestive gland are dark green; they extend from halfway in the body to the tip of the cerata.

INTERNAL FEATURES. - The small pharynx was broken before its shape and the number of teeth could be determined. Only a row of five teeth of the uniseriate radula and a bundle of well over eight teeth in the ascus were saved. The teeth are pen-shaped and have a length of 9-10 µm (Fig. 2D). The penis bears a short, hooked style with a

total length of about 6 µm (Fig. 2E).

HABITAT AND BEHAVIOUR. - The specimen was collected around the high-high water line in shaded clay with a minuscule green alga cf. *Derbesia marina*. It was subterranean and emerged when the clay was submerged in seawater for weeks. The salinity of the water in the ditch varied between 4 and 20‰ during the year, but that was on the bottom of the ditch below the zone in which the specimens occurred. During very high tides, seawater enters further in the area, which will increase the salinity during submersion. Three other sacoglossans were found in the ditch but these were staying in pools during low tide in a lower intertidal level. They were *Elysia bangtawaensis*, *Ercolania tentaculata*, and *Ercolania* sp.

DISCUSSION. - The species is provisionally placed in the genus *Gascoignella*, with which it has in common the rounded foot, the half circular velum

without tentacles or rhinophores, the flat body clearly consisting of two parts with a connection at the postero-dorsal side of the anterior body, the smooth body wall, foot not distinctly set off from the body, the black pigment, the slow behaviour, the slowly beating heart, the similar green colour of the digestive gland, and the partly subterranean life. It differs, however, in the posterior part with the continuation of the main branches of the digestive gland into two cerata, in having the genital openings and perhaps also the anus on the sides of the body, in the small, strongly curved penial style, and the pen-shaped, very small radular teeth. A unique character is found in the two large posteriorly implanted cerata, which are strictly kept in a posterior direction and as such show similarity with a visceral sack although other organs than the digestive gland are not entering.

The taxonomic position of *G. jabae* n. sp. is uncertain like the position of the whole order Acochlidea (Gosliner & Ghiselin, 1984; Jensen, 1996). It may well be that this new species has to be placed in another genus and even in another family when more of its anatomy is known.

Another small sacoglossan with cerata located at the posterior part of the body and possessing remarkably small radular teeth is *Olea hansineensis* Agersborg, 1923, which deviates from most sacoglossans by feeding on opisthobranch eggs (Crane, 1971). The species is additionally described by Gascoigne (1975), and presently placed in the Limapontiidae (Stiligeridae) by Gascoigne (1976). It differs by having an indefinite number of cerata of variable sizes, while the number of cerata seems fixed to one pair in *G. jabae* n. sp. It has a vaginal ridge, foot and body clearly set off, the metapodium tapering in a long point and it possesses labial lobes and short rhinophores, which are all missing in *G. jabae* n. sp.

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