

NOTES ON THE ECOLOGY OF *LINCUS SPURCUS* AND *L. MALEVOLUS* (HETEROPTERA : PENTATOMIDAE : DISCOCEPHALINAE) ON PALMAE IN FORESTS OF PERUVIAN AMAZONIA

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Résumé. — Notes sur l'écologie de *Lincus spurcus* et *L. malevolus* (*Heteroptera* : *Pentatomidae* : *Discocephalinae*) sur Palmiers dans la forêt amazonienne du Pérou. — Les deux espèces de *Lincus* ont été étudiées sur différentes espèces de palmiers natifs en Amazonie péruvienne. Le nombre d'individus est beaucoup plus élevé sur les palmiers fertiles que sur les palmiers stériles. Les adultes sont plus nombreux que les larves sur *Astrocaryum* spp. Sur *Elaeis oleifera* les larves sont, au contraire, plus abondantes. Sur *Astrocaryum*, les adultes sont regroupés dans les gaines des feuilles, tandis que les larves se trouvent le plus souvent dans les structures reproductives. Sur *E. oleifera* adultes et larves se trouvent ensemble dans ces dernières structures. Dans tous les cas les œufs n'ont été trouvés que sur les palmiers fertiles. La sex ratio est très différente d'une espèce à l'autre. Les différences dans la distribution spatiale des *Lincus* peuvent être attribuées à l'anatomie des palmiers.

Summary. — The two species of *Lincus* have been studied on different native palm species of the Peruvian Amazonia. The number of bugs found is much higher on fertile than on sterile palms. On *Astrocaryum* spp., adults are more abundant than nymphs; on *Elaeis oleifera*, the opposite happens, and nymphs are found in higher numbers. On *Astrocaryum*, adult bugs are grouped on the foliar sheaths, while the nymphs are generally found on reproductive structures. On *E. oleifera*, both adults and nymphs are found together on the latter. In all cases, the eggs are only found on fertile palms. Both species of *Lincus* strongly differ by their sex ratio. The differences in the spatial distribution of these bugs in the palm, may be closely related to its anatomy.

Bugs of the genus *Lincus* (Pentatomidae, Discocephalinae) are pointed out as vectors of *Phytomonas* spp. (Trypanosomatidae) which are pathogens of « marchitez sorpresiva » and « hartrot », African oil palm (*Elaeis guineensis* Jacq.) and coconut (*Cocos nucifera* L.) diseases in Central and South America (Desmier de Chenon *et al.*, 1983, Desmier de Chenon, 1984; Dolling, 1984; Perthuis *et al.*, 1985; Louise *et al.*, 1986; Dollet & Wallace, 1987). Three species of *Lincus* have been reported on native palm species of the genus *Astrocaryum* in Peruvian Amazonia (Couturier & Kahn, 1989), all of which, new species,

have been described by Rolston (1989). *Lincus malevolus* Rolston was found on *Astrocaryum macrocalyx* Burret, in the Lower Ucayali basin, *L. spurcus* Rolston on *A. sp. aff. A. murumuru* Mart. in the Upper Huallaga valley, and *L. hebes* Rolston on *A. sp. aff. macrocalyx* Burret in Madre de Dios. *L. spurcus* had also been collected in two African oil palm plantations (Palmas del Espino and Tocache) in the Upper Huallaga valley before (Rolston, 1989). We have recently found *L. malevolus* on another species of *Astrocaryum* in the Manifí River valley, and on *Elaeis oleifera*, the American native oil palm, in the Lower Ucayali River valley.

The biology and ecology of *Lincus* spp. are almost unknown, except for the observations of Desmier de Chenon (1984). In order to help fill the gap, data on frequency, density, sex ratio and eggs of *L. malevolus* and *L. spurcus* on amazonian native palms are presented and discussed.

Study areas and palm descriptions

The study was carried out in three regions in Peruvian Amazonia:

A) In the Upper Huallaga River valley, Department of San Martín, Province of Mariscal Cáceres, 20 km from Uchiza, 8°17'S, 76°26'W, 500 m above sea level. Average annual rainfall is 3.0 m with a peak from December to March, and a drier period from June to August; average annual temperature is 26 °C. The native palm species sampled *Astrocaryum sp. aff. A. murumuru* forms dense populations in a restingaforest on alluvial soils which are periodically flooded by the Huallaga River (Kahn & Mejia, in press). Flooding lasts several weeks in February-March.

B) In the Lower Ucayali River valley, Department of Loreto, Province of Requena, 200 km southwest of Iquitos, near the village of Jenaro Herrera, 4°55'S, 73°40'W, 125 m above sea level. Average annual rainfall is 2.9 m with a rainy season from December to April and a drier period from May to November; average annual temperature is 25.9 °C. *Astrocaryum macrocalyx* forms very dense populations in the restinga-forests on periodically flooded alluvial soils, and also occurs in the seasonal swampforests, in lower density however (Kahn & Mejia, in press). *Elaeis oleifera* is an unfrequent palm which forms dense populations on limited areas in seasonal swamp forests (Kahn & Mejia, 1986).

C) In the Manifí River valley, Department of Loreto, Province of Maynas, near the village of Paparo, 3°24'S, 72°45'W, about 125 m above sea level. Average annual rainfall is 2.3 m with a peak in February and the driest period in August. *Astrocaryum sp.* is found on deforested areas and secondary forests on hill slopes and plateaux which are never flooded.

Astrocaryum spp. and *Elaeis oleifera* are medium-sized palms with large leaves (table I).

TABLE I

Leaf and stem sizes (cm) of natives palms sheltering *Lincus* spp. (P : number of palms; L : total number of leaves measured in each population from which means are calculated).

P/L	N pairs of pinnae	Rachis length	Total length	Median segment length	width
A — <i>Astrocaryum sp. aff. A. murumuru</i> (3 leaves measured per palm) :					
21/63	103.1 ± 11.1	478.5 ± 56.4	668.7 ± 66.4	100.9 ± 11.0	5.7 ± 0.8
B — <i>Astrocaryum macrocalyx</i> (3 leaves measured per palm) :					
8/24	100.0 ± 10.5	485.5 ± 62.7	691.1 ± 93.9	95.6 ± 10.9	4.3 ± 0.7
5/15	93.9 ± 8.6	482.3 ± 42.9	649.0 ± 37.9	104.5 ± 7.8	5.4 ± 0.6
C — <i>Astrocaryum sp.</i> :					
3/4	82-104	450-535	—	110-124	6.8-8.0
D — <i>Elaeis oleifera</i> (1 leaf measured per palm) :					
30/30	82 ± 6.3	504.3 ± 42.6	765.2 ± 50.6	109.2 ± 12.8	5.8 ± 0.6

The former species elaborates an erect trunk, up to 8 m in height and 20 cm in diameter, while the latter is a procumbent palm with a creeping broad trunk, rooting at the lower side, and submerged by water after strong rainfall. Except for *A. sp. aff. A. murumuru* which forms clumps of 2-6 axes, usually with only one adult, the other species are single-stemmed palms. All *Astrocaryum* spp. are strongly armed with black, flattened spines on the abaxial side of the sheath, petiole and rachis of the leaves. Those of the sheath are very dense and longer, up to 20 cm in length. The sheath of the dead leaves persist on the trunk and form a continuous, spiny muff which shelters a diversified fauna: many insects, spiders, scorpions, snakes, frogs and small rodents.

Elaeis oleifera is not a prickly palm. Leaf sheaths of dead leaves are only persistent at the base of the crown. Abaxial and adaxial sides of sheath and petiole are smooth and green.

Methods

The populations of *Astrocaryum* spp. in the three regions were sampled at least once every season. Sample size usually consisted of 10 adult-sized plants. Each palm was cut down in such a way that the crown fell on a previously clean ground area, where escaping bugs could be easily detected and captured; then, the aerial part of each palm was dissected with a machete, each leaf sheath, inflorescence and infructescence carefully examined.

Sample size with *Elaeis oleifera* consisted of 20 adult-sized plants. For each plant only leaves 9, 17, 25, 33 and 41, and the corresponding inflorescences and infructescences, were cutted and observed. Palms were not killed and could be reexamined every season.

RESULTS

The bugs hide between the spines and the brown fibers of the leaf sheaths. It is difficult to see and capture them as a result, but easy to detect them by their characteristic odor; when the palm is cut down, they generally fall on the forest ground under the lying crown and remain hidden under the dead leaves.

Both species of bugs develop their whole biological cycle on the palm species, as pointed out by the occurrence of eggs, nymphs and adults (table II).

A) *Lincus spurcus* on *Astrocaryum* sp. aff. *A. murumuru* in the upper Huallaga valley. — Bugs are found on 90.8% of the fertile palms, and on 19.2% of the sterile palms. Bug density is about 24 times higher on the former than on the latter. On sterile palms, 79.0% of the bugs are adults, of which 85.0% are found in the leaf sheaths; and 39.4% are nymphs, of which 68.6% are found on reproductive structures, mainly the infructescences (55.2%). The sex ratio is about 1:1. Eggs are found with a higher frequency during the rainy season. They are laid in groups of 7-8 in straight rows of about 7 mm in length deposited on the leaf sheaths as well as on their peduncles. Each egg is pearly-grey and ornamented at its upper side.

B) *Lincus malevolus* on *Astrocaryum macrocalyx* in the Lower Ucayali valley. — Bugs are found on 88.9% of the fertile palms and on 9.8% of the sterile palms. Bug density is about 5 times higher on the formers. Adults represent 95.7% of the population on sterile palms, and 56.9% on fertile palms. On these latter, 56.6% of the nymphs are on reproductive structures while 98.6% of the adults are on the leaf sheaths. Males are always in low density; sex ratio on fertile palms is about 1 male for 34 females. Eggs are present on inflorescence peduncles.

C) *Lincus malevolus* on *Astrocaryum* sp. in the Maniti River valley. — Frequency and density of bugs is clearly higher on fertile than on sterile palms. On the former, 53.2% of the bugs are adults, of which 90.4% are on the leaf sheaths, while 56.2% of the nymphs are on infructescences. Sex ratio on fertile palms is about 1 male for 5 females. Eggs are present on leaf sheaths and peduncles.

D) *Lincus malevolus* on *Elaeis oleifera* in the Lower Ucayali River valley. — Bugs

are found on 83.3% of the fertile palms and on 4.0% of the sterile palms. Bug density is about 137 times higher on the former than on the latter. On fertile palms, 47.0% of the bugs are adults, of which 83.5%, as well as 93.5% of the nymphs, are on reproductive structures. The only 3 bugs found on the sterile palms were females. Sex ratio on fertile palms is about 1 male for 6 females; no males have been captured during the rainy season. Eggs were present on inflorescence peduncle during the transition from dry to rainy season.

TABLE II

Population size and structure on *Lincus spurcus* and *L. malevolus* on Amazonian native palms (n: number of bugs; F: frequency of palms with bugs (%); N: palm sample size; m: mean density per palm with bugs; M: mean density calculated per palm, from N).

	eegs	nymphs	females	males	n	F	N	m	M
A — <i>L. spurcus</i> on <i>Astrocaryum</i> sp. aff. <i>A. murumuru</i> (data cumulated from April 1988 to February 1989) :									
sterile palms	0	8	15	15	38	19.2	26	7.6	1.5
fertile palms	14	299	240	239	778	90.8	22	38.9	35.4
leaves	3	94	205	202	501			25.1	22.8
flowers	10	40	6	3	49			2.5	2.2
fruits	1	165	29	34	228			11.4	10.4
B — <i>L. malevolus</i> on <i>Astrocaryum macrocalyx</i> (data cumulated from January 1988 to April 1989) :									
sterile palms	0	1	21	1	23	9.8	34	5.8	0.7
fertile palms	4	53	68	2	123	88.9	9	15.4	13.7
leaves	0	23	68	1	92			13.1	10.2
flowers	4	6	0	0	6			3.0	0.7
fruits	0	24	0	1	25			6.3	2.8
C — <i>L. malevolus</i> on <i>Astrocaryum</i> sp. (data cumulated from June 1988 to March 1989) :									
sterile palms	0	0	1	0	1	14.3	7	1.0	0.1
fertile palms	11	73	69	14	156	66.7	9	26.0	17.3
leaves	6	32	61	14	107			17.8	11.9
flowers	—	—	—	—	—			—	—
fruits	5	41	8	0	49			8.2	5.4
D — <i>L. malevolus</i> on <i>Elaeis oleifera</i> (data cumulated from June 1988 to April 1989) :									
sterile palms	0	0	3	0	3	4.1	47	1.5	0.1
fertile palms	3	123	94	15	232	89.3	28	9.3	8.3
leaves	0	8	15	3	26			2.6	0.9
flowers	3	50	36	8	94			7.8	3.4
fruits	0	65	43	4	112			11.2	4.0

DISCUSSION

Lincus spurcus and *L. malevolus* are present and form dense populations on native Amazonian palms, *Astrocaryum* sp. aff. *A. murumuru* for the former, *A. macrocalyx*, *A. sp.*, and *Elaeis oleifera* for the latter.

The differences in the spatial distribution of bugs in the palm may be related to the abundant, flattened, black spines and the leaf sheath fibers of *Astrocaryum* spp., which are absent in *E. oleifera*. These spines allow the bug to hide, and avoid it from falling to the bottom of the leaf sheath where it can be crushed by the wind induced movements, or drowned in the water accumulated after rainfall. They also accumulate lots of litter, under which these bugs are often hidden, as first pointed out, for *Lincus* sp., by Louise *et al.* (1983).

The adults are likely to be attracted by the aromatic volatile compounds of the inflorescences, new palms being colonized as a result. We never managed to capture the species of *Lincus* by light trap; they are photophobic and probably move by night flight.

The two bug species of *Lincus* spp. differ by their reproductive strategy, as shown

by their sex ratio, and by the differences found in both the density and the stability of their populations.

Lincus malevolus has been found on *Astrocaryum macrocalyx* and *Elaeis oleifera*; both palm species are present in the same plot in a seasonal swamp forest. However, *L. malevolus* have also been found on *A. macrocalyx* in forests on periodically flooded alluvial soils where *E. oleifera* is absent. The natural populations of these latter palm species are unfrequent and not extended, while those of *A. macrocalyx* are common and cover large areas in seasonal swamp forests as well as in forests on alluvial soils in western and central Amazonia. This is also true with *A. aff. A. murumuru* in the western region of the Amazon basin, where *L. spurcus* was found.

Finding several species of the genus *Lincus* on several species on the genus *Astrocaryum* shows a clear relationship between both bug and palm genera, which seems to be the natural reservoir of *Lincus* spp.; *E. oleifera* would be an occasional hostage, as *E. guineensis* (in plantation) is. More data corroborates this conclusion: *Lincus hebes* has been collected on *Astrocaryum* sp. aff. *A. macrocalyx* in Madre de Dios, Perú (F. Kahn & J.A. Llosa, Oct. 1987, unpublished data), and *Lincus* sp. has been found on *Astrocaryum* cf. *chonta* in Beni Reserve, Bolivia (F. Kahn, August 1989, unpublished data). *Lincus* spp. have not been found yet on other palm genera, though we have systematically searched them. Their presence on other genera cannot be excluded, however. The occurrence of *Lincus* spp. on the genus *Elaeis* is not surprising: both palm genera *Astrocaryum* and *Elaeis* belong to the same tribe Cocoeae of the Arecoideae, both develop similar medium-sized palms with large leaves. Moreover the natural populations of *E. oleifera* constitute unfrequent but dense concentrations near dense and extensive populations of some *Astrocaryum* spp., which is also true with most Amazonian plantations of *E. guineensis* (Palmas del Espino, Emdepalma and Maniti in Perú; Shushufindi in Ecuador; Río Urubu, and Belém in Brazil).

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LITERATURE CITED

- COUTURIER G. & KAHN F., 1989. — Bugs of *Lincus* spp. vectors of Marchitez and Hartrot (oil palm and coconut diseases) on *Astrocaryum* spp., Amazonian native palms. — *Principes*, 33: 19-20.
- DESMIER DE CHENON R., 1984. — Recherches sur le genre *Lincus* Stal, Hemiptera Pentatomidae Discocephalinae, et son rôle éventuel dans la transmission de la Marchitez du palmier à huile et du Hartrot du cocotier. — *Oléagineux*, 39 (1) : 1-6.
- DESMIER DE CHENON R., MERLAND E., GENTY P., MORIN J. P. & DOLLET M., 1983. — Research on the genus *Lincus*, Pentatomidae Discocephalinae and its possible role in the transmission of the Marchitez of oil palm and Hartrot of coconut. — *IV Reun. del Com. tec. Reg. Sanidad vegetal SARH-IIICA, Cancún, Mexico*.
- DOLLET M. & WALLACE, F.G., 1987. — Report on the first *Phytomonas* Workshop. — *Oléagineux*, 42 (12): 465-468.
- DOLLING W.R., 1984. — Pentatomid bugs (Hemiptera) that transmit a flagellate disease of cultivated palms in South America. — *Bull. ent. Res.*, 74 : 473-476.
- KAHN F. & MEJIA K., 1986. — The American oil palm, *Elaeis oleifera*, in Peruvian Amazonia. — *Principes*, 30 : 180.
- KAHN F. & MEJIA K., 1990. — The palm communities in wetland forest ecosystems of Peruvian Amazonia. — *Forest Ecology and management*, 33 (sous presse).
- LOUISE C., DOLLET M. & MARIAU D., 1986. — Recherches sur le Hartrot du cocotier, maladie à *Phytomonas* (Trypanosomatidae) et sur son vecteur *Lincus* sp. (Pentatomidae) en Guyane. — *Oléagineux*, 41 (10): 437-446.

- PERTHUIS B., DESMIER DE CHENON R. & MERLAND E., 1985. — Mise en évidence du vecteur de la Marchitez sorpresiva du palmier à huile, la punaise *Lincus lethifer* Dolling (Hemiptera Pentatomidae Discocephalinae). — *Oléagineux*, 40 (10): 473-476.
- ROLSTON L. H., 1989. — Three new species of *Lincus* (Hemiptera : Pentatomidae) from palms. — *Jl. N. Y. ent. Soc.*, 97 : 271-276.