

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Faculty Publications from the Harold W. Manter
Laboratory of Parasitology

Parasitology, Harold W. Manter Laboratory of

2-28-1995

Morphology and Morphometrics of Three Oxyurids Parasitic in Primates with a Description of *Lemuricola microcebi* n. sp.

Jean-Pierre Hugot

Museum National d'Histoire Naturelle, hugot@cimrs1.mnhn.fr

Serge Morand

Centre de Biologie et de Gestion des Populations, morand@ensam.inra.fr

Scott Lyell Gardner

University of Nebraska - Lincoln, slg@unl.edu

Follow this and additional works at: <https://digitalcommons.unl.edu/parasitologyfacpubs>



Part of the [Parasitology Commons](#)

Hugot, Jean-Pierre; Morand, Serge; and Gardner, Scott Lyell, "Morphology and Morphometrics of Three Oxyurids Parasitic in Primates with a Description of *Lemuricola microcebi* n. sp." (1995). *Faculty Publications from the Harold W. Manter Laboratory of Parasitology*. 66.
<https://digitalcommons.unl.edu/parasitologyfacpubs/66>

This Article is brought to you for free and open access by the Parasitology, Harold W. Manter Laboratory of at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Faculty Publications from the Harold W. Manter Laboratory of Parasitology by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.



Morphology and Morphometrics of Three Oxyurids Parasitic in Primates with a Description of *Lemuricola microcebi* n. sp.

J. P. HUGOT*, S. MORAND† and S. L. GARDNER‡

*Muséum national d'Histoire Naturelle, Paris, Laboratoire de Biologie Parasitaire–Protistologie–Helminthologie, URA No. 114, 61, rue Buffon, 75231 Paris cedex 05, France

†Université de Perpignan, Laboratoire de Biologie Animale, URA No. 698, 66025 Perpignan, France

‡University of Nebraska State Museum, W529, Nebraska Hall, 68588-0514, Lincoln, Nebraska, U.S.A.

(Received 1 August 1994; accepted 28 February 1995)

Abstract—Hugot J. P., Morand S. & Gardner S. L. 1995. Morphology and morphometrics of three oxyurids parasitic in primates with a description of *Lemuricola microcebi* n. sp. *International Journal for Parasitology* 25: 1065–1075. Classical and morphometric analyses were conducted on several samples of oxyurid nematodes parasitic in strepsirrhine primates: *Cheirogaleus major*, *Galago senegalensis*, and *Microcebus murinus*. A diagnosis of *Lemuricola contagiosus* Chabaud & Petter, 1959 from *C. major* is given using syntypes, from which a lectotype is selected. The rest of the specimens were compared to *L. contagiosus*. From measurements taken from each sex, an initial Principal Component Analysis (PCA) was performed on log-transformed data and a second PCA was performed on log-shape ratios after elimination of the isometric differences. The parasites collected from *M. murinus*, which can be differentiated from the closely related *L. contagiosus* by both standard morphological characters and morphometric variables, are described as *Lemuricola microcebi* n. sp. The parasites collected from *Galago* are morphologically very similar to *L. microcebi* n. sp. The most probable explanation for this resemblance is considered to be a transfer from *Microcebus* to *Galago* but, due to the small numbers of individuals in our samples, it is impossible to eliminate the possibility that the parasites of *Galago* belong to an undescribed species. Until more material or information can be obtained, it is proposed to refer to the parasites from *Galago* as *Lemuricola* sp.

Key words: Morphology; morphometrics; *Lemuricola contagiosus*; *Lemuricola microcebi* n. sp.; *Lemuricola* sp.; Strepsirrhini; primates; Oxyurida; Nemata.

INTRODUCTION

Eight species have been described in genus *Lemuricola* Chabaud & Petter, 1959, including *L. lemuris* (Baer, 1935) (the type species) from *Lemur macaco*, *L. baltazardi* Chabaud, Brygoo & Petter, 1965 from *Lemur fulvus*, *L. bauchoti* Chabaud *et al.*, 1965 from *Hapalemur* sp., *L. contagiosus* Chabaud & Petter, 1959 from *Cheirogaleus major*, *L. inglisi* Chabaud, Petter & Golvan, 1961 from *Lepilemur*

mustelinus, *L. nycticebi* (Baylis, 1928) from *Nycticebus coucang*, *L. vauceli* Chabaud *et al.*, 1965 from *Lemur fulvus* and *L. daubentoniae* Petter *et al.*, 1972 from *Daubentonia madagascariensis*. All species of *Lemuricola* but *L. nycticebi* (described from a loris from Borneo) have been described from lemurs from Madagascar. *Lemuricola contagiosus* was described by Chabaud & Petter (1959) from an individual lemur that died in the facilities of the Faculty of

Medicine in Paris 4 years after its capture in the forest of the eastern coast of Madagascar. In the same work, the authors described other pinworms, similar in morphology, but smaller. These nematodes were collected from an individual *Galago senegalensis* kept in the same quarters as the individual *Cheirogaleus* mentioned above. In a more recent paper, Petter, Chabaud, Delavenay & Brygoo (1972) noted that it may be appropriate to compare the parasites collected from the individual *Galago* with other nematode specimens collected subsequently from several *Microcebus murinus* living in captivity in the Faculty of Medicine in Paris or captured in their natural habitat. The authors concluded that *L. contagiosus* is host-specific to *Cheirogaleus major*, since some of the nematodes were obtained from hosts collected in their natural habitats and that the specimens collected from *M. murinus* are presumably a different species (specific to *Microcebus*); the specimens found in the *Galago* were probably transferred from *Microcebus*. In the present work we confirm that the specimens collected from *M. murinus* represent a new species, described here as *Lemuricola microcebi* n. sp. We also provide a diagnosis of *L. contagiosus* based on the syntypes defined by Chabaud & Petter (1959), from which a lectotype is selected. After re-examination of the specimens collected from *Galago*, we discuss their classification.

MATERIALS AND METHODS

Observations. Specimens stored in 70% ethanol were studied under the light microscope as temporary wet mounts, first in water and later in lactophenol. We studied cross-sections made "free-hand" using small pieces of razor blade and a small brush. Drawings were made with the aid of a drawing tube.

Morphometrics. Individual measurements of specimens made using a curvometer are given in micrometers. Counting the eggs in the uteri of the mature females was performed by varying the focus while slowly sweeping the specimen at 20× magnification, thus the total count is an approximation. For each mature female measured, the length and width of the egg presented in the table is the mean of 5 measurements. In Table 2, the specimen labelled F* was measured from the sketch of Chabaud & Petter (1959) in the original description of *Lemuricola contagiosus*. Statistical analysis was performed using the SYSTAT 5.1.2 package (1992). Because of the small number of specimens in some groups, the analyses should be considered preliminary. From measurements taken from each sex, an initial Principal Component Analysis (PCA) was performed on log-transformed data (therefore it deals with size and shape), and a second PCA was performed on log-shape ratios after elimination of the isometric changes, following Mossimann (1970), Mossimann & James (1979) and Kasmierczak (1985). Since all

variables were log-transformed, size was defined for each individual as the arithmetic mean of all variables. The log-shape ratio was calculated by subtracting the log-size value from each variable for each individual. In the analysis of the females, all variables relating to the presence of eggs were deleted since no mature females were found in *L. contagiosus*.

List of abbreviations. In the Tables and Figures we use the following abbreviations: body L, body length; W(max), W(blb), W(ex), W(vlv) or W(as), maximum body width, body width measured at level of oesophageal bulb, at excretory pore, at vulva or anus, respectively; cvc L, cephalic vesicle length; cvc W, cephalic vesicle width; ospg L, length of oesophagus; blb L, length of oesophageal bulb; blb W, width of oesophageal bulb; apex to: nv, ex or vlv, distance from anterior end to nerve ring, excretory pore or vulva, respectively; T, tail length; tp, length of tip of tail or caudal appendix; spc L, length of spicule; egg L, length of egg; egg W, width of egg; L-T, total body length minus tail length; T-tp, tail length minus tip of tail.

In male oxyurids, the tail is considered to begin at the posterior lip of the cloaca and to end at the extremity of the caudal appendix (the so-called tip of tail), which is the part of the tail that extends past the peduncles of the last pair of genital papillae. In females, the tail extends from the posterior lip of anus to the distal extremity of the body.

RESULTS

Lemuricola microcebi n. sp.

Description

Holotype male. Buccal aperture delimited by three lips partly covering corresponding teeth; triangular oesophageal teeth well developed (Fig. 1B); cephalic papillae readily visible with ventral papillae closest to amphids; cephalic vesicle consisting of large, shallow cuticular ring followed by several less prominent cuticular rings. Lateral alae consisting of simple triangular crest (Fig. 1C) beginning half-way between anterior extremity and nerve ring, and ending anterior to caudal bursa (Fig. 1A). Oesophageal bulb longer than wide. Posterior to excretory pore, ventral cuticle exhibiting *area rugosa* represented by split in ventral region of each annule (Fig. 1D); in this region, cuticle inflated into a large round ventral crest with corresponding hypertrophied myocytes (Fig. 1C). Four pairs of caudal papillae present, 1st and 4th pairs pedunculated, 2nd and 3rd pairs sessile, flanking longitudinal cloacal aperture. Phasmidial tubes beginning near origin of peduncles of 4th pair, rooted into trunk of long, robust and conical tip of tail. In this region, cuticle inflated into ventral tumescent bubble (Figs 2A, B). Second and 3rd pairs surrounded by 4 chitinized rings connected behind posterior end of cloacal aperture. Thickening of cuticle corresponding to these rings extending laterally as 2 butterfly wing-shaped structures (Figs 2A, B). Spicule with rounded

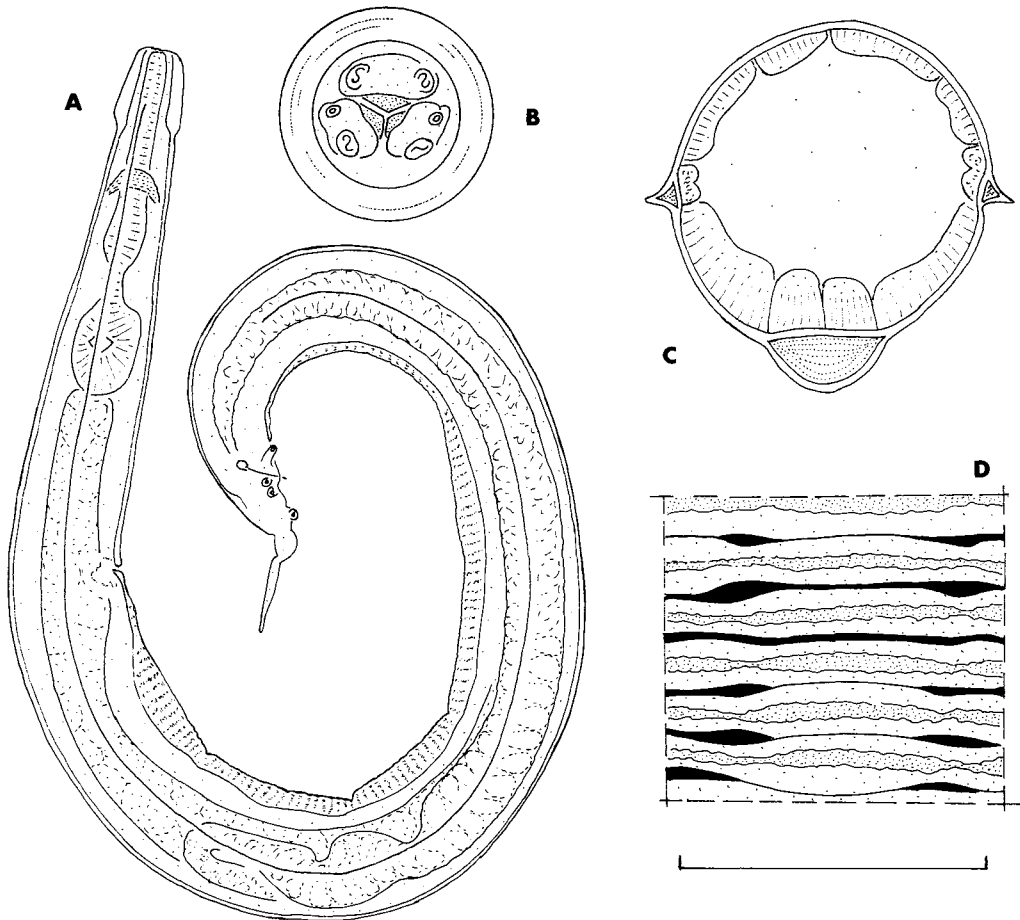


Fig. 1. *Lemuricola microcebi* n. sp. Male: A, right lateral view of holotype; B, head, apical view; C, transverse section of body at level of ventral crest; D, detail of the crest on a ventral view. Scale bar: A, 250 μ m; B, D, 50 μ m; C, 100 μ m.

cuticularized anterior part, into which musculature is inserted (Fig. 2C).

Allotype female. Buccal structures identical to those of male (Fig. 3B). Lateral alae composed of a cervical part, consisting of a simple triangular crest beginning half-way between apex and nerve ring and ending at level of oesophageal bulb, and a posterior part with 2 parallel crests, triangular in cross-section, running along body and ending close to caudal extremity without converging (Fig. 3A); complete hiatus observed between the two parts. Oesophageal bulb longer than wide. Vulva in anterior half of body, followed in turn by muscular vagina directed posteriorly and short uterine tube divided into 2 parts by cellular accumulation (forming a wall). Posterior part of common uterus leads to 2 amphidelphic uterine branches. Eggs oblong, symmetrical, unembryonated, thin shelled (Fig. 3C).

Measurements. Table 1 (males), Table 2 (females).

Diagnosis

General. Oesophageal bulb longer than wide (bulb width inferior or equal to 80% of bulb length). Males: oesophageal length about 17% of distance between anterior end and cloacal aperture. Bulb length about 30% of total oesophageal length. Tip of tail present, about 73% of total length of tail. Total tail length about 10% of distance between anterior end and cloacal aperture. Spicule relatively slender and short. Preloacal papillae with long peduncles. Pericloacal ornamentation of cuticle extending laterally as 2 butterfly wing-shaped structures. Females: oesophageal length about 13% of distance between anterior end and cloacal aperture. Bulb length about 30% of total oesophageal length. Total tail length about 16% of distance between anterior end and anus. Eggs 90 μ m long.

Host. *Microcebus murinus* (J. F. Miller, 1777).

Site in host. Caecum and colon.

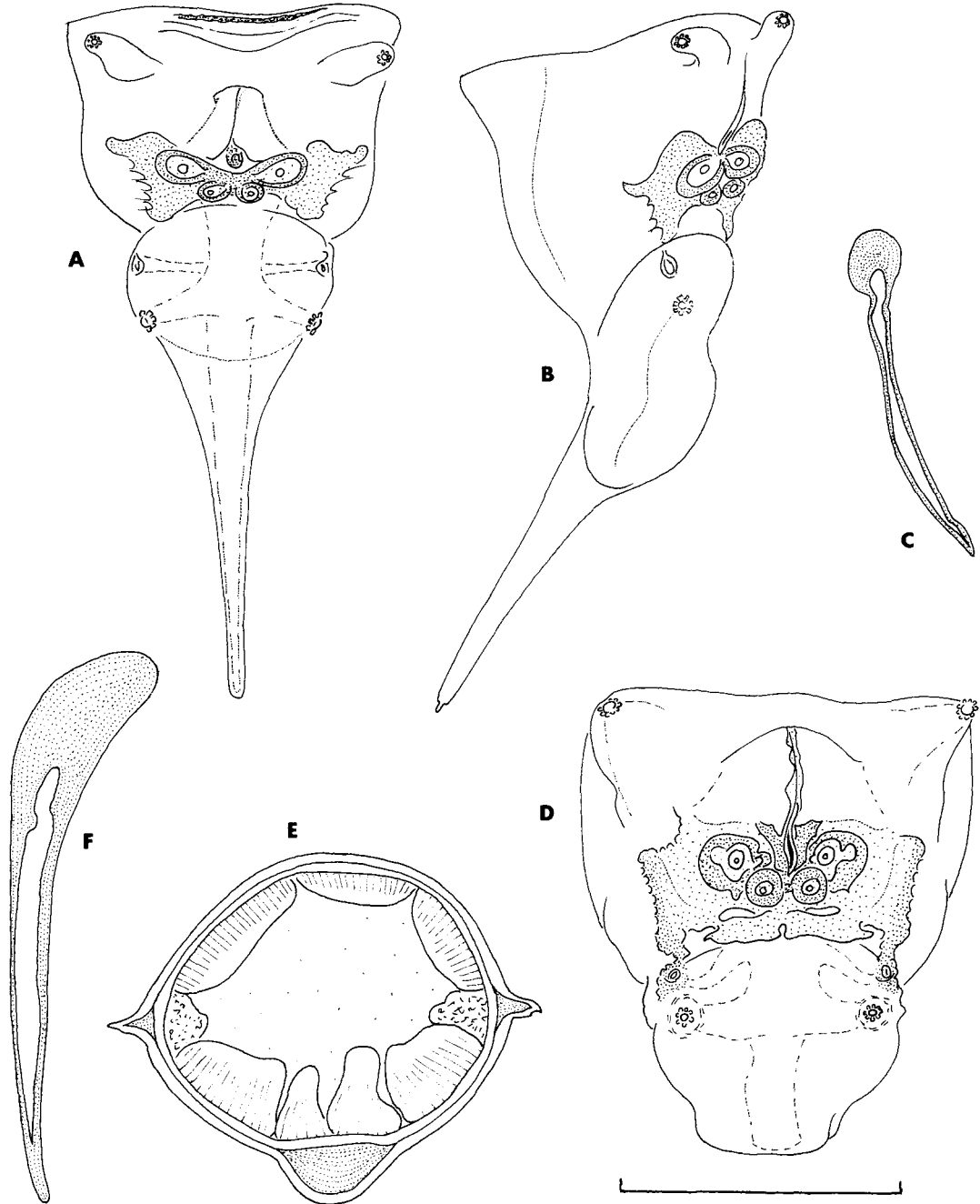


Fig. 2. Male of *Lemuricola microcebi* n. sp.: A, caudal bursa, ventral view; B, caudal bursa, right lateral view; C, spicule right lateral view. Male of *Lemuricola contagiosus* Chabaud & Petter, 1959; D, caudal bursa, ventral view; E, transverse section of body at level of ventral crest; F, spicule right lateral view. Scale bar: A, B, C, D, F, 50 µm; E, 100 µm.

Locality and date of collection. The first host died in captivity at the Faculty of Medicine, Paris, and was necropsied on 9 November 1962 (MNHN-Q 10). The second was captured in the vicinity of Tulear (Mada-

gascar) and autopsied in Paris, shortly after arrival in France, on 28 October 1967 (MNHN-Q 298).

Specimens deposited. Laboratoire de Biologie Parasitaire-Protistologie-Helminthologie, Muséum

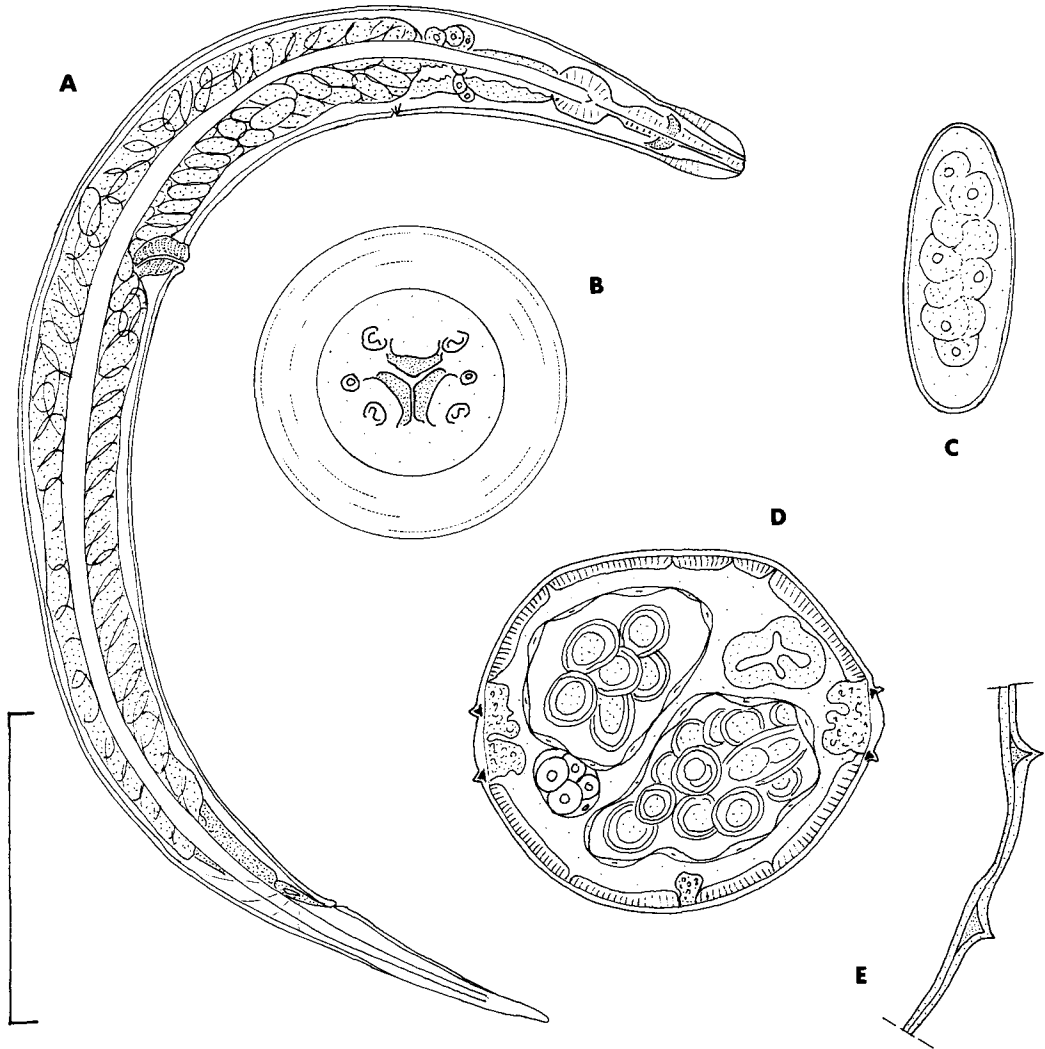


Fig. 3. Females of *Lemuricola microcebi* n. sp.: A, right lateral view of allotype; B, head, apical view; C, egg; D, transverse section at level of mid-body; E, *idem*, detail of a lateral wing. Scale bar: A, 500 μ m; B, E, 50 μ m; C, 100 μ m; D, 70 μ m.

national d'Histoire Naturelle, Paris. Numerous nematodes of both sexes (MNHN-Q 10). Four males and 24 adult females (MNHN-Q 298). Holotype male and allotype female selected from lot MNHN-Q 298.

Lemuricola contagiosus Chabaud & Petter, 1959

Description

For general features see Chabaud & Petter (1959). Diagnostic characters are listed below, illustrated in Figs 2D, E and F, and explained in the Discussion. For measurements see Tables 1 and 2.

Diagnosis

General. Oesophageal bulb as long as wide (ratio about 1). Males: oesophageal length about 20% of

distance between anterior end and cloacal aperture. Bulb length about 20% of total oesophageal length. Tip of tail present, about 90% of total length of tail. Total tail length about 20% of distance between anterior end and cloacal aperture. Spicule relatively strong and long. Precloacal papillae with short peduncles. Pericloacal ornamentation of cuticle extending posterior to the juxta-cloacal papillae. Lateral extensions of this ornamentation thick and cylindrical. Females: oesophageal length about 20% of distance between anterior end and cloacal aperture. Bulb length about 20% of total oesophageal length. Total tail length about 40% of distance between anterior end and anus. Eggs more than 100 μ m long.

Table 1—Measurements of males in micrometers. For each line: \bar{X} is the mean; min. is the minimum and max. the maximum; *CV* is the coefficient of variation. Seven specimens were measured for *L. microcebi* n. sp., 5 for *Lemuricola* sp. and 5 for *L. contagiosus*

	<i>Lemuricola microcebi</i> n. sp.					<i>Lemuricola</i> sp.				<i>Lemuricola contagiosus</i>				
	Holotype	\bar{X}	min.	max.	<i>CV</i>	\bar{X}	min.	max.	<i>CV</i>	Lectotype	\bar{X}	min.	max.	<i>CV</i>
body L	2016	1718	1201	2016	15	1372	1201	1523	10	2214	2232	1838	2678	13
W(max)	108	106	100	120	7	131	121	144	7	155	152	131	172	11
W(blb)	80	80	75	85	4	86	80	90	5	105	103	95	110	7
W(ex)	90	97	90	110	7	102	80	115	13	110	124	110	145	11
W(as)	65	54	45	65	14	53	45	62	12	65	65	50	81	18
cvcL	75	75	70	82	7	79	70	85	7	115	113	95	125	10
cvcW	55	55	53	60	4	53	50	55	4	65	72	62	82	12
ospg L	293	263	245	293	6	247	218	273	8	407	384	328	436	13
blb L	85	76	70	85	7	78	70	85	9	88	85	69	95	12
blb W	55	55	53	60	5	65	60	70	6	82	81	62	90	13
apex to:														
-nv	105	103	100	110	4	98	85	108	8	115	116	90	130	14
-ex	450	415	324	450	11	392	356	432	9	556	520	423	569	12
T	142	141	124	156	9	137	130	142	3	335	356	268	436	18
tp	101	103	88	115	11	105	99	109	4	304	324	248	396	17
spc L	59	58	53	65	8	64	55	76	13	88	102	88	119	12
<i>Ratios:</i>														
L-T/W(max)	17.4	14.8	11.3	17.4	13	9.4	8.7	10.4	7	12.1	12.3	10.9	13.6	8
L-T/W(blb)	23.4	19.7	14.1	23.4	16	14.4	11.9	16.1	12	17.9	18.2	16.5	20.4	9
ospg L/L-T	0.16	0.17	0.15	0.22	14	0.20	0.18	0.23	13	0.22	0.21	0.18	0.22	8
T/L-T	0.08	0.09	0.07	0.12	23	0.11	0.10	0.12	10	0.18	0.19	0.17	0.21	8
blb W/blb L	0.65	0.72	0.65	0.79	7	0.84	0.80	0.90	5	0.93	0.95	0.89	1.02	6
blb L/ospg L	0.29	0.29	0.28	0.31	3	0.32	0.30	0.34	5	0.22	0.22	0.21	0.25	8
tp/T	0.71	0.73	0.70	0.74	2	0.77	0.76	0.78	1	0.91	0.91	0.91	0.93	1

Host. *Cheirogaleus major* E. Geoffroy, 1812.

Site in host. Caecum and colon.

Locality and date of collection. Died in captivity at the Faculty of Medicine, Paris (1959).

Specimens deposited. Laboratoire de Biologie Parasitaire–Protistologie–Helminthologie, Muséum national d'Histoire Naturelle, Paris. Eleven adult (but immature) females and 5 males (MNHN-KB 395). Lectotype male selected from lot KB 395.

Lemuricola sp.

Description

For most of its morphological characters this species resembles *Lemuricola microcebi* n. sp. The characters which discriminate between the two populations are listed below with explanation in the Discussion. For measurements see Tables 1 and 2.

Diagnosis

General. Oesophageal bulb longer than wide (bulb width inferior or equal to 80% of bulb length). Males: oesophageal length about 20% of distance between anterior end and cloacal aperture. Bulb length about 30% of total oesophageal length. Tip of tail present, measuring about 77% of total length of tail. Total tail length about 11% of distance between anterior end and cloacal aperture. Spicule relatively

slender and short. Precloacal papillae with long peduncles. Thickenings of pericloacal ornamentation of cuticle extending laterally as 2 butterfly wing-shaped structures. Females: oesophageal length about 17% of distance between anterior end and cloacal aperture. Bulb length about 30% of total oesophageal length. Total tail length about 25% of distance between anterior end and anus. Eggs less than 90 μ m long.

Host. *Galago senegalensis* E. Geoffroy, 1796.

Site in host. Caecum and colon.

Locality and date of collection. Died in captivity at the Faculty of Medicine, Paris (1959).

Specimens deposited. Laboratoire de Biologie Parasitaire–Protistologie–Helminthologie, Muséum national d'Histoire Naturelle, Paris. Numerous specimens of both sexes (MNHN-KB 396).

Morphometric analyses

PCA of males

The results of PCA of the log-transformed measurements of the males are given in Fig. 4a & b. Axis 1 explained 86% and axis 2, 25% of the variation (axes 1 and 2 combined = 91%). Tail measurements (T and tp) were the characters with the heaviest loading on axis 1, while body length (L-T) has the heaviest loading on axis 2. Axis 1

Table 2—Measurements of females in micrometers. For each line: \bar{X} is the mean; min. is the minimum and max. the maximum; *CV* is the coefficient of variation. Ten specimens were measured for *L. microcebi* n. sp., 10 for *Lemuricola* sp. and 5 for *L. contagiosus*. F* is a specimen measured after the sketch given by Chabaud & Petter (1959) in the original description of *Lemuricola contagiosus*; it was excluded for calculation of the means and ranges

	<i>Lemuricola microcebi</i> n. sp.					<i>Lemuricola</i> sp.				<i>Lemuricola contagiosus</i>				
	Allotype	\bar{X}	min.	max.	<i>CV</i>	\bar{X}	min.	max.	<i>CV</i>	F*	\bar{X}	min.	max.	<i>CV</i>
bodyL	2938	2782	2570	2938	5	2409	2231	2545	5	3876	3151	2808	3445	10
W(vlv)	220	202	185	225	7	237	209	263	7	331	201	179	241	12
W(blb)	130	121	106	135	8	141	130	163	7	183	128	112	144	9
W(ex)	180	169	160	190	6	200	181	224	7	279	165	143	178	9
W(as)	80	67	50	86	18	77	61	90	11	129	85	72	94	11
cvc L	150	121	100	150	11	98	88	108	8	111	135	128	145	5
cvc W	95	76	60	95	13	78	67	91	10	106	89	79	98	9
ospg L	345	323	305	345	3	325	301	353	5	411	459	414	481	6
blb L	110	103	100	110	3	107	94	112	5	82	97	85	109	9
blb W	85	80	75	85	4	90	80	98	6	76	91	83	104	9
apex to:														
-nv	120	110	92	120	9	110	90	130	11	122	127	119	137	7
-ex	630	609	535	650	7	525	460	589	9	716	617	583	695	7
-vlv	1231	1150	1050	1231	6	955	828	1074	8	1175	907	857	965	5
T	414	380	364	414	4	474	456	493	3	1147	905	806	1019	9
egg L	90	89	87	92	2	84	78	87	3	103	—	—	—	—
egg W	37	37	35	39	3	39	36	43	5	44	—	—	—	—
Ratios:														
L-T/W(vlv)	11.5	11.9	10.8	13.2	7	8.2	7.4	9.8	9	8.2	11.2	10.3	12.4	9
L-T/W(blb)	19.4	20.0	16.3	23.1	9	13.7	12	15	6	14.9	17.5	15.2	19.1	9
ospg L/L-T	0.14	0.13	0.13	0.15	4	0.17	0.16	0.18	3	0.15	0.21	0.19	0.23	9
T/L-T	0.16	0.16	0.15	0.18	6	0.25	0.22	0.27	5	0.42	0.41	0.35	0.50	15
apex (vlv)/L-T	0.49	0.48	0.45	0.50	3	0.49	0.44	0.55	6	0.43	0.41	0.36	0.46	11
blb W/blb L	0.77	0.78	0.71	0.81	3	0.84	0.79	0.88	4	0.93	0.94	0.89	0.98	4
blb L/ospg L	0.32	0.32	0.31	0.33	2	0.33	0.31	0.36	5	0.20	0.21	0.20	0.23	5
eggs in uteri	159	134	109	159	12	165	135	212	14	240	—	—	—	—
egg W/egg L	0.41	0.41	0.39	0.44	3	0.46	0.43	0.53	6	0.43	—	—	—	—

separated *L. contagiosus* (tail with a very long tip) from both *L. microcebi* and *Lemuricola* sp. The last 2 species were separated along the second axis, and they differed principally in the length of the body. In the PCA of the log-shape ratios (Figs 4c, d): axis 1 explained 75% and axis 2, 10% of the variation (axes 1 and 2 combined = 85%). Axes 1 and 2 were influenced by the same variables but, while in the previous analysis there was a positive correlation between body length (L-T) and most of the variables, there was now no correlation or a negative correlation, especially with variables linked to body width. Bulb length (blb L) and bulb width (blb W) were not correlated. Oesophageal length (ospg L) was independent of bulb length and negatively correlated with bulb width. A strong negative correlation was observed between tail and tail tip lengths (T and tp) versus bulb length. Spicule length (spc L) was not correlated with body length. The three samples were more clearly separated, except for one individual parasite from *Microcebus* which appeared closer to the parasites from *Galago*. Axis 1 differentiated *L. contagiosus* (tip of tail relatively long) from *L. microcebi*-*Lemuricola* sp. (oesophageal bulb rela-

tively longer than wide). Axis 2 differentiated *L. microcebi* (body and oesophageal bulb relatively longer) from *Lemuricola* sp. (body and bulb relatively wider, spicule relatively longer).

PCA of females

The results of PCA of the log-transformed female measurements are given in Fig. 5a & b. Axis 1 explained 54% and axis 2, 19% of the variation (axes 1 and 2 combined = 73%). In the PCA of the log-shape ratios (Fig. 5c, d): axis 1 explained 56% and axis 2, 22% of the variation (axes 1 and 2 combined = 76%). In the females, the differences between the 2 analyses were less marked, probably because the isometric part of the body length is less important in this gender. Some characteristics were observed in both males and females, such as negative correlation between body length (L-T) and variables linked to body width, and oesophageal length independent of bulb length and negatively correlated with bulb width. A very strong negative correlation was observed between tail length and bulb length. Bulb width was independent from bulb length, but this seemed to be less significant than in males.

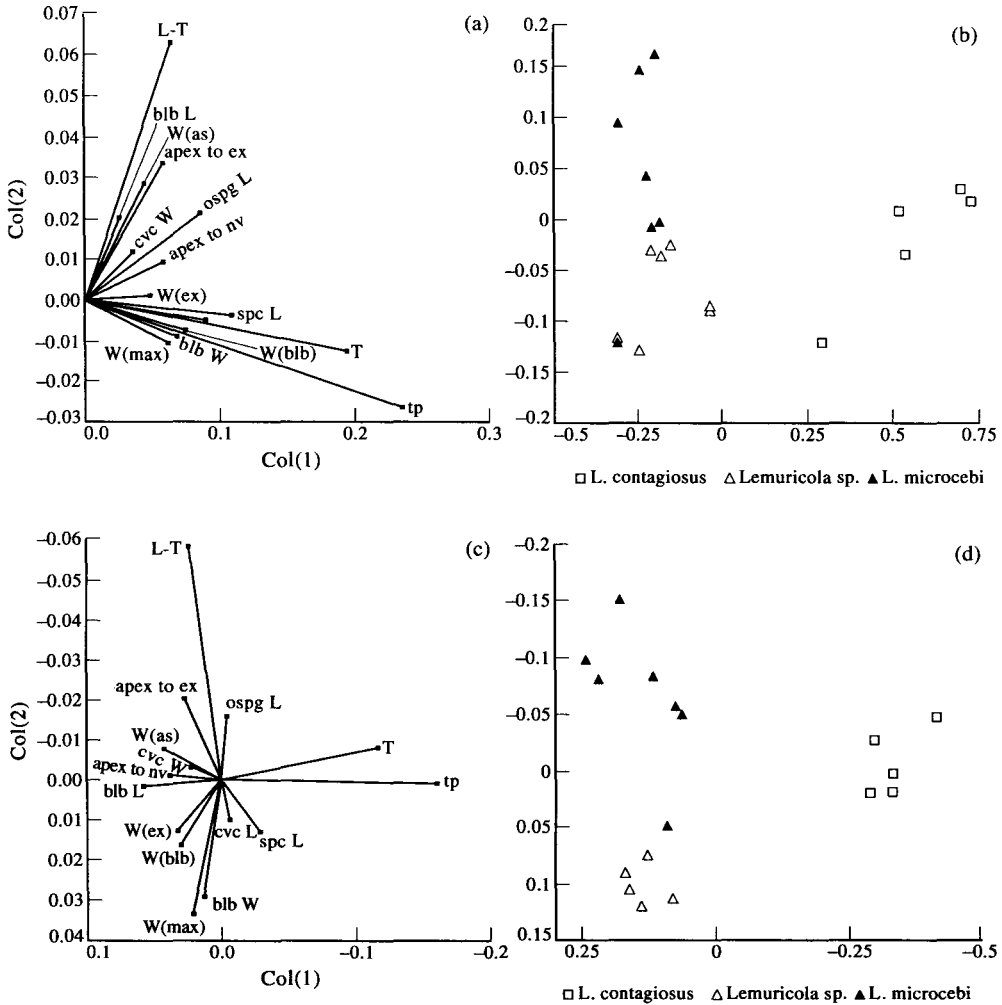


Fig. 4. PCA of males. a, eigenvalues of variables and b, individuals scores in the plane F1 x F2 for PCA using log-transformed variables. c, eigenvalues of variables and d, individuals scores in the plane F1 x F2, for PCA using log-shape variables.

DISCUSSION

The species described in the genus *Lemuricola* can be separated into 2 groups by the presence or absence of a tip in the tail of males (Chabaud, Brygoo & Petter, 1965). All of our samples belonged to the first group which also includes *Lemuricola nycticebi* and *L. daubentoniae*. The last 2 species can be distinguished from those in our samples by a very short tail tip (less than 20% of total tail length) and a different pattern of pericloacal ornamentation (Inglis & Dunn, 1963; Chabaud *et al.*, 1965).

The parasites collected from *Microcebi murinus* can be differentiated from *L. contagiosus*, the most closely related species, by most of the morphometric variables (Table 3) and by morphological characters. In the former, the shape of the spicule is different

(Fig. 2C and F), the preloacal papillae are more clearly pedunculated, the phasmid apertures are more posteriorly placed and are not surrounded by extensions of the pericloacal ornamentation of cuticle, the lateral extensions of this ornamentation are thin and butterfly wing-shaped, whereas they are thick and cylindrical in *L. contagiosus*, and there is no extension of the ornamentation posterior to the juxta-cloacal papillae (Fig. 2A and D). We consider these as a new species, *Lemuricola microcebi* n. sp., named after the host.

The specimens collected from *Galago* can be differentiated from *L. contagiosus* by the same morphological characters which separate *L. contagiosus* from *L. microcebi*. These specimens are morphologically very similar to *L. microcebi* but

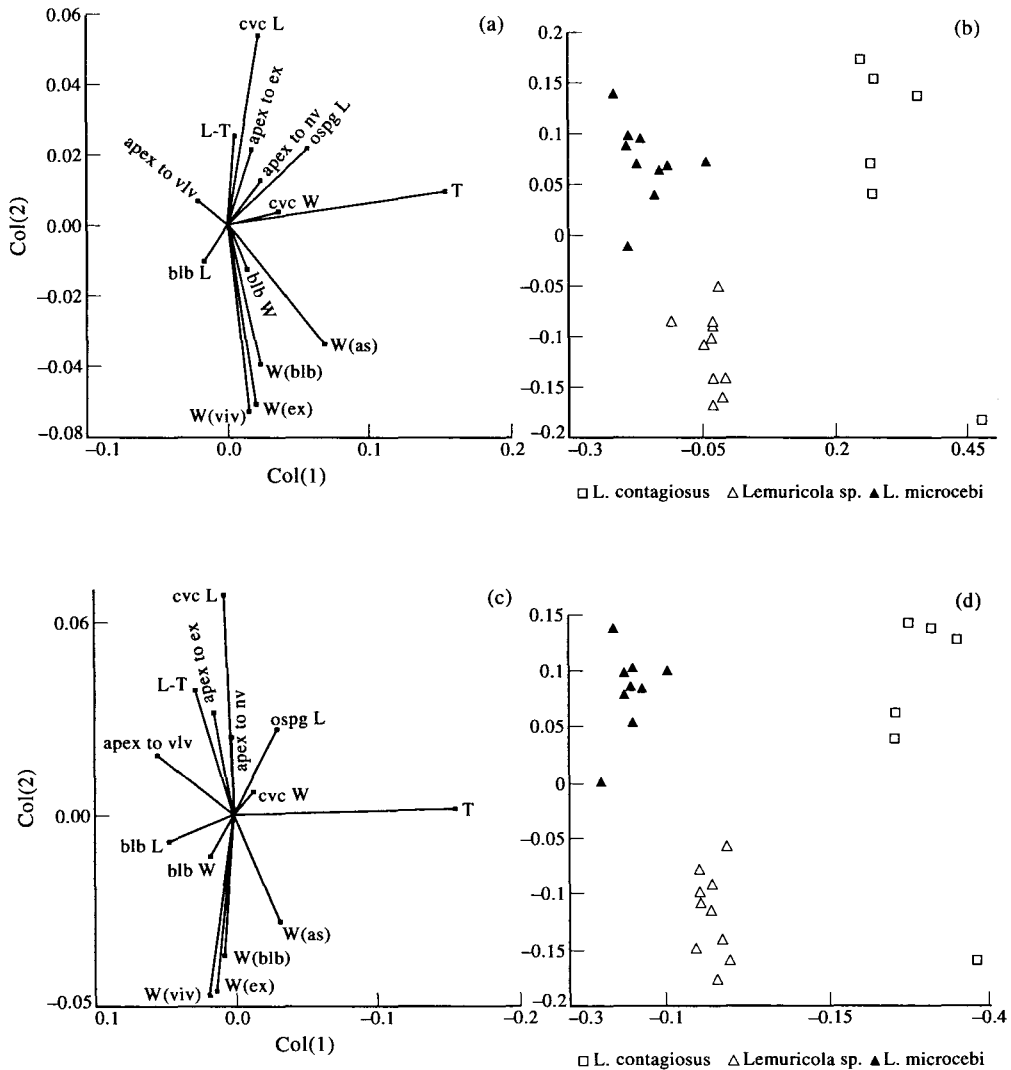


Fig. 5. PCA of females. a, eigenvalues of variables and b, individuals scores in the plane F1 \times F2 for PCA using log-transformed variables. c, eigenvalues of variables and d, individuals scores in the plane F1 \times F2, for PCA using log-shape variables.

can be clearly separated for some measurements; in addition, for some ratios, *Lemuricola* sp. is closer to *L. contagiosus* (Table 3). These observations suggest several hypotheses. *Lemuricola* sp. may be an undescribed species specific to *Galago*, *Lemuricola* sp. may be the result of a host transfer from either *Cheirogaleus* or *Microcebus*, to *Galago*, or *Lemuricola* sp. may be the result of a host transfer from both *Cheirogaleus* and *Microcebus*, to *Galago* and must be interpreted as a hybrid of the 2 other parasite species. The morphometric analysis which allowed us to distinguish the females supports the first hypothesis. Against this hypothesis is the fact that, after dissection of more than 60 individual *Galago*

collected in their natural habitat and in different localities, we have found no pinworm parasites. In addition most of these individuals were parasitised by subulurid nematodes and it seems that subulurids and oxyurids, which are both inhabitants of the caecum, are antagonistic (A. G. Chabaud, personal communication). In favour of a transfer are the presence of the hosts in the same quarters and the very low specificity of pinworm parasites for primates when kept in captivity. In similar circumstances we have observed numerous cases of transfer from man to apes or monkeys, including marmosets. If *Lemuricola* sp. is the result of a host transfer, its greater resemblance to *L. microcebi* n. sp. can be

Table 3—Variables or their ratios which best allow comparison of the samples: means, range in brackets, coefficient of variation in square brackets

	blb W/blb L	blb L/osp L	osp L/L-T	T/L-T	tp/T	spc L	L-T/W(max)
♂♂							
<i>L. contagiosus</i>	0.95 (0.89-1.01) [6]	0.22 (0.21-0.25) [8]	0.21 (0.18-0.22) [8]	0.19 (0.17-0.21) [8]	0.91 (0.91-0.93) [1]	102 (88-119) [12]	12.3 (16.5-20.4) [8]
<i>Lemuricola</i> sp.	0.84 (0.80-0.90) [5]	0.32 (0.30-0.34) [5]	0.20 (0.18-0.23) [13]	0.11 (0.10-0.12) [10]	0.77 (0.76-0.78) [1]	64 (55-76) [13]	9.4 (8.7-9.6) [7]
<i>L. microcebi</i> n. sp.	0.72 (0.65-0.79) [7]	0.29 (0.28-0.31) [3]	0.17 (0.15-0.22) [14]	0.09 (0.07-0.12) [23]	0.73 (0.70-0.74) [2]	58 (53-65) [8]	14.8 (11.3-14.4) [13]
♀♀							
<i>L. contagiosus</i>	0.94 (0.89-0.96) [4]	0.21 (0.20-0.23) [5]	0.21 (0.15-0.23) [9]	0.41 (0.35-0.50) [15]	103	240	11.2 (8.2-12.4) [9]
<i>Lemuricola</i> sp.	0.84 (0.79-0.88) [4]	0.33 (0.31-0.36) [5]	0.17 (0.16-0.18) [3]	0.25 (0.22-0.27) [5]	84 (78-87) [3]	165 (135-212) [14]	8.2 (7.4-9) [9]
<i>L. microcebi</i> n. sp.	0.78 (0.71-0.81) [3]	0.32 (0.31-0.33) [2]	0.13 (0.13-0.14) [4]	0.16 [0.15-0.18] [6]	89 (87-91) [2]	134 (109-153) [12]	11.9 (10.8-13.2) [7]
					egg length	eggs in uteri	L-T/W(vlv)

explained as a consequence of a host transfer from *Microcebus* to *Galago*. However, considering that for some values *Lemuricola* sp. is either intermediate between the two other species or similar to one of them, it cannot be completely excluded that it is a hybrid. In conclusion, we consider a transfer from *Microcebus* to *Galago* the most probable explanation but, as we were not able to obtain large numbers of individuals it was not possible to adequately test the statistical significance of the differences in measurements. Thus, we are unable to conclude whether *Lemuricola* sp. belongs to a different species or must be interpreted as a population of a known species. Until more material or information can be obtained, we propose to refer to them simply as *Lemuricola* sp.

Acknowledgements—For assistance in reading drafts of this paper and helpful criticisms on earlier versions of the manuscript, we thank Michel Baylac, Renaud Fortuner, and 2 anonymous referees. This work was supported in part by NATO collaborative research grant No. CRG 920612 to S. L. Gardner, J. P. Hugot, and S. Morand, in part by a National Science Foundation Grant DEB-9024816 to S. L. Gardner and by the Groupe de travail Morphométrie et Analyse de Forme du Muséum National d'Histoire Naturelle.

REFERENCES

Baer J. G. S. 1935. Etudes de quelques helminthes de Lémuriens. *Revue Suisse de Zoologie* **42**: 275-292.

Baylis H. A. 1928. Some further parasitic worms from Sarawak. *Annals and Magazine of Natural History* **1**: 606-608.

Chabaud A. G. & Petter A. J. 1959. Les Nématodes parasites de Lémuriens Malgaches. II. Un nouvel Oxyure: *Lemuricola contagiosus*. *Mémoires de l'Institut Scientifique de Madagascar série A* **13**: 127-132.

Chabaud A. G., Petter A. J. & Golvan Y. 1961. Les Nématodes parasites de Lémuriens Malgaches. III. Collections récoltées par M. et Mme François Petter. *Annales de Parasitologie Humaine et Comparée* **36**: 113-126.

Chabaud A. G., Brygoo E. R. & Petter A. J. 1965. Les Nématodes de Lémuriens Malgaches. VI. Description de six espèces nouvelles et conclusions générales. *Annales de Parasitologie Humaine et Comparée* **40**: 181-214.

Inglis W. G. & Dunn F. L. (1963) The occurrence of *Lemuricola* (Nematoda: Oxyurida) in Malaya: with the description of a new species. *Zeitschrift für Parasitenkunde* **23**: 354-359

Kasmierczak J. B. 1985. Analyse logarithmique. Deux exemples d'application. *Revue de Statistique Appliquée* **33**: 13-24.

Mossimann J. E. 1970. Size allometry: size and shape variables with characterizations of the lognormal and generalized distributions. *Journal of the American Statistical Association* **56**: 930-945.

Mossimann J. E. & James F. C. 1979. New statistical methods for allometry with application to Florida red-winged Blackbirds. *Evolution* **33**: 444-459.

- Petter A. J., Chabaud A. G., Delavenay R. & Brygoo E. R. 1972. Une nouvelle espèce de Nématode du genre *Lemuricola*, parasite de *Daubentonia madagascariensis* Gmelin, et considérations sur le genre *Lemuricola*. *Annales de Parasitologie Humaine et Comparée* **47**: 391–398.
- SYSTAT 1992. *Statistics, Version 5.2 Edition*. Evanston, IL: SYSTAT, Inc., 1992, 236 pp.