

# ***Noctuidonema daptria*, n. sp. (Nematoda: Aphelenchoididae), an Ectoparasite of the Moth *Lesmone porcia* (Stoll)**

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**Abstract:** Described and illustrated for the first time is a bisexual aphelenchoidid ectoparasitic nematode found on a noctuid male moth in Guadeloupe, West Indies. Sexes are polymorphic, having in common an elongated stylet of 53–69  $\mu\text{m}$  with well-developed basal knobs and double set of protractors, excretory pore near head end, multiple rows of germ cells, and a mucronate tail terminus. The male is particularly distinctive in having a low, smooth head, spicules 38–49  $\mu\text{m}$  long with a tubular rostrum and a ventral arm well separated from the dorsal, an external cloacal cylinder, and a pre- and postanal pair of genital papillae. Distinctive for the female are a unique, multinucleate uterine gland complex, lack of a functional rectum and anus, and, by marked contrast to the male, a high, hemispherical head marked by six annules and a large uninucleate renette cell.

**Key words:** Aphelenchoididae, description, ectoparasite, Guadeloupe, insect nematode, *Lesmone porcia*, morphology, nematode, new species, Noctuidae, *Noctuidonema daptria*, taxonomy.

Recent discoveries of multiple infestations of noctuid moths by aphelenchoidid ectoparasites have intensified interest in the use of these nematodes in insect pest management programs (1,4,5). In 1986, a survey of noctuid moths in Guadeloupe by A. Kermarrec, B. Lalanne-Cassou, and H. Mauleon was conducted to determine the kinds and distribution of ectoparasitic nematodes having biocontrol potential. Of 93 males and females of 24 species in 21 genera of Noctuidae sampled, 31% were infested with *Noctuidonema guyanese* Remillet and Silvain, 1988. Of these moths, 34% harbored 50–340 ectoparasitic nematodes, suggesting an injurious effect on their host. *Noctuidonema guyanese* previously was known to occur only in French Guiana, where it has a similar noctuid host range (4), but recently it has been found infesting noctuid adults of *Spodoptera frugiperda* in southeastern Florida and Texas by Rogers et al. (5). Further study of the Guadeloupe nematode survey collection housed in Antibes, France, has resulted in finding two

unknown ectoparasitic species, one of which is described here.

## MATERIALS AND METHODS

Moth species of the family Noctuidae and their nematode parasites were collected from various habitats in Guadeloupe as described in Anderson and Laumond (1). Nematodes were obtained from the abdomens of moths by brushing or vigorous rinsing; then they were heat relaxed, fixed in formalin, processed to glycerine through an ethanol-glycerine series, and mounted on Cobb's metal slides. Microscopic observations with light and interference contrast optics were based on permanent slide mounts of over 200 specimens and on sections rolled in glycerine under a coverglass.

## SYSTEMATICS

*Noctuidonema daptria* n. sp.  
(Figs. 1A–E, 2A–H)

**Holotype (male):** L. = 512  $\mu\text{m}$ ; a = 4.7; c = 85.3; c = 0.7; T = 75. Stylet length = 58  $\mu\text{m}$ ; M = 77. Spicule length = 45  $\mu\text{m}$ ; ventral arm = 32  $\mu\text{m}$ . Head height = 1.9  $\mu\text{m}$ , width = 7.3  $\mu\text{m}$ . Length from anterior end to base of metacarpus = 86  $\mu\text{m}$ , to excretory pore = 14  $\mu\text{m}$ .

**Allotype (female):** L = 463  $\mu\text{m}$ ; a = 13.2;

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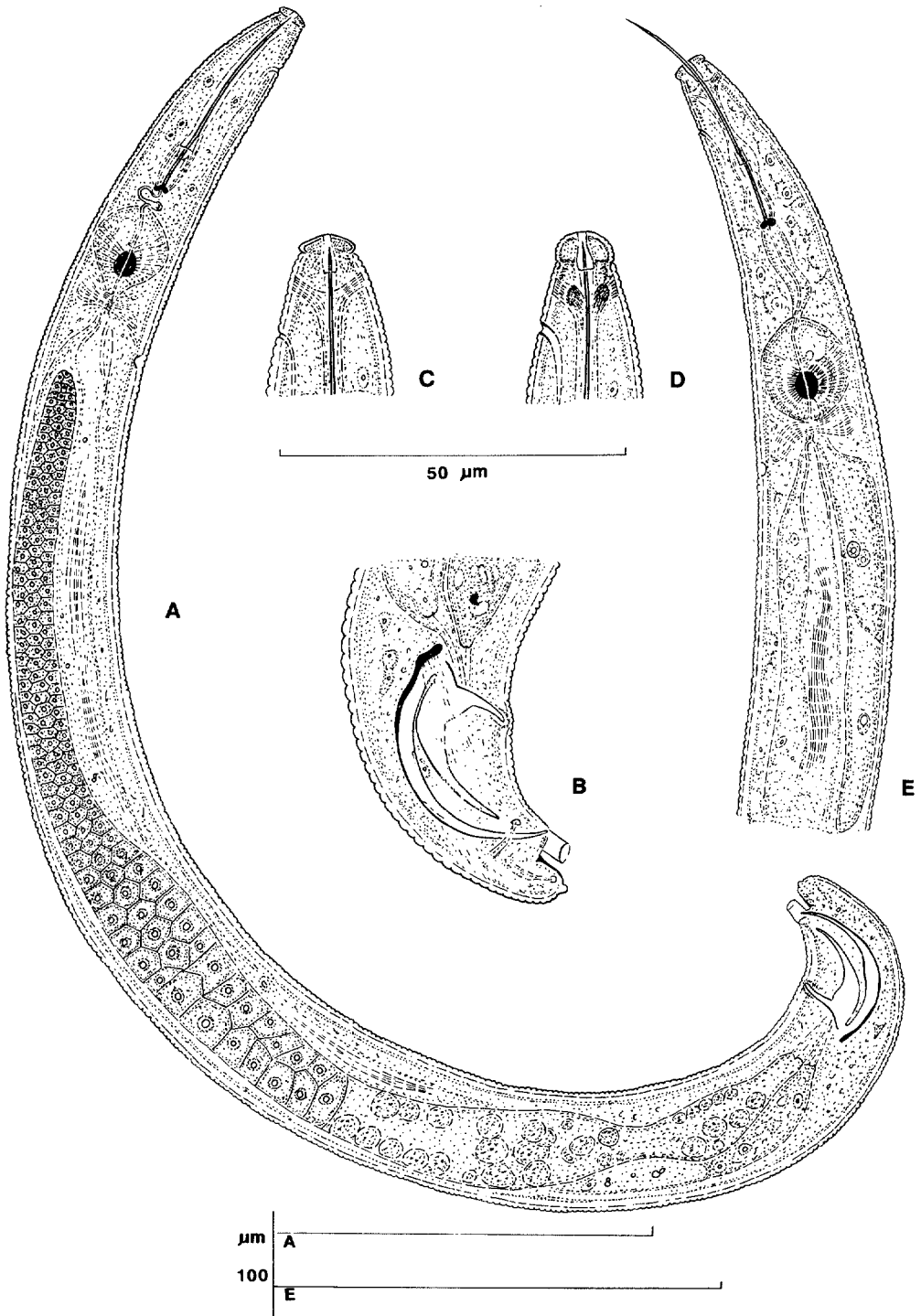


FIG. 1. *Noctuidonema daptria* n. sp. Male. A) Adult in typical relaxed state. B) Tail region with the diagnostic secondary sex features of the spicules, cloacal cylinder, genital papillae, and ventrally thickened cuticle of the tail, which serves as a spicule guide. C) Head end. Note the attachment of the stylet protractors and anterior position of the excretory pore. D) Female head. Note the marked differences from the male in shape and annulation of the head, and in size and cuticularization of the excretory pore and duct lining. E) Esophageal region. The dorsal gland lobe nucleus and nucleolus are typically larger than those of the subventral gland lobes.

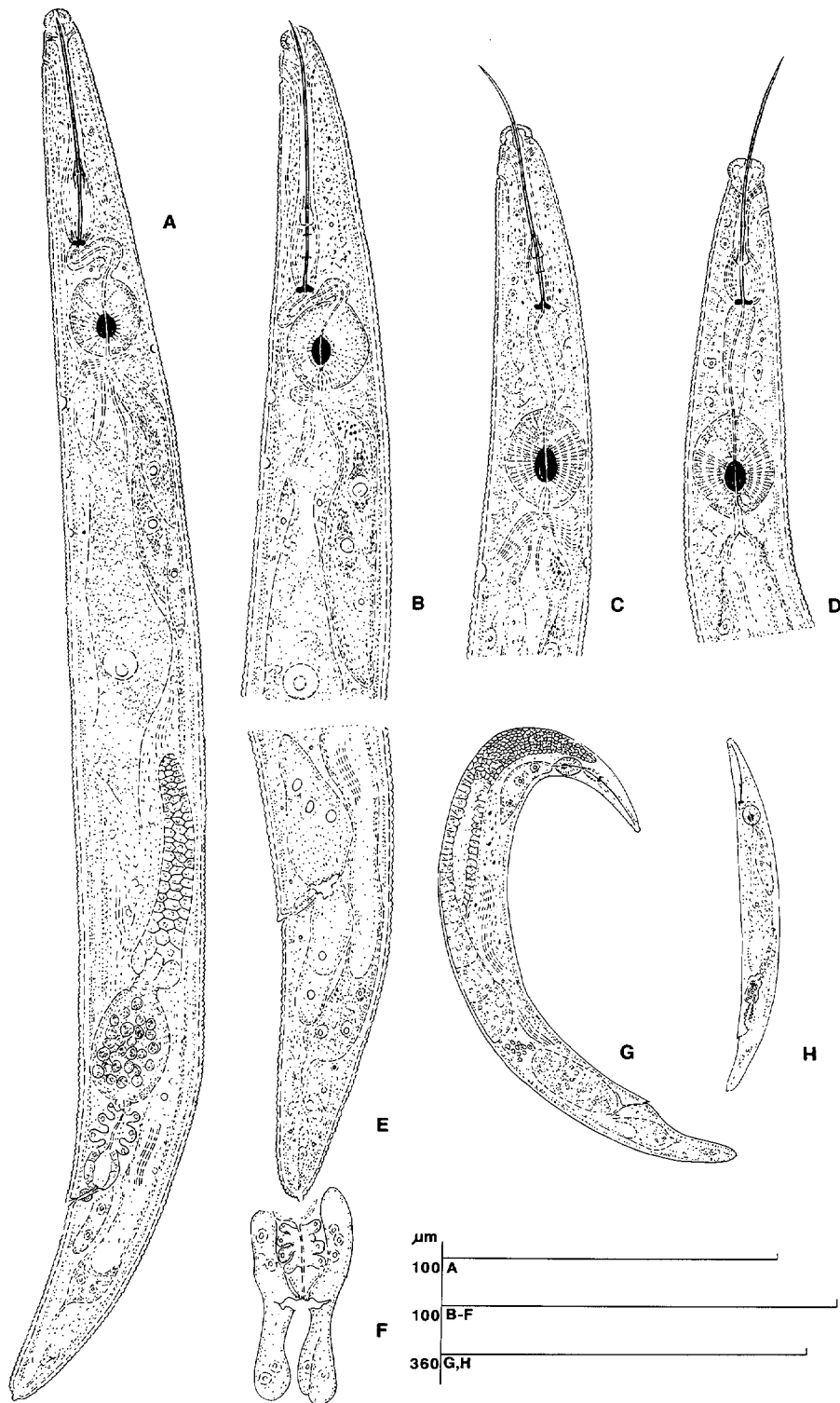


FIG. 2. *Noctuidonema daptria* n. sp. Female. A) Young adult. Note the large subventral esophageal gland nuclei and nucleoli compared to that in the dorsal gland lobe, and the large, uninucleate renette cell. B-D) Esophageal regions show the stylet in progressive stages of protraction, E, F) Tail region showing the uterine gland complex in lateral aspect and dorsal (F) view. G, H) Comparison of size differences between gravid (G) and young adult (H) specimens.

b = 2.2; V = 87; ovary = 22%. Stylet length = 63  $\mu\text{m}$ ; M = 71. Head height = 3.1  $\mu\text{m}$ , width = 8.1  $\mu\text{m}$ . Length from anterior end to metacarpus base = 114  $\mu\text{m}$ ; to excretory pore = 12  $\mu\text{m}$ , from vulva to tail tip = 62  $\mu\text{m}$ , divided by body width at vulva = 2.5.

*Paratypes*: Measurements in Table 1 and 2.

TABLE 1. Measurements ( $\mu\text{m}$ ; range, mean  $\pm$  standard deviation) and ratios of the male of *Noctuidonema daptria* n. sp.

Morphological character	Male (n = 22)
Length (L)	471-517 (486 $\pm$ 26.2)
a	13-16 (13.8 $\pm$ 0.8)
b	2.0-3.4 (2.8 $\pm$ 0.3)
c	65-129 (91.5 $\pm$ 18.4)
c	0.5-0.9 (0.67 $\pm$ 0.9)
Reproductive system	
L	203-338 (275.5 $\pm$ 38.1)
% body L	45-69 (57.2)
testis L	236-312 (279.7 $\pm$ 20.4)
Esophagus	
L	151-249 (174.7 $\pm$ 23.5)
L to base metacarpus	81-104 (89.7 $\pm$ 7.5)
Metacarpus	
L	21-29 (22.8 $\pm$ 1.8)
Width	18-21 (19.2 $\pm$ 0.7)
Esophageal gland lobe L	65-160 (85 $\pm$ 21.5)
Excretory pore (L from anterior end)	12-21 (15.1 $\pm$ 2.2)
Stylet L	53-60 (57.7 $\pm$ 2.0)
Conus L	38-43 (40.8 $\pm$ 1.5)
M	67-43 (70.6 $\pm$ 2.3)
Spicule L	38-49 (43 $\pm$ 3.3)
ventral arm L	18-22 (21 $\pm$ 1.2)
% spicule L	63-90 (75.7 $\pm$ 9.7)

## Description

*Male* (n = 33): Body ventrally arcuate to varying degrees, posterior part more strongly arcuate. Body width 32-40 (35.1  $\pm$  2.3)  $\mu\text{m}$ , annules 1.5-1.9  $\mu\text{m}$  wide, continuous, rarely anastomosed, not interrupted at lateral field. Head low, smooth, without annules, width 7.7-9.2 (8.2  $\pm$  0.4)  $\mu\text{m}$ , height 1.9-2.3 (2.1  $\pm$  0.2)  $\mu\text{m}$ . Head surface slightly sloping posteriorly from oral opening. Stylet conus 38-43 (40.8  $\pm$  1.5)  $\mu\text{m}$  long, basal knobs well developed, 3.1-4.6 (3.9  $\pm$  0.4)  $\mu\text{m}$  wide. Excretory pore and anterior region of duct moderately cuticularized, 12-29  $\mu\text{m}$  posterior to anterior end, renette and nucleus not discernible. Esophageal dorsal gland lobe nucleus and nucleolus usually larger than subventrals, respective nucleolus diameters 1.5-2.5 (1.92  $\pm$  0.35)  $\mu\text{m}$ , 1.0-1.8 (1.28  $\pm$  0.24)  $\mu\text{m}$ .

Testis outstretched, rarely reflexed, germ cells in rows of 4-6, rachis absent. Posterior region of testis typically set off by constriction, containing mixtures of spermatocytes and sperms having diameters, respectively, 6.0-6.6, 2.5-3.0  $\mu\text{m}$ . Spicules separate, arcuate, manubria (heads) reduced, rostra distally tubular, extending midventrally to body wall, tips ensheathed. Spicule blades heavily sclerotized, tapering distally to fine points; ventral arms well separated from blades. Cloacal opening surrounded by elevated cylinder (cloacal cylinder) of thin cuticle, oriented parallel to axis of tail. Cuticle of ventral surface of tail tip thickened, proximally wedge-shaped, serving as spicule guide. Tail terminus bearing one short mucro. Tail region with two pairs ventrolateral genital papillae; one pair slightly precloacal, one near tail terminus.

*Female* (n = 135): Body robust, fusiform, linear or slightly arcuate (young, mature) to strongly arcuate ventrally (gravid). Body width 33-55  $\mu\text{m}$  (young, mature) 57-94  $\mu\text{m}$  (gravid); body annules 1.1-1.5  $\mu\text{m}$  wide (young) to 1.5-1.7  $\mu\text{m}$  wide (gravid), continuous, not interrupted by lateral field, rarely anastomosed. Head

TABLE 2. Measurements ( $\mu\text{m}$ ; range, mean  $\pm$  standard deviation) and ratios of three developmental stages of adult females of *Noctuidonema daptria* n. sp.

Morphological character	Young (n = 20)	Mature (n = 15)	Gravid (n = 7)
Length (L)	232-430 (331 $\pm$ 93.2)	445-584 (508.1 $\pm$ 40.8)	553-772 (655 $\pm$ 70.8)
a	6.7-11.6 (9.5 $\pm$ 1.41)	10-12 (11.2 $\pm$ 0.9)	8.2-10.5 (9.1 $\pm$ 0.85)
b	1.7-2.8 (2.2 $\pm$ 0.24)	2.1-3.0 (2.7 $\pm$ 0.2)	3.1-3.8 (3.4 $\pm$ 0.28)
Reproductive system			
L	67-163 (115.2 $\pm$ 26.0)	179-339 (242.7 $\pm$ 44.8)	421-545 (482.1 $\pm$ 48.2)
% body L	82-87 (84.8 $\pm$ 1.2)	83-87 (85.1 $\pm$ 0.9)	84-88 (85.5 $\pm$ 1.27)
Ovary L	42-101 (61.1 $\pm$ 21.0)	116-202 (161.7 $\pm$ 35.2)	300-399 (353 $\pm$ 40.2)
% body L	10-24 (17.3 $\pm$ 3.6)	23-42 (31.6 $\pm$ 6.1)	47-58 (53.2 $\pm$ 4.4)
Esophagus			
L	111-202 (158.1 $\pm$ 28.6)	160-236 (188.5 $\pm$ 21.2)	168-224 (191.1 $\pm$ 19.7)
L to base metacarpus	72-110 (89.1 $\pm$ 13.16)	80-115 (95.2 $\pm$ 11.3)	88-123 (104.4 $\pm$ 12.0)
Metacarpus			
L	21-26 (23.7 $\pm$ 1.52)	21-26 (23.6 $\pm$ 1.8)	23-31 (26.6 $\pm$ 2.7)
Width	18-22 (19.5 $\pm$ 1.1)	19-22 (20.3 $\pm$ 1.1)	19-22 (20.7 $\pm$ 0.9)
Esophageal gland lobe L	38-94 (69 $\pm$ 17.6)	75-125 (93.3 $\pm$ 12.6)	61-105 (87.3 $\pm$ 13.6)
Excretory pore (L from anterior end)	9-15 (11.6 $\pm$ 1.7)	8-14 (10.7 $\pm$ 1.9)	8-13 (11.4 $\pm$ 1.6)
Stylet L	63-69 (65.7 $\pm$ 2.5)	62-67 (63.6 $\pm$ 1.6)	59-65 (62.2 $\pm$ 1.9)
Conus	40-49 (45 $\pm$ 2.3)	41-49 (44.2 $\pm$ 1.9)	39-49 (42.8 $\pm$ 0.4)
M	67-70 (68.5 $\pm$ 1.7)	66-74 (69.2 $\pm$ 2.1)	65-78 (68.5 $\pm$ 4.3)
L vulva to tail terminus (VTL)	40-64 (52.9 $\pm$ 7.8)	64-94 (78 $\pm$ 8.4)	69-109 (95.5 $\pm$ 13.1)
VTL/width at vulva	1.6-2.6 (2.1 $\pm$ 0.3)	2.2-2.7 (2.5 $\pm$ 0.2)	1.4-2.2 (1.9 $\pm$ 0.27)

set-off, hemispherical, 7.7-9.0  $\mu\text{m}$  wide, 4-5  $\mu\text{m}$  high, marked by usually five or six annules, the posterior four being more distinct. Head framework moderately sclerotized; basal ring narrow, arched; cuticle lining central tube thickened, vestibule extension extending far posterior, ending 13-20 (16.3  $\pm$  1.7)  $\mu\text{m}$  anterior to stylet base.

Stylet conus 40-49 (45  $\pm$  2.3)  $\mu\text{m}$  long, distally attenuated, appearing hollow throughout length to near tip, then solid. Basal knobs well developed, 4.6-6.0  $\mu\text{m}$

wide, rounded or with concave anterior surfaces. Stylet protractors strongly developed; composed of two sets of muscles, one set attaching abruptly along body wall slightly posterior to head, second set inserting along thickened lining of vestibule base, presumably functioning to further stylet extension.

Excretory pore and anterior duct lining strongly cuticularized; outside pore diameter 1.5-2.0  $\mu\text{m}$ , inside 0.8  $\mu\text{m}$ , located 9-15 (11.6  $\pm$  1.7)  $\mu\text{m}$  posterior to head end. Excretory duct sometimes traceable

to large, lateral (left) saccate gland cell (renette) containing a nucleus about 10  $\mu\text{m}$  diameter. Maximum width of renette near midbody, then abruptly narrowing, proceeding posteriorly for an undetermined distance (Fig. 2A). Hemizonid, when observed, immediately posterior to nerve ring.

Esophagus corpus subcylindrical, constricted at junction of metacarpus. Basal esophageal glands composed of three, usually tandem lobes, dorsal lobe being most posterior. Subventral gland nuclei large, diameter 6.0–8.0 (7.3)  $\mu\text{m}$ , with large nucleolus diameter 2.0–4.5 (3.4  $\pm$  0.61)  $\mu\text{m}$ , dorsal gland nucleus less well delineated, nucleolus smaller than subventrals, respective diameters 1.5–3.0 (2.5  $\pm$  0.24)  $\mu\text{m}$ .

Intestinal lumen of adults and juveniles greatly expanded throughout most of intestine, always observed with parallel arrays of crystalline-like filaments. Luminal lining thickened in anterior region of intestine, first cylindrical at origin in metacarpus, expanding slightly posterior to metacarpus. Intestine broadly rounded distally, containing accumulations of nuclei and dense cytoplasm. Rectum and anus (ventral, lateral views) not observed.

Ovary outstretched, never reflexed, in gravids extending well anterior to metacarpus, containing over 1,000 germ cells arranged around cytoplasmic core (rachis); core absent in young and mature adults. Spermatheca saccate, containing sperms, sometimes spermatocytes, in all adult stages; sperm diameter 2.5–3.0  $\mu\text{m}$ . Vulva with slightly protruding anterior lip, cuticle thickened. Vagina 11–15  $\mu\text{m}$  deep, dorsoventrally flattened, opening into large laterally expanded chamber continuous with lateral uterine gland complex, composed of lateral (right, left) pair of trinucleate lobes anterior to vagina, continuous with two lateral bilobed pairs posterior to vagina (Fig. 2E, F). Body region posterior to vulva gradually tapering to broadly rounded, annulated terminus bearing one short mucro. Egg ( $n = 4$ ; intrauterine) 94–108 (102) by 32–42 (36)  $\mu\text{m}$ .

#### *Type host and locality*

Collected by A. Kermarrec, B. Lalanne-Cassou, and H. Mauleon from the abdominal surfaces of an adult male moth. *Lesmone porcia* Stoll, in Guadeloupe.

#### *Type designations*

Holotype (male), type slide no. 479, deposited in the Collection Nationale de Nématodes, Laboratoire des Vers, Muséum national d'Histoire naturelle, 75005 Paris, France. Allotype (female), type slide no. 479a, and paratypes (14 females, 2 males), deposited as for holotype. Other paratypes deposited as follows: 89 females, 22 males, Antibes Nematode Collection, Laboratoire de Biologie des Invertébrés, 06606 Antibes, France; 17 females, 7 males in Canadian National Collection of Nematodes, Biosystematics Research Centre, Canada Agriculture, Ottawa, Ontario, K1A 0C6, Canada; 5 females, 2 males each in: Nematode Collection of Instituut voor Dierkunde, Ledeganckstraat 35, B-9000 Gent, Belgium; U.S. Department of Agriculture Nematode Collection, Nematology Laboratory, USDA, ARS, BARC-West, Beltsville, MD 20705; Nematode Collection of the Entomology and Nematology Department, Rothamsted Experimental Station, Harpenden, Herts., AL5 2JQ, England.

#### *Diagnosis*

Fecund ectoparasites of adult noctuids. Males and females characterized by having a long stylet of 53–69  $\mu\text{m}$ , with a conus 65–78% of total stylet length, and strongly developed basal knobs, an expanded intestinal lumen containing arrays of thin filaments, multiple rows of germ cells, and a short mucro on the tail tip.

Sexes polymorphic. Primarily distinctive for the female are: a set-off, hemispherical head with six annules; a large, heavily cuticularized excretory pore and duct joining a distinct uninucleate renette; large bilateral uterine glands; subventral nuclei and nucleoli of esophageal gland lobes larger

than dorsal; and absence of rectum and anus. By contrast, the male has a low, slightly set-off, smooth head and a smaller and less heavily sclerotized excretory pore and duct, lacks a discrete renette, and has a dorsal esophageal gland lobe nucleus and nucleolus often larger than those of the subventrals.

Distinctive of the primary and secondary sexual features of the males are a spicule length of 38–49  $\mu\text{m}$ , with the ventral arm well separated from the dorsal and a tubular rostrum, an elevated, continuous bursal cylinder surrounding the cloacal opening, and a preanal and postanal pair of genital papillae.

#### *Relationships*

Aphelenchoididae, Acugutturinae. Most similar to the monotypic species of *Acugutturus parasiticus* Hunt, 1980 and *Noctuidonema guyanense* Remillet & Silvain, 1988 in: mode of parasitism; excessive length of the stylet (53–185  $\mu\text{m}$ ) and of the conus (at least 64% of total stylet length); the large, cuticularized excretory pore and duct and its position near the head; arrangement of oogonia in multiple rows; lack of a post-uterine sac; and apparent absence of a rectum and anus. In many other characters, these species differ greatly.

The new species is readily separable from *A. parasiticus* and *N. guyanense* by its strongly developed stylet knobs (versus absent) with protractors inserted along the

body wall near the head (versus at base of head framework), and, most markedly, by the spicule structure, which is a simple rose-thorn form in *A. parasiticus* (2), by contrast to a complex structure of tissues, sheaths, and sclerotized parts in *N. guyanense* (1). These and other marked character differences of the new species confirm its generic status. Because it appears to have more characters in common with *N. guyanense*, we provisionally assign it to the genus *Noctuidonema*.

#### LITERATURE CITED

1. Anderson, R. V., and C. Laumond. 1990. *Noctuidonema guyanense* Remillet & Silvain, 1988: Morphologie du spicule, redescription du mâle et diagnose amendée du genre *Noctuidonema*. *Revue de Nématologie* 13:433–436.
2. Hunt, D. J. 1980. *Acugutturus parasiticus* n. g., n. sp. a remarkable ectoparasitic aphelenchoid nematode from *Periplaneta americana* (L), with proposal of Acugutturinae n. subf. *Systematic Parasitology* 1:167–170.
3. Remillet, M., and J. F. Silvain. 1988. *Noctuidonema guyanense* n. g., n. sp. (Nematoda: Aphelenchoididae) ectoparasite de noctuelles du genre *Spodoptera* (Lepidoptera: Noctuidae). *Revue de Nématologie* 11:21–24.
4. Rogers, C. E., O. G. Marti, A. M. Simmons, and J. F. Silvain. 1990. Host range of *Noctuidonema guyanense* (Nematoda: Aphelenchoididae): An ectoparasite of moths in French Guiana. *Environmental Entomology* 19:795–798.
5. Simmons, A. M., and C. E. Rogers. 1990. Distribution and prevalence of an ectoparasitic nematode, *Noctuidonema guyanense* Remillet and Silvain (Nematoda: Aphelenchoididae) in southeastern United States. *Journal of Agricultural Entomology* 7:241–245.