

TWO NEW SPECIES OF BROOD PROTECTING DESMODORIDAE (NEMATODA) FROM GUADELOUPE

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Two new Desmodoridae species are described: *Croconema otti* sp. n. and *Pseudochromadora incubans* sp. n. The cuticular ornamentation and somatic setae of *C. otti* sp. n. display features previously unknown within the genus. In *P. incubans* sp. n. the position of the cephalic setae and latero-subdorsal amphids on the cephalic capsule, which is divided into two sections, are characteristic.

Brood protection occurs in both species. In *C. otti* sp. n. a single line of similar embryos is attached laterally on the left side of the body. In *P. incubans* sp. n. up to three eggs, at different developmental stages, hang in a row under the modified area immediately anterior to the vulva.

Keywords: Brood protection, marine nematodes, Guadeloupe, taxonomy, descriptions.

Two peculiar Desmodoridae species, new to science, occur in Guadeloupe littoral deposits: *Croconema otti* sp. n. and *Pseudochromadora incubans* sp. n. Both species have evolved in different ways towards brood protection, a rare phenomenon among nematodes, which is discussed in this paper.

MATERIALS AND METHODS

The material was sampled during a collecting trip sponsored by "Mission Muséum-Antilles" (1979) to study the littoral meiobenthos of Guadeloupe. The stations are located north of the junction of the twin islands (Grande-Terre and Basse-Terre) in the Grand Cul-de-Sac marin (Renaud-Mornant & Gourbault, 1981).

Sampling and methodology are described in our previous papers (Gourbault & Renaud-Mornant, 1983) and in Vincx (1986). Type specimens are deposited in the nematode collections of the Muséum national d'Histoire naturelle, Paris (MNHN) and the Institute of Zoology, Gent (RUG).

DESCRIPTIONS

Family Desmodoridae Filipjev, 1922

Subfamily Desmodorinae Filipjev, 1922

1. Genus *Croconema* Cobb, 1920

Croconema otti sp. n.
(Figs 1A-B, 2A-G, 3A-C)

Material studied: 4 males, 6 females, 8 juveniles.

Type specimens: holotype ♂ 1 on slide BN9; paratype ♀ 1 BN10; other paratypes on slides BN11-16 (MNHN) and slides n° 20 and 38 (RUG).

Type locality: Guadeloupe, Grand Cul-de-Sac Marin, Ilet à Fajou, station 2, sample n° 5, April 1979.

Habitat: Marine, in calcareous (89% CaCO₃) medium to coarse ripplemark deposits collected by diving.

Etymology: dedicated to Prof. Dr. Jörg A. Ott, Vienna who described the first case of brood protection among Desmodoridae.

Holotype (♂ 1) $\frac{9 \ 80 \ 145 \ - \ 985}{29 \ 41 \ 42 \ 46 \ 39}$ 1080 μm , a = 23.5, b = 7.5, c = 11.4, c' = 2.4.

Paratype males (n = 3). L = 1145-1190 μm , a = 22.8-24.0, b = 6.5-7.3, c = 11.4-12.7, c' = 2.2-2.8.

Paratype female carrying eggs (♀ 1) $\frac{165 \ M \ 780 \ 925}{44 \ - \ 80 \ 24}$ 1010 μm , a = 12.6, b = 6.1, c = 11.9, c' = 3.5, V = 77.2%.

Paratype females (n = 4). L = 1075-1255 μm , a = 18.7-21.3, b = 6.2-6.9, c = 11.7-15.5, c' = 2.3-3.0, V = 64.6-80.8%.

Body cylindrical with blunt head and tapering posteriorly to conical tail with punctuated tip. Females distinctly swollen at level of reproductive system. Cuticle brownish, thick and annulated; 10 annules cover about 16 μm in cervical and tail regions, and 14 μm in mid-body. Striations (particularly distinct in an ecdysis) ornamented as in Epsilonematidae, with longitudinal bars and junctions between two annules. Eight rows of somatic setae with two morphological types: with truncate ends in the two pairs of sublateral rows, thinner and with pointed tips in the subventral and subdorsal rows (Fig. 2E, G).

Cephalic capsule well developed, one large annule 27-29 μm high, up to 30 μm wide. Six internal labial papillae and six external labial setae (2-3 μm long) on the strongly cuticularised lip region. The four cephalic setae are 4-5 μm long and located at anterior border of cephalic capsule (Fig. 2C). Eight subcephalic setae (5-6 μm long) are located a few μm behind cephalic setae in males, and at mid-part of cephalic capsule in females (Fig. 2A). In males, some additional setae, on four sublateral and two subventral or subdorsal rows (followed by the somatic setae files) are present, posterior to the amphids. The amphideal fovea is loop-shaped with circular outline and 1 $\frac{1}{4}$ turns, ventrally wound: 12-14 μm in diameter *i.e.* 40 to 48% of the corresponding head width in male, only 8-9 μm diameter (29-30%) in female.

Buccal cavity conical with large dorsal tooth, two smaller subventral teeth, field of denticles at the anterior part surrounded by muscular buccal bulb.

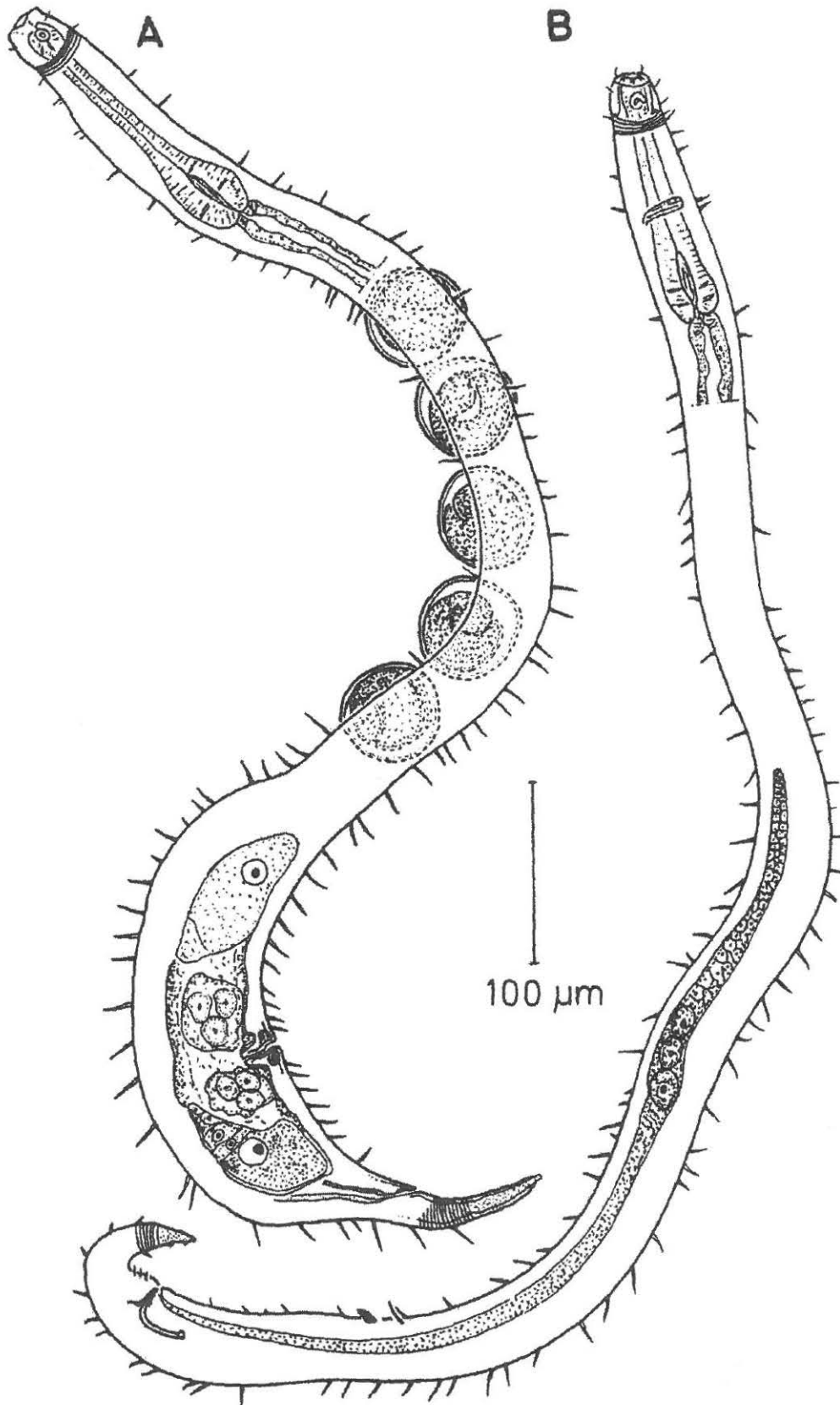


Fig. 1. *Croconema otti* sp. n. A: female (♀ 1) carrying eggs; B: holotype (♂ 1), internal view.

Brownish granular glands filling cephalic capsule at anterior part of pharyngeal bulb (Fig. 2B). Pharynx 145-175 μm long, its posterior third with a terminal bulb with cuticularized lumen wall. Nerve ring at 56-58% of pharyngeal length; no ventral pore found. Numerous glands in pharyngeal region in connection with somatic setae.

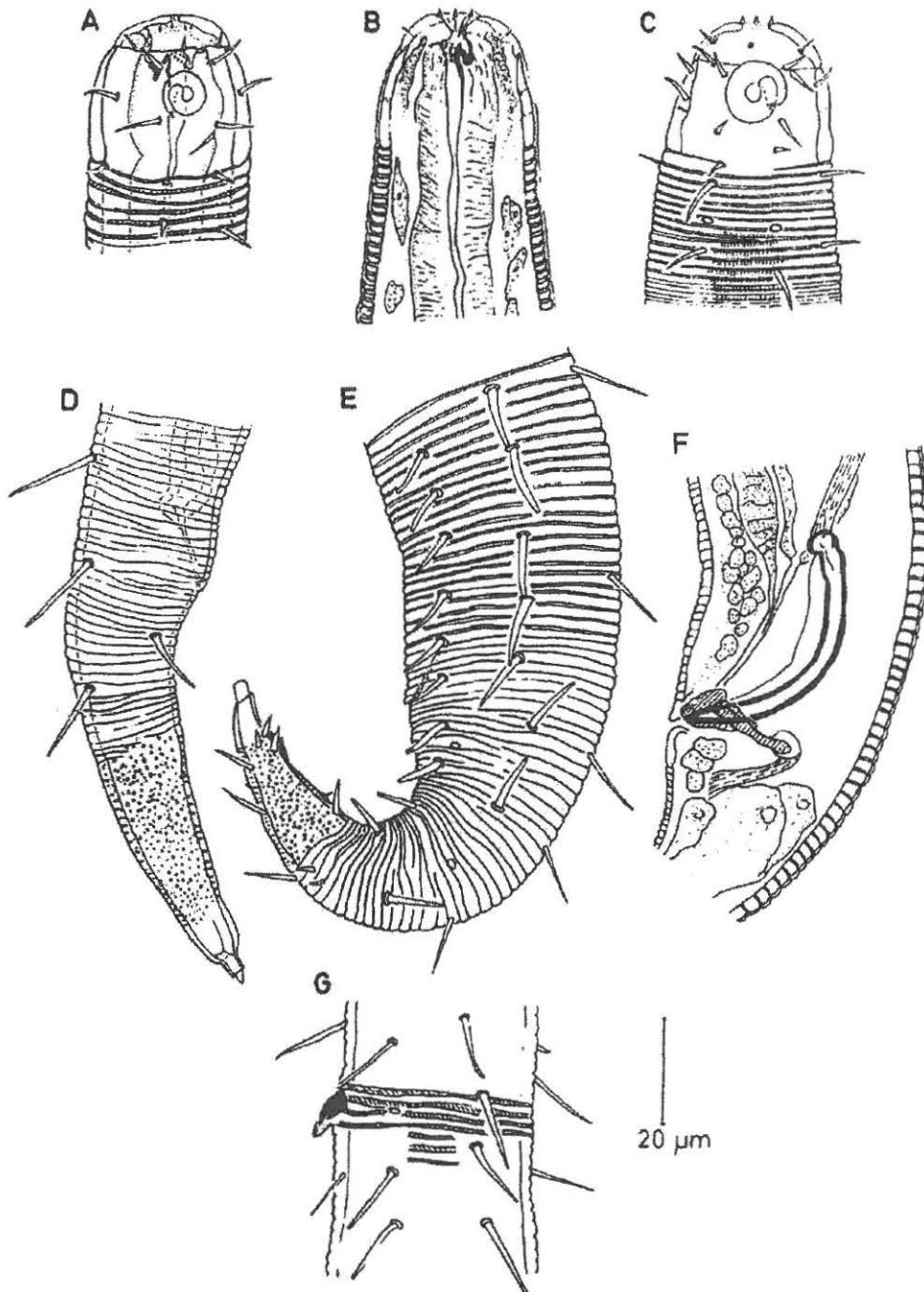


Fig. 2. *Croconema otti* sp. n. A: head of female (♀ 1), surface view; B: head of holotype (♂ 1), internal view and C: surface view; tail region in surface view, D: female (♀ 1) and E: holotype (♂ 1); F: copulatory apparatus and G: copulatory horns of holotype (♂ 1).

Tail conical, 90-105 μm long in males (2.2-2.8 anal diameter) and 75-100 μm (2.3-3.0 a.d.) in females; its posterior part not striated but ornamented by numerous typical pores. In males, the vacuolized part bearing some setae and ventral protuberances is at about 1/3 length of tail (Fig. 2E). Punctuated part of female tail glabrous (Fig. 2D), usually longer than in male (32-43% of total length); spinneret distinct.

Male monorchic. Testis (200 μm long) beginning 300 μm behind posterior end of pharynx, *i.e.* at 36% of body length. Large sperm cells with cytoplasmic globules, narrow vas deferens. Paired arcuated spicules 60-63 μm long (1.5-1.7 anal diameter) with weak ventrally bent capitulum and weakly sclerotized velum. Gubernaculum with dorso-caudal apophysis 15-17 μm long and median quadrangular plate (Fig. 2F). Pair of ventral precloacal bifid copulatory horns located 85-100 μm in front of cloacal opening (Figs 1B, 2G).

Female didelphic, amphidelphic with reflexed ovaries right and ventral to intestine, filling up 25% of body length but located rather strongly posteriorly. Very small round cuticularized vulva. Short vagina; sperm cells observed in spermatheca but no eggs found in uterus, which is long and empty in most females. In a female (Q 1), five eggs are attached in single file on left lateral side of body, paralleling anterior part of intestine to position shortly before anterior ovary (Figs 1A, 3A). Brooded eggs spherical, about 58 μm in diameter. Embryos stout, vermiform, all at the same stage of development, fully separated (Fig. 3B).

Juveniles similar to adults in habitus, but in youngest stages, cuticle without bars joining two annules, somatic setae not modified. Small amphid as in female (32% of the head diameter). In a stage IV $j\sigma$, somatic setae are present on tail but horns are not yet developed.

Differential diagnosis: The ten valid species of *Croconema* share all the characters of the genus (see Vincx, 1986), however, as far as preanal supplements and cuticular modifications are concerned, some differences occur. The type-species, *C. cinctum* (Cobb, 1920) Gerlach, 1963, was described as having 2-3 preanal cuticularized supplements and small ventral papillae on the punctuated part of the tail. Similar structures are present in a few other species: *C. mammillatum* Steiner & Hoeppli, 1926, *C. mediterranea* Wieser, 1954, *C. sphaericum* (Kreis, 1928) Luc & De Coninck, 1959, *C. stateni* Allgen, 1928 and *C. torquens* (Gerlach, 1963) Gerlach, 1964. By contrast, preanal supplements and cuticular modifications are lacking in a second group of species: *C. boucheri* Ott, 1976, *C. longisetum* Stekhoven, 1950, *C. mawsoni* Inglis, 1968 and *C. ovigerum* Ott, 1976.

The new species *C. otti* is related to the first group but it differs from all the known species in some characteristic features: Amphids are twice as large as in *C. cinctum* which possesses long subcephalic setae, numerous preanal supplements and thin, weakly arcuated spicules. Cephalic setae are shorter than in *C. torquens*, a large species with long cephalic setae and a cylindrical buccal

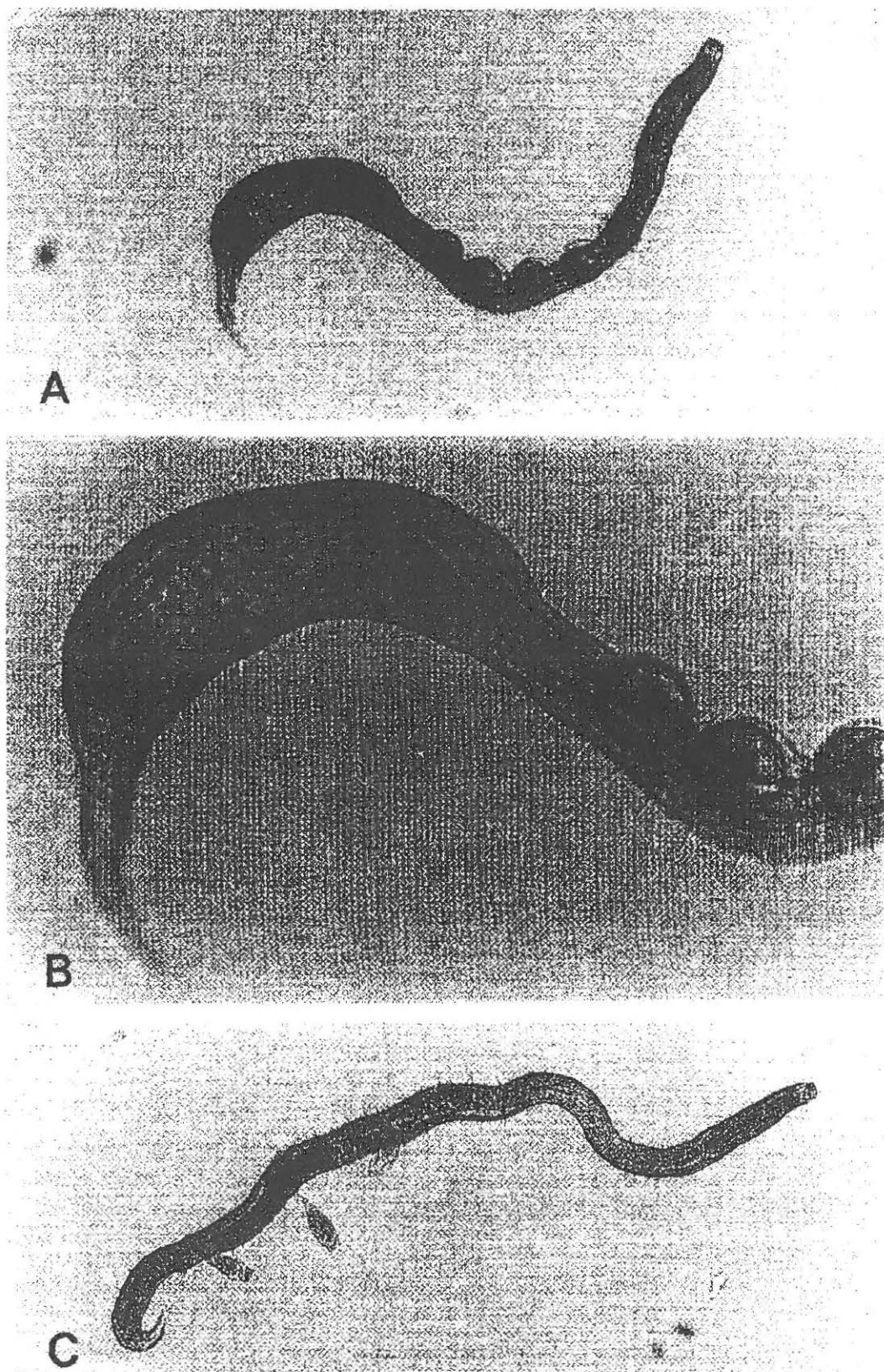


Fig. 3. *Croconema otti* sp. n. ♀ 1 carrying embryos: A: total view, B: posterior part; C: paratype male with Suctorium.

cavity, and are not surrounded by many additional setae as in *C. sphaericum*. Tail is longer than in *C. mediterranea* and gubernaculum shape and position of copulatory horns are different. Porelike openings located in front of the spinneret of *C. mammillatum* are lacking. Cuticular differentiations are of great interest in *Croconema otti* because they resemble those found in Epsilonematidae (as in *C. mammillatum*). Another point to emphasize is the peculiar structure of the somatic setae, which are similar to those characteristic of *Echinodesmodora* Blome, 1982.

Remarks: The occurrence of Suctorina on the cuticle is a rather frequent phenomenon in *Croconema* species. In some of them, up to four may be present (Fig. 3C) as in males and females of *C. otti*. They have been already observed on *C. sphaericum* and *C. stateni*. At the type locality some were found attached to two females of *Spirinia*, but apparently they belong to different species.

2. Genus *Pseudochromadora* Daday, 1889

Pseudochromadora incubans sp. n.

(Figs 4, 5A-G, 6A-C)

Material studied: 8 males, 22 females, 44 juveniles.

Type specimens: holotype ♂ 1 on slide BN17, paratype ♀ 1 on slide BN18; other paratypes BN19-23 (MNHN) and n° 18-19 (RUG).

Type locality: Guadeloupe, Grand Cul-de-Sac Marin, Lagune de Belle Plaine, station 24, sample n° 6, April 1979.

Habitat: Marine mangrove, on muddy banks, between *Rhizophora mangle* L. roots; 0.7% CaCO₃.

Etymology: from latin *incubare* = to brood.

Holotype (♂ 1) $\frac{9 \ 70 \ 130 \ M \ 645}{20 \ 33 \ 35 \ 40 \ 23}$ 730 μm, a = 18.2, b = 5.6, c = 8.6, c' = 3.7.

Paratype males (n = 6). L = 615-810 (720) μm, a = 17.3-24.6 (20.2), b = 5.4-6.3 (5.8), c = 8.2-9.9 (8.9), c' = 3.2-3.8 (3.5).

Paratype female carrying eggs (♀ 1) $\frac{10 \ 110 \ 420 \ 570}{20 \ 35 \ 50 \ 14}$ 640 μm, a = 12.8, b = 5.8, c = 9.1, c' = 5.0, V = 65.6%.

Paratype females with eggs (n = 10). L = 640-725 (690) μm, a = 10.5-13.1 (12.3), b = 5.8-6.3 (6.0), c = 8.4-9.7 (8.8), c' = 4.3-5.7 (4.5), V = 60.3-66.6 (64.4)%.

Paratype female not carrying eggs (n = 3). L = 690-730, a = 12.5-14.0, b = 5.5-6.3, c = 8.7-9.2, c' = 4.0-5.1, V = 63.7-73.7%.

Short, broad cylindrical body with large head and cylindro-conical, pointed tail. Pharyngeal region ventrally curved so that buccal cavity is in close proximity to part of body where numerous micro-organisms are present. Cuticle distinctly annulated, annule thickness 1.5 μm in pharyngeal region, 2.2 μm at mid-body. Lateral alae 5 μm wide, extending from 60 μm behind pharyngeal

end to cloacal level. In females, lateral alae lacking in vulvar region. Eight rows of somatic setae, more numerous in posterior part of body.

Well developed cephalic capsule, 23 μm wide, 16 μm high, consisting of two annules with thick cuticle; in its half posterior part, cuticle regularly vacuolized (Fig. 5A). Brownish glandular granulations present in high, well-sclerotized lip region (5-6 μm long). Six internal labial papillae, six short (1.5 μm long) papilliform external labial sensilla situated on heavily sclerotized lip region; the four cephalic setae, 4 μm long, at amphid level, below first cephalic annule.

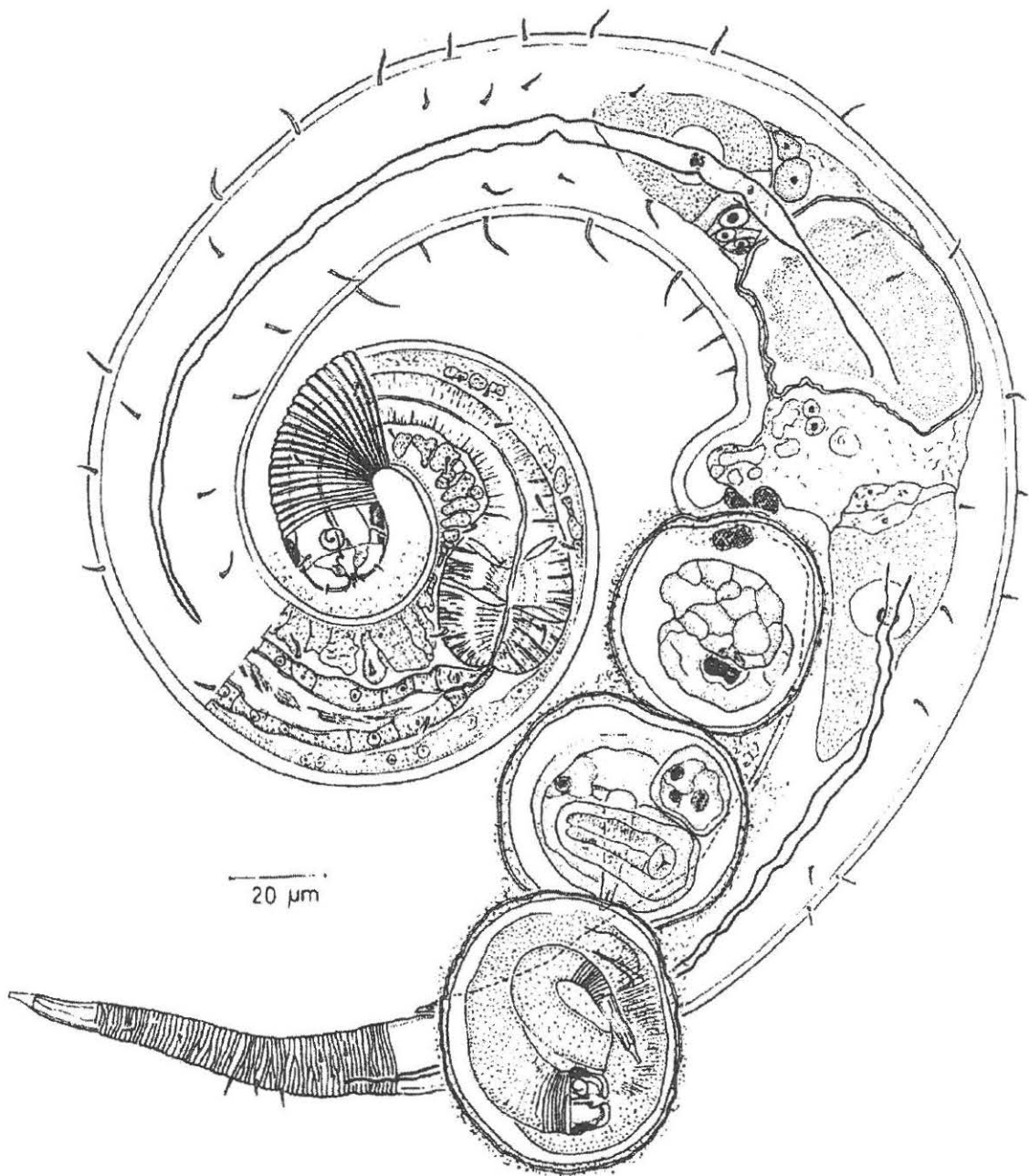


Fig. 4. *Pseudochromadora incubans* sp. n. female (♀ 1), internal view, carrying eggs and embryos.

Amphideal fovea loop-shaped, ventrally wound, spiral with $1\frac{1}{4}$ turns, $7\ \mu\text{m}$ wide, *i.e.* 33% of head diameter, located sub dorsally (may be displaced to dorsal body side through pharynx plicature) across both cephalic annules (Fig. 5A, C).

Buccal cavity small, with pointed dorsal tooth and small subventral left tooth, completely surrounded by swollen anterior part of pharynx. Posterior quarter of pharynx consisting of an ovoid muscular bulbus with well sclerotized lumen wall (Fig. 5B). Cardia $8\ \mu\text{m}$ long. Nerve ring at 54% of pharyngeal length. Ventral gland and pore not found.

Male monorchic with outstretched testis reaching up to $280\ \mu\text{m}$ behind cardia, at left of intestine (right in σ BN19). Spicules regularly curved, with distinct capitulum and pointed tips, velum present. Gubernaculum plate-shaped, $18\text{-}20\ \mu\text{m}$ long (Fig. 5E). Copulatory horns in two groups: anterior group of one small and three large horns, posterior group of three small horns, located respectively $90\text{-}95\ \mu\text{m}$ (1st group) and $60\text{-}70\ \mu\text{m}$ (2nd group) ventrally in front of the cloacal opening (Fig. 5D). On preanal area somatic setae of subventral rows become more numerous, ventral row of thick setae present.

Male tail conical, 3.7 times (mean 3.5) as long as anal diameter, with smooth tip and short spinneret. In its median part, tail ventrally enlarged and with three large and one small cuticular spines (Fig. 5D). Three caudal glands.

Female similar to male but with narrower tail ($c' = 4.5$ instead of 3.5) without cuticular expansions. Reproductive system short, 25% of the total length, didelphic, amphidelphic with ovaries reflexed, both to right of intestine. Presence of two spermathecae usually filled with globular sperm cells. In unfertilized females, vulvar region flattened normally (Fig. 5F); small vulva opening into long vagina. By contrast, in females ready to lay eggs (Figs 5G, 6A) or carrying them, prevulvar region bulges to, with eggs hanging out (Figs 4, 6B-C). Eggs with sticky envelope (Fig. 4) that facilitates adhesion both to the mother and to each other. Broods surrounded by numerous micro-organisms and comprising one to three eggs, distal egg bearing the most fully developed embryo. First egg $34\text{-}35\ \mu\text{m}$ in diameter when laid; when it reaches $45\text{-}50\ \mu\text{m}$ in diameter, another egg is laid and a third one may follow. At appearance of third egg, first laid egg is up to $55\ \mu\text{m}$ in diameter, with a fully developed embryo from which juvenile is ready to hatch (Fig. 4).

Juveniles similar to male; in a stage IV individual (moulting σ) spicules already distinct, while cuticular horns typical of the male are not yet developed; ventral part of tail already enlarged. Cuticular expansion of body annules conspicuous.

Differential diagnosis: *Pseudochromadora incubans* sp. n. shares all the distinctive taxonomic characters with other *Pseudochromadora* species; the well developed cephalic capsule is divided in two parts. In the new species the four cephalic setae are located at the base of the apical part, and the sublaterodorsal amphids overlap both parts. Amphids are loop-shaped with a circular profile. Lateral

alae are present, at all growth stages. The new species differs from the two hitherto recognized species of the genus (Vincx, 1986) by the locations of the cephalic setae and amphideal fovea.

A similar ventrally curved pharyngeal region occurs in *Manunema* Gerlach, 1957; the location of the buccal cavity close to the part of the body where

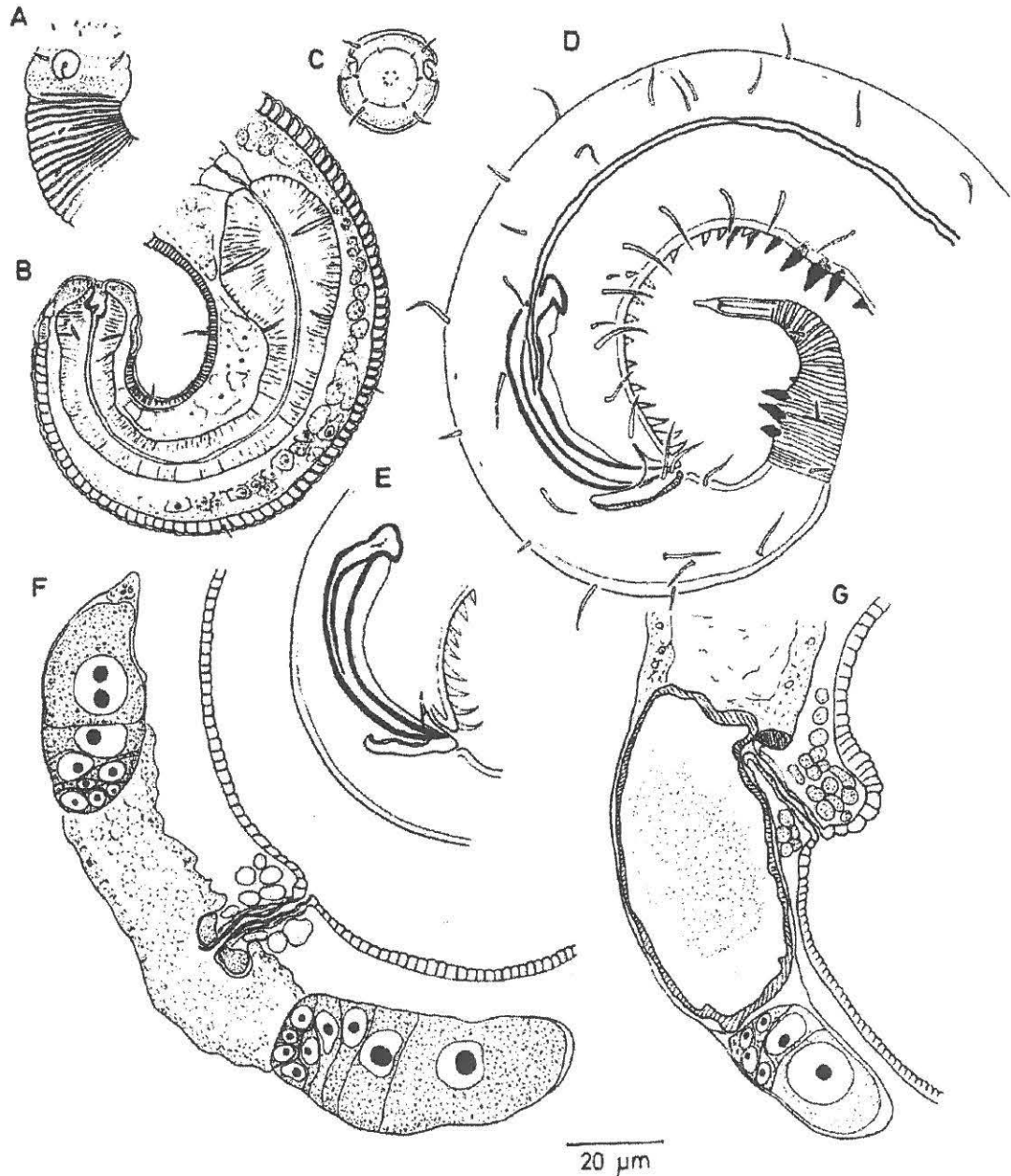


Fig. 5. *Pseudochromadora incubans* sp. n. A: head of holotype (♂1) surface view; B: female pharyngeal region, internal view; C: apical section of juvenile head; D: posterior region and E: copulatory apparatus of holotype (♂1); F: female reproductive system; G: modified prevulvar region in female ready to lay eggs. Sheet of micro-organisms are omitted from the drawings for clarity.

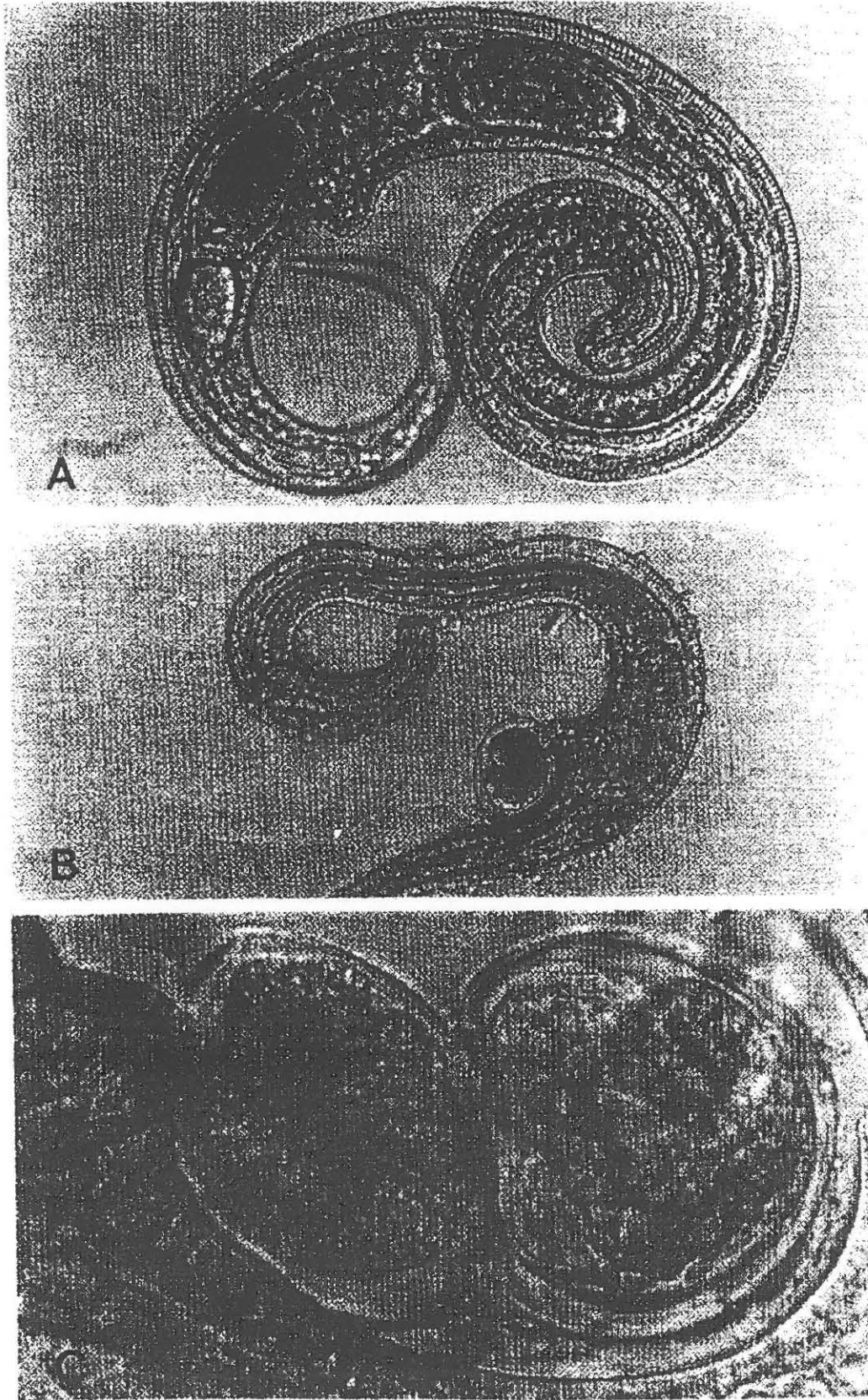


Fig. 6. *Pseudochromadora incubans* sp. n. A: paratype female with a bulging prevulvar region; B: female carrying one egg; C: detail of two embryonated eggs.

numerous micro-organisms are present may indicate some gardening activities in these species.

DISCUSSION

Brood protection mechanisms. Hitherto, brood protection—*i.e.* eggs carried by female after they have left the reproductive system—has been reported in very few marine nematodes. It occurs in three species of Desmoscolecidae: two eggs were observed on the tail of *Tricoma intermedia* Steiner, 1916, and a single one on the ventral side of *Desmoscolex laevis* Kreis, 1926 (cf. Timm, 1970). Females of *Tricoma absidata lizardiensis* Decraemer, 1979 were described carrying one to five eggs, at different developmental stages, attached to their body, but mainly located in the tail region. In Ceramonematidae, Hopper (1973) observed *Pselionema annulatum* (Filipjev, 1922) with two eggs in egg sacs attached to the vulva. This phenomenon was also reported from *P. annulatum* var. *beauforti* by Ott (1976) who also recorded the occurrence of brood protection in *Croconema ovigerum*, the females of which carry their eggs in a row on the lateral side of the body behind the pharyngeal bulb.

Croconema otti sp. n. and *C. ovigerum* exhibit the same kind of brood protection: a single file of many eggs are attached to the lateral side of the body (five in *C. otti*, nine to ten in *C. ovigerum*). All their embryos seem to be more or less at the same stage of development, suggesting that the oocytes are fertilized and laid simultaneously. As already reported by Ott (1976, p. 177), several (six in ♀ BN11) equal-sized ova are present in the distal part of each ovary instead of a single large one as is usually found.

By contrast, in *Pseudochromadora incubans* sp. n., large oocytes are laid one by one. A string of up to three eggs at different developmental stages is attached to the modified prevulvar region, evidently after fertilisation. The bulging ventral region is presumed to protect the eggs during locomotion. A similar protection strategy is exhibited by females of *Prorhynchonema warwicki* Gourbault, 1982 and serves to maintain the transferred spermatophora (Gourbault & Renaud-Mornant, 1983).

The one to five eggs carried by *Tricoma absidata lizardiensis* on the unmodified posterior region are not arranged in strict accordance to their developmental stage, although the more highly developed embryo is located near the tail tip.

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RÉSUMÉ

Deux espèces nouvelles de Desmodoridae (Nematoda) de Guadeloupe, à pontes portées par les femelles.

Description de deux espèces nouvelles de Desmodoridae: *Croconema otti* sp. n. à ornementation cuticulaire et soies somatiques très originales pour le genre; *Pseudochromadora incubans* sp. n.

caractérisée par la position des soies céphaliques et des amphides latéro-dorsales sur la capsule céphalique à double annélation.

Chez les femelles, la protection des pontes diffère: - simple file de plusieurs oeufs embryonnés, au même stade et collés sur le même côté gauche de l'animal pour la première espèce, - chapelet de trois embryons maximum, à différents stades de développement, suspendu sous la région vulvaire modifiée, pour la seconde.

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