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Systematics and Ecology of Ground Spiders (Araneae, Gnaphosidae) from Central Amazonian Inundation Forests

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ABSTRACT

Five new species of the spider family Gnaphosidae are described from annually flooded central Amazonian blackwater forests: *Camillina taruma, Tricongius amazonicus, Zimiromus atrifus, Z. boistus*, and *Z. cristus*. The first three species were collected in abundance, constituting up to 11.8 percent of all spiders captured in pitfall and arboreal traps. Whereas *C. taruma* and *T. amazonicus* spiderlings are active both day and night, and show pronounced vertical migration just prior to the inundation, those of *Z. atrifus* are slower, active only at night, and appear only rarely in arboreal traps during the same period.

INTRODUCTION

Our knowledge of Neotropical spiders is generally poor; relatively few groups have been revised, most described species cannot be recognized accurately from their initial descriptions, and the available collections (which are sparse compared to existing Nearctic samples) are often poorly sorted and difficult to access. Hence it is normal to find numerous unidentifiable and undescribed species in any sizable Neotropical collection, such as the one reported on here, taken in annually flooded forests in the central Amazon region of Brazil. This paper deals with five species of the family Gnaphosidae cap-

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tured in a survey, using pitfall and arboreal traps as well as hand searching, that was designed to study how the spider fauna copes with these periodic inundations. Because four of the species belong to genera that have recently been revised, we expected to be able to identify them easily. In fact, however, all five species are undescribed and appear not to have been collected previously; one belongs to a genus that has apparently not been recollected since its original description almost a century ago. These findings thus underscore the pressing need for additional sampling throughout the rapidly disappearing forests of both tropical and south temperate South America.

The format of the descriptions and the abbreviations used follow Platnick and Shadab (1975); measurements (provided for type material only) are in millimeters. We thank Dr. M. U. Shadab of the American Museum of Natural History (AMNH) for assistance with illustrations, and Drs. C. D. Dondale of the Biosystematics Research Centre, Ottawa, and C. E. Griswold of the National Museum of Natural History, Smithsonian Institution, for helpful comments on a draft of the manuscript. Types are deposited in the Instituto Nacional de Pesquisas da Amazonia, Manaus (INPA), other specimens in AMNH and the Staatliches Museum für Naturkunde, Karlsruhe.

STUDY AREA AND METHODS

Rivers in central Amazonia show annual water-level fluctuations. Consequently, vast areas of rainforest along river banks are annually flooded, to a depth of several meters, for 5–6 months of the year. Based on the different chemical composition of white- and blackwater rivers, two types of inundation forests have been distinguished, the várzea and the igapó (Prance, 1979; Adis, 1984; Junk, 1984). The biotas of these forests are distinct from those of adjacent dryland forests, and the riverine inundation system has apparently played an important role in the evolution of the very high biodiversity displayed by central Amazonian rainforests (Erwin and Adis, 1982). As part of a long-term investigation of inundation forests near Manaus, Brazil, carried out by the Max-Planck-Institut für Limnologie's "Tropical Ecology" working group in cooperation with the Brazilian National Research Institute of Amazonia (INPA), the spider fauna of a blackwater inundation forest (igapó) was investigated from 1987–1988.

The igapó forest studied is situated on the lower course of the Rio Tarumã Mirím (03°02'S, 60°17'W) about 20 km upstream from Manaus; the site was described in detail by Adis (1984). The Rio Tarumã Mirím is a tributary of the Rio Negro; both are typical blackwater rivers with very acidic waters containing low concentrations of electrolytes and mineral nutrients. In response to heavy rainfalls in its upper catchment areas, the water level of the Rio Negro begins to increase in November or December, and reaches its maximum in June or July, several weeks after the beginning of the dry season in the Manaus area. Because of this effect, the local rainfall has only a small impact on the actual water level of the large rivers (Junk and Furch, 1985).

The lower portion of the study site is inundated to a depth of up to 8 m for 6–8 months annually, producing a vegetation of widely dispersed shrubs and small trees, an open canopy, and a relatively low species diversity (26 species; Adis, 1984). The duration and depth of inundation decrease gradually with increasing altitude, as the forest turns gradually from a typical igapó into a terra firme forest. The upper igapó is characterized by higher plant diversity (48 species; Adis, 1981; Worbes, 1983), high buttressed trees (*Aldina latifolia var. latifolia* and *Swartzia polyphylla*), four distinguishable stories, an almost closed canopy, and a distinct humus layer (Adis, 1984).

Spiders were collected in both parts of the study site during the noninundated period of 1987–1988, using two circular pitfall traps, four ground-photoeclectors (emergence traps), and one arboreal photoeclector for upwardly moving animals (these techniques are described by Adis, 1981; Funke, 1971; and Funke and Herlitzius, 1984). In combination, these traps yielded data on activity levels on both the ground surface and tree trunks, species diversity, abundance, dominance, and phenology. To observe possible reactions of spiders to the flood event (flight from the

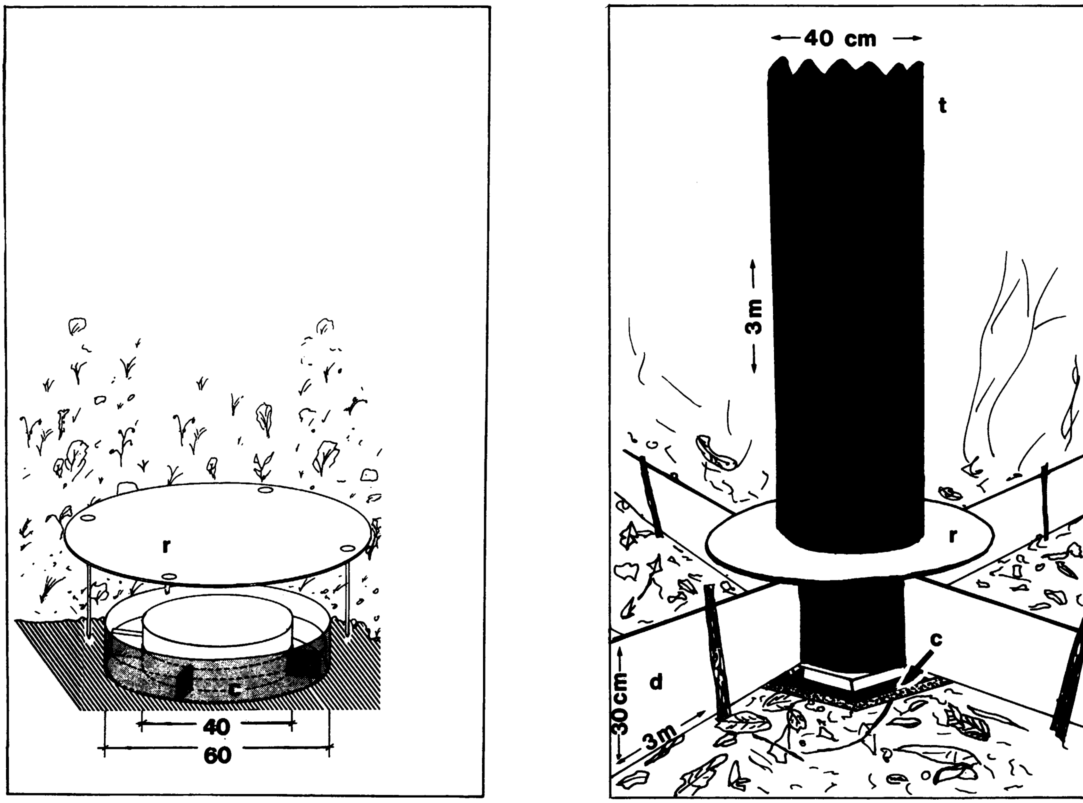


Fig. 1. Circular pitfall traps without (left, dimensions in cm) and with (right) directional barriers and an imitation tree trunk; c = compartmentalized capture device; d = directional barrier; r = rain shield; t = imitation tree trunk.

advancing waterline, horizontal and vertical migration, etc.), four special circular pitfall traps (fig. 1) were used in pairs. One of the two traps was equipped with an imitation tree trunk (fig. 1); all the traps were equipped with four 3 m long metal barriers designed to detect differences in the direction of activity. Comparisons of catches with and without imitation tree trunks determined the possible attraction of trunks (or at least their silhouettes) to migrating spiders. Although the total number of traps used was small, the diversity of trap types, together with field observations, allowed differences in the life cycle and flood reactions of various species to be demonstrated.

Three gnaphosid species are among those frequently found on the ground surface, but show different phenologies and reactions to the inundation. Two other species were collected in lesser numbers in the same area, and three of them have also been found in a nearby whitewater inundation forest.

SYSTEMATICS

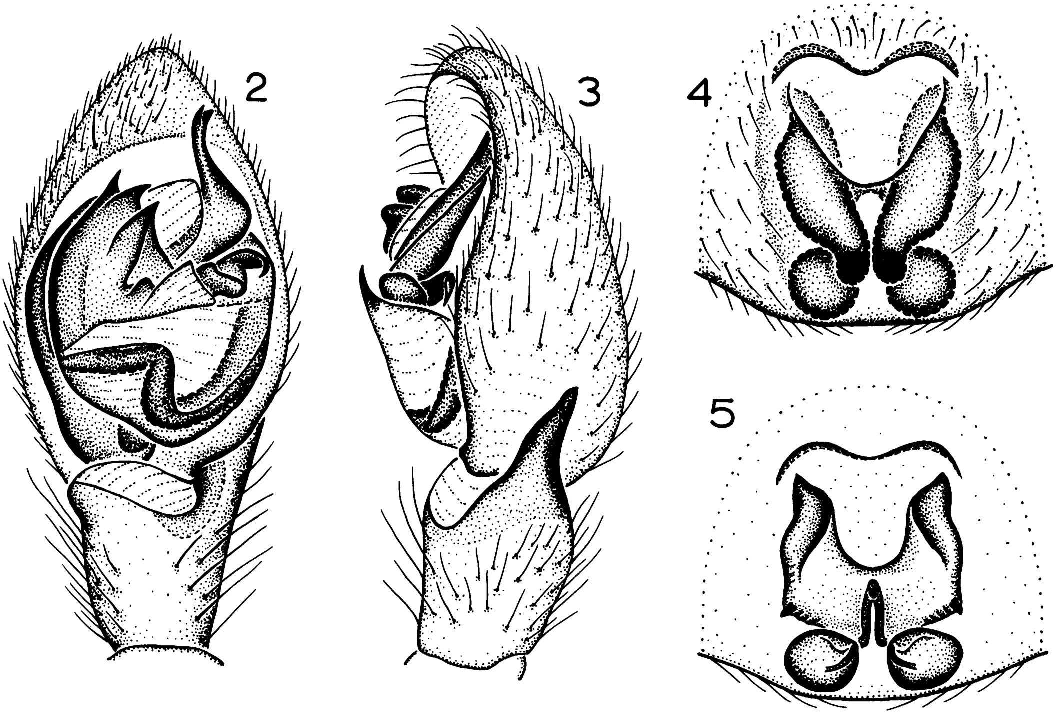
Camillina Berland

The American species of this widespread genus, including six species known to occur in Brazil, were reviewed by Platnick and Shadab (1982) and Platnick and Murphy (1987). Three additional species were described from eastern Brazil by Müller (1987), but the igapó forest has yielded yet another.

Camillina taruma, new species

Figures 2–6

TYPES: Male holotype from igapó forest at Rio Tarumã Mirím, Amazonas, Brazil (Nov. 9, 1988; H. Höfer), and female allotype from the same locality (Nov. 6, 1987; H. Höfer), deposited in INPA.



Figs. 2–5. *Camillina taruma*, new species. **2.** Left male palp, ventral view. **3.** Same, retrolateral view. **4.** Epigynum, ventral view. **5.** Same, dorsal view.

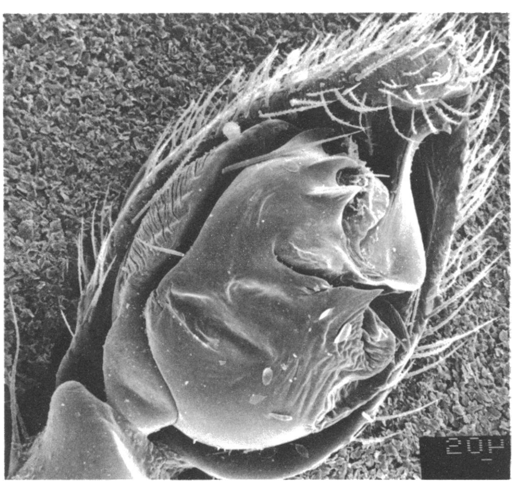


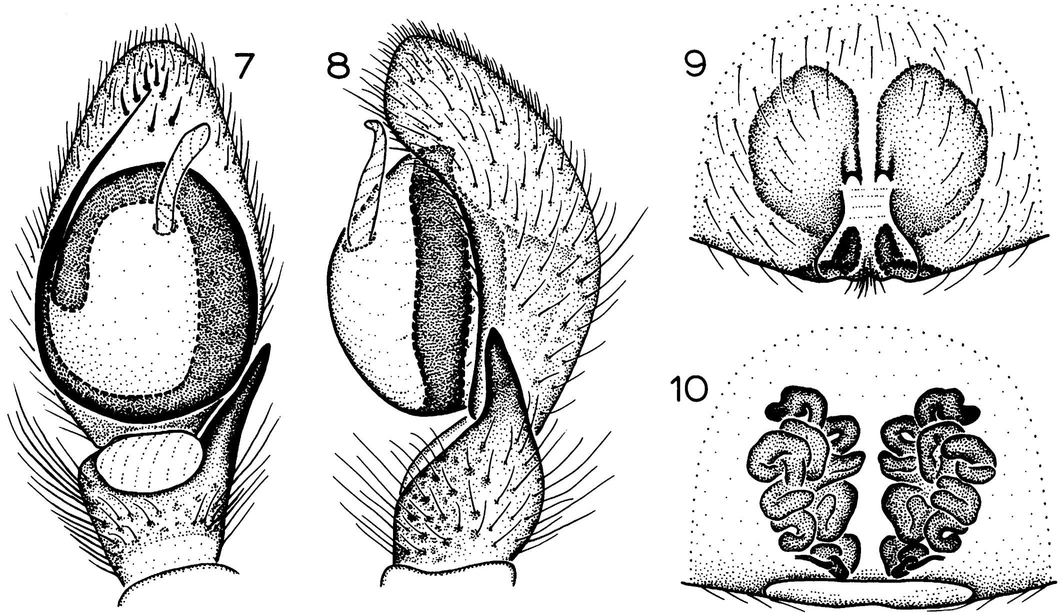
Fig. **6.** *Camillina taruma*, new species, left male palp, ventral view.

Etymology: The specific name is a noun in apposition taken from the type locality.

Diagnosis: The combined presence of an elongate, proximally bulbous embolus and a three-pointed terminal apophysis in males (figs. 2, 3, 6), and of a triangular epigynal plate (fig. 4) and elongate lateral epigynal ducts (fig. 5) in females, is diagnostic.

Male: Total length 3.41. Carapace 1.48 long, 1.03 wide. Femur II 0.86 long. Eye sizes and interdistances: AME 0.07, ALE 0.07, PME 0.10, PLE 0.07; AME-AME 0.04, AME-ALE 0.02, PME-PME 0.01, PME-PLE 0.04, ALE-PLE 0.03; MOQ length 0.20, front width 0.18, back width 0.21. Terminal apophysis with three points, most distal point directed distally; embolus long, folded prolaterally, expanded basally (figs. 2, 3, 6). Leg spination: femora: II p0-0-0; III, IV p0-0-0, r0-0-0; patella III r0-0-0; tibiae: III p0-1-0, v0-1p-2, r0-1-0; IV v1p-2-2; metatarsi: II v0-0-0; III p0-1-1, v0-0-0, r0-1-1; IV p0-2-2, v1p-1p-0, r0-2-1.

Female: Total length 3.45. Carapace 1.39 long, 1.00 wide. Femur II 0.86 long. Eye sizes and interdistances: AME 0.07, ALE 0.06, PME 0.09, PLE 0.08; AME-AME 0.04, AME-ALE 0.01, PME-PME 0.01, PME-PLE 0.02,



Figs. 7–10. *Tricongius amazonicus*, new species. **7.** Left male palp, ventral view. **8.** Same, retrolateral view. **9.** Epigynum, ventral view. **10.** Same, dorsal view.

ALE-PLE 0.03; MOQ length 0.19, front width 0.18, back width 0.19. Epigynal plate triangular, separated from spermathecae by elongate lateral ducts (figs. 4, 5). Leg spination: femora: II p0-0-0; III, IV p0-0-0, r0-0-0; patella III r0-0-0; tibiae: III p0-1-1, v0-1p-2, r0-1-0; IV v1p-2-2; metatarsi: II v0-0-0; III p0-2-1, v0-0-0, r0-1-1; IV p0-2-2, v0-1p-0, r0-2-1.

MATERIAL EXAMINED: Other males and females from the type locality.

DISTRIBUTION: Known only from Amazonas, Brazil.

Tricongius Simon

This genus has remained virtually unknown since Simon (1893a) established it for a Venezuelan species, *Tricongius collinus* Simon. As Simon (1893b) indicated, the genus can be recognized easily by the flattened carapace, the protruding chelicerae with relatively long fangs, and especially the peculiar modification of the cheliceral promargin, which bears at the base of the fang a distinct lobe, provided with several stiff setae, that Simon likened to an artist's paintbrush. Simon also pointed out that the palpal endites appear to lack the oblique depression characteristic of gnaphosoids, but the fully gnaphosid-like anterior lateral spinnerets leave no doubt that the genus is a gnaphosid and that the endital depression has therefore presumably been lost. The stiff setae situated on the posterior rim of the sternum and extending between the fourth coxae, and the highly convoluted epigynal ducts, indicate that *Tricongius* is probably a close relative of the Neotropical gnaphosid genus *Lygromma* Simon.

One other species was subsequently described, *Tricongius granadensis* Mello-Leitão (1941) from Colombia, but Mello-Leitão's descriptions of the chelicerae and legs as unarmed, as well as his epigynal illustration and the relatively large size of the species, indicate that his female is misplaced in *Tricongius.*

Tricongius amazonicus, new species
Figures 7–11

TYPES: Male holotype and female allotype from igapó forest at Rio Tarumã Mirím, Amazonas, Brazil (Mar. 10, 1987; H. Höfer), deposited in INPA.

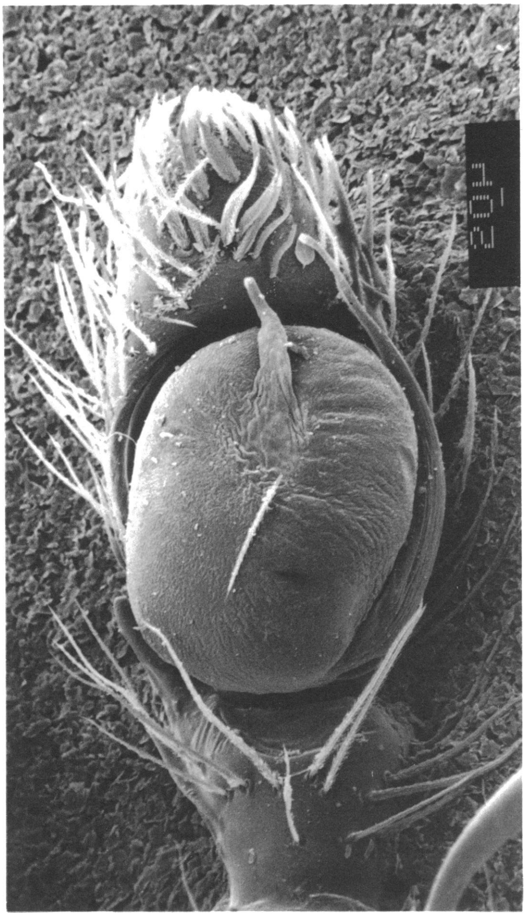


Fig. **11.** *Tricongius amazonicus*, new species, right male palp, ventral view.

ETYMOLOGY: The specific name refers to the type locality.

DIAGNOSIS: Males differ from those of *T. collinus* in having a shorter embolus (originating prolaterally rather than retrolaterally; figs. 7, 8, 11), females in having the mass of epigynal ducts extending far anterior of the anterior epigynal margins (figs. 9, 10).

MALE: Total length, not including porrect chelicerae, 2.40. Carapace 1.14 long, 0.85 wide. Femur II 0.83 long. Eye sizes and interdistances: AME 0.05, ALE 0.05, PME 0.04, PLE 0.05; AME-AME 0.02, AME-ALE 0.02, PME-PME 0.09, PME-PLE 0.06, ALE-PLE 0.06; MOQ length 0.11, front width 0.12, back width 0.17. Palpal cymbium with about seven thickened setae distally; bulb with long prolateral embolus and long, translucent median apophysis (figs. 7, 8, 11). Leg spination (only surfaces bearing spines listed): femora: I–IV d1-0-1; tibiae: III d0-1-0, v1p-2-2; IV d0-1-0, p1-0-1, v1p-2-2, r1-1-1; metatarsi: III p0-1-0, v0-2-2, r0-1-0; IV p0-1-0, v0-2-2, r0-2-0.

FEMALE: Total length, not including porrect chelicerae, 3.26. Carapace 1.22 long, 0.92 wide. Femur II 0.79 long. Eye sizes and interdistances: AME 0.05, ALE 0.07, PME 0.05, PLE 0.07; AME-AME 0.03, AME-ALE 0.03, PME-PME 0.11, PME-PLE 0.06, ALE-PLE 0.05; MOQ length 0.13, front width 0.13, back width 0.21. Epigynal openings paired, situated paramedially at about half length of spermathecal mass (figs. 9, 10). Leg spination as in male except femora I, IV d1-0-0; tibiae: II v0-1p-0; III d0-0-0, v1p-2-2, r0-1-0; IV d1-0-0, p1-1-1, v1p-2-2, r1-1-1; metatarsi: III p0-0-0, v0-2-2, r0-0-0; IV p0-1-1, v0-1p-2, r0-2-0.

OTHER MATERIAL EXAMINED: Other males and females from the type locality.

DISTRIBUTION: Known only from Amazonas, Brazil.

Zimiromus Banks

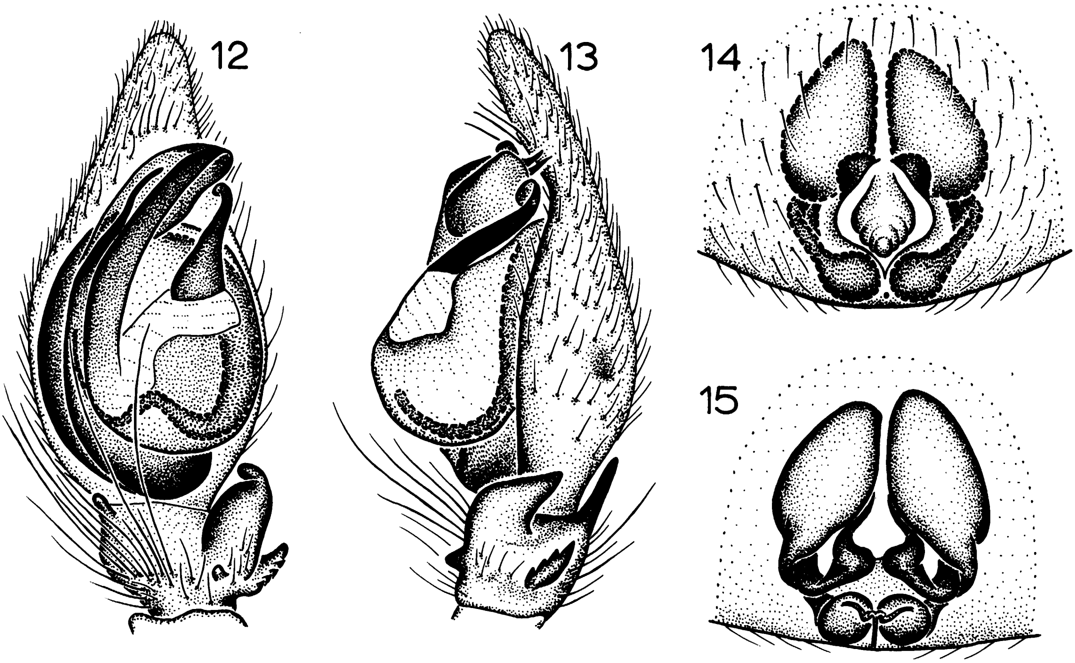
This tropical genus, found from Chiapas, Mexico, south to southern Brazil and Bolivia, was revised by Platnick and Shadab (1976), who knew only two species from Brazil, *Z. medius* (Keyserling) from southern Brazil and *Z. reichardti* Platnick and Shadab from Amazonas. Subsequently, *Z. sinop* was described by Platnick and Shadab (1981) from Mato Grosso. Three species of the genus occur in the new Amazonian collections, and all three appear to be undescribed.

Zimiromus atrifus, new species
Figures 12–16

TYPES: Male holotype from igapó forest at Rio Tarumã Mirím, Amazonas, Brazil (Dec. 6, 1987; H. Höfer), and female allotype from the same locality (Sept. 25, 1987; H. Höfer), deposited in INPA.

ETYMOLOGY: The specific name is an arbitrary combination of letters.

DIAGNOSIS: Males can be easily recognized by the unique, four-pronged lobe situated retrobasally on the palpal tibia (figs. 12, 13, 16);



Figs. 12–15. *Zimiromus atrifus*, new species. **12.** Left male palp, ventral view. **13.** Same, retrolateral view. **14.** Epigynum, ventral view. **15.** Same, dorsal view.

females by the relatively short, diamond-shaped, and striated epigynal scape (fig. 14).

MALE: Total length 3.53. Carapace 1.59 long, 1.23 wide. Femur II 1.43 long. Eye sizes and interdistances: AME 0.11, ALE 0.09, PME 0.06, PLE 0.10; AME-AME 0.08, AME-ALE 0.03, PME-PME 0.11, PME-PLE 0.06, ALE-PLE 0.03; MOQ length 0.31, front width 0.30, back width 0.28. Palpal tibia with three apophyses: most ventral one large, bearing lobe at base; median one bearing four prongs; distal one narrow (figs. 12, 13, 16). Leg spination: femur I d1-1-1; tibiae: II v0-1r-1p; IV d1-1-0; metatarsi I, II v1r-0-0.

FEMALE: Total length 4.69. Carapace 1.80 long, 1.39 wide. Femur II 1.50 long. Eye sizes and interdistances: AME 0.11, ALE 0.10, PME 0.11, PLE 0.10; AME-AME 0.06, AME-ALE 0.05, PME-PME 0.07, PME-PLE 0.07, ALE-PLE 0.03; MOQ length 0.27, front width 0.28, back width 0.29. Epigynal scape small,

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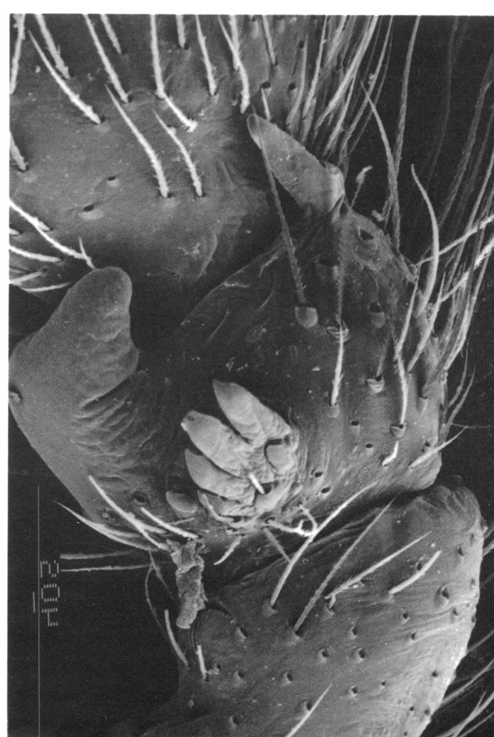
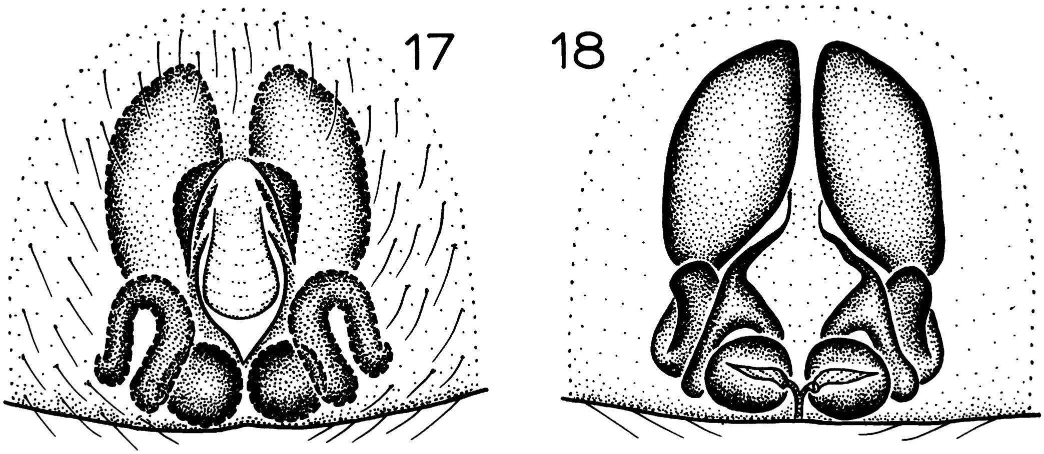


Fig. 16. *Zimiromus atrifus*, new species, left male palpal tibial, retrolateral view.



Figs. 17, 18. *Zimiromus boistus*, new species, epigynum, ventral and dorsal views.

striated, diamond-shaped, situated in atrium only slightly wider than scape; spermathecal ducts narrowed anteriorly (figs. 14, 15). Leg spination: femur I d1-1-1; tibiae: I v0-1r-1p; II v0-1r-1p; IV d1-0-1; metatarsus: I v1r-0-0.

OTHER MATERIAL EXAMINED: Other males and females from the type locality.

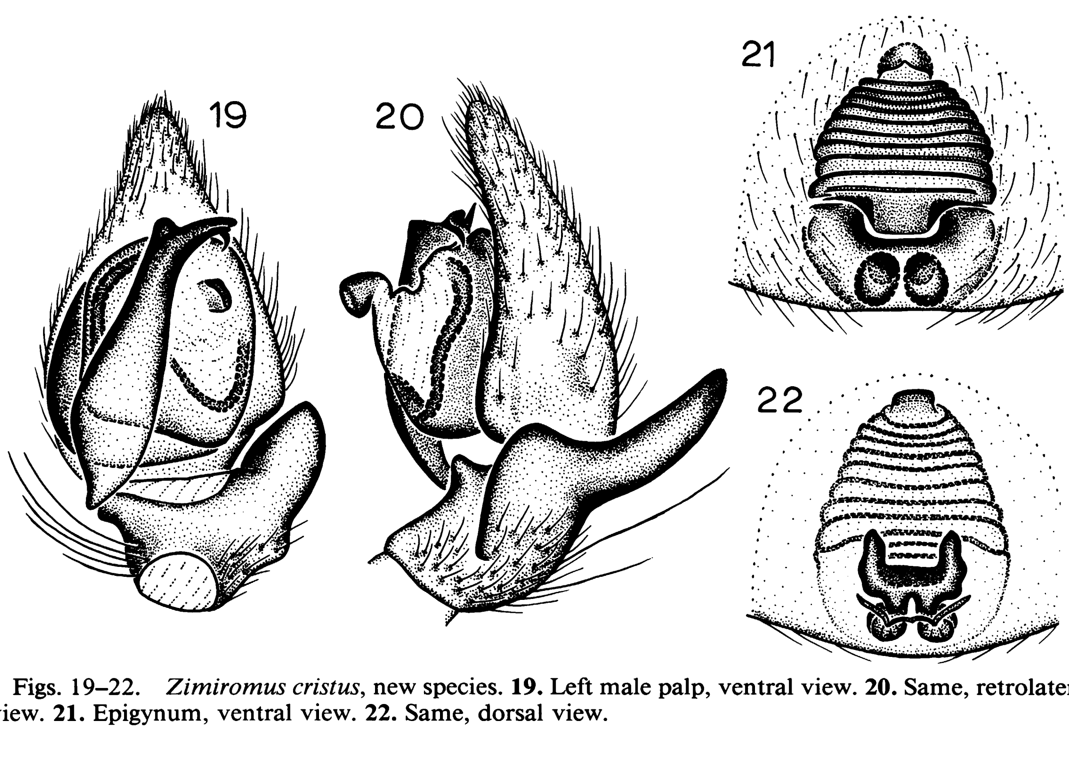
DISTRIBUTION: Known only from Amazonas, Brazil.

Zimiromus boistus, new species
Figures 17, 18

TYPE: Female holotype from a várzea inundation forest on Ilha da Marchantaria (Nov. 24, 1987; H. Höfer), deposited in INPA.

ETYMOLOGY: The specific name is an arbitrary combination of letters.

DIAGNOSIS: Females resemble those of *Z.*



Figs. 19–22. *Zimiromus cristus*, new species. **19.** Left male palp, ventral view. **20.** Same, retrolateral view. **21.** Epigynum, ventral view. **22.** Same, dorsal view.

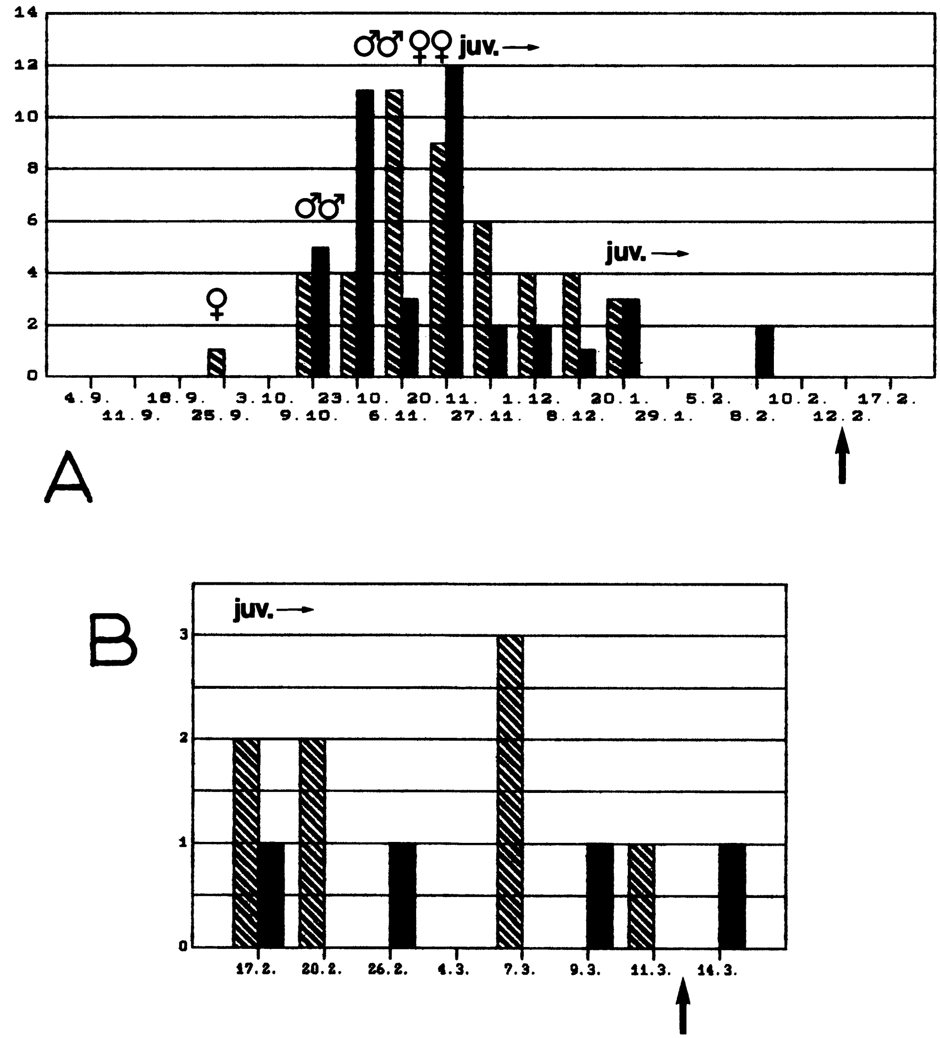


Fig. 23. Activity density of *Zimiromus atrifus*, new species, on the ground during the emergence period of September 1987–March 1988; hatched bars show the numbers of specimens captured in a circular pitfall trap without an imitation tree trunk, black bars show captures of the same trap type with an imitation trunk; arrows indicate the initial date of inundation of the forest floor around the trap (at which time the collecting containers floated, preserving their contents). **A.** Lower igapó. **B.** Upper igapó.

reichardti, also from Amazonas, but have a longer epigynal atrium and posteriorly bifid epigynal ducts (figs. 17, 18).

MALE: Unknown.

FEMALE: Total length 5.74. Carapace 2.29 long, 1.80 wide. Femur II 1.76 long. Eye sizes and interdistances: AME 0.11, ALE 0.14, PME 0.15, PLE 0.12; AME-AME 0.09, AME-ALE 0.04, PME-PME 0.06, PME-PLE 0.07, ALE-PLE 0.04; MOQ length 0.37, front width 0.31, back width 0.36. Epigynal scape rectangular, unstriated; anterior epigynal margins large, situated far from spermathecae (figs. 17, 18). Leg spination: femora: III r0-1-1; IV p0-1-1; tibiae: I, II v2-2-1p; IV d1-0-1; metatarsus III v2-2-1p.

OTHER MATERIAL EXAMINED: Four females taken from igapó forest at Rio Tarumã Mirím, Amazonas, Brazil (May 7, 1987; H. Höfer).

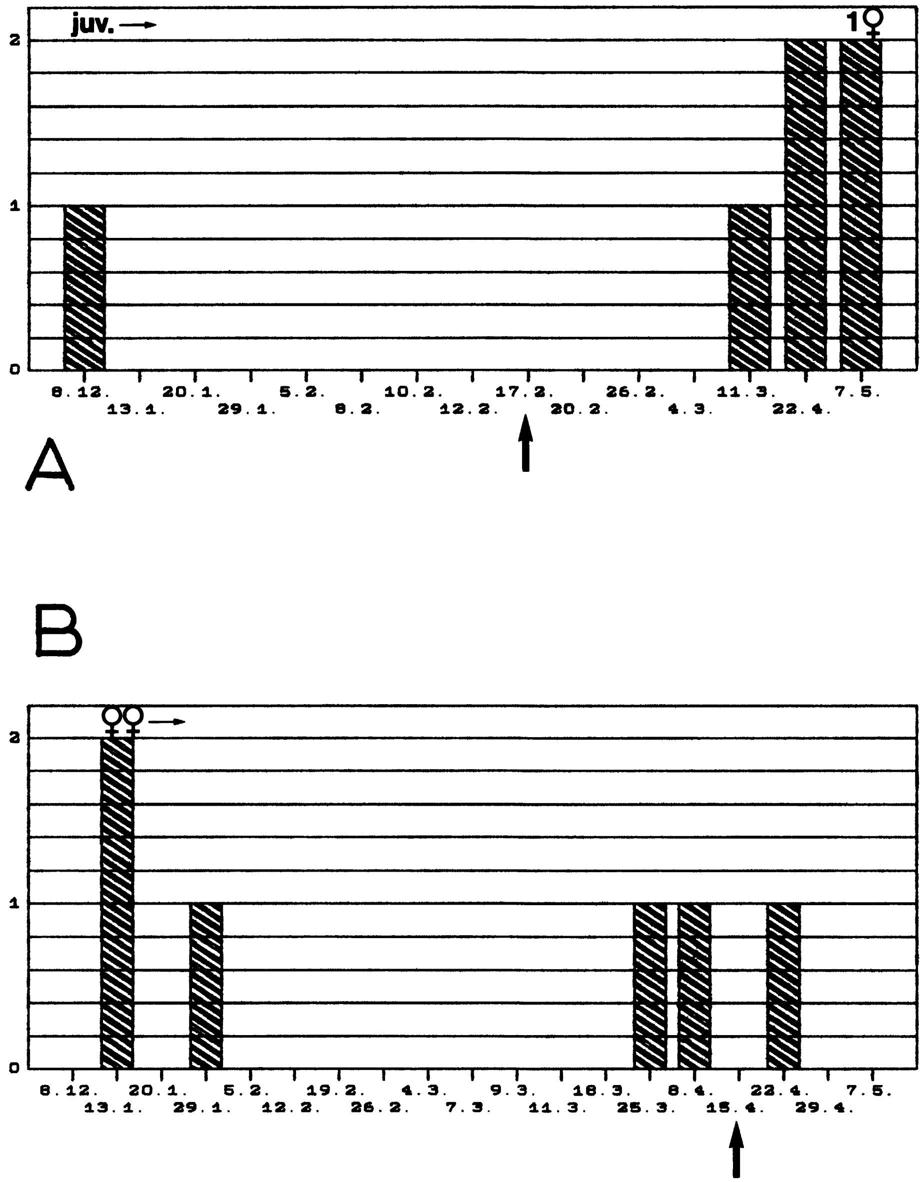


Fig. 24. Activity density of *Zimiromus atrifus*, new species, on tree trunks during the period of December 1987–May 1988, showing the numbers of upwardly migrating specimens captured in arboreal photoeclectors situated at a height of 3 m; arrows indicate the date of inundation of the trunk base. **A.** Lower igapó. **B.** Upper igapó.

DISTRIBUTION: Known only from Amazonas, Brazil.

Zimiromus cristus, new species
Figures 19–22

TYPES: Male holotype and female allotype from igapó forest at Rio Tarumã Mirím, Amazonas, Brazil (Sept. 2, 1976; J. Adis), deposited in INPA.

ETYMOLOGY: The specific name is an arbitrary combination of letters.

DIAGNOSIS: Both sexes can be recognized easily by their bizarrely modified genitalia; the retrolateral tibial apophysis of the male

TABLE 1
Absolute Numbers and Dominance Values Detected by Different Trap Types
(RBof = circular pitfall traps without imitation trunks; RKB = circular pitfall traps with imitation trunks; NB = arboreal photoeclectors; E = ground photoeclectors)

Species	Lower Igapó							Upper Igapó							
	RBof 1		RKB 2		NB 1		E	RBof 3		RKB 4		NB 2		E
C. taruma	35	2.6	61	48	24	1.7	2	11	1.1	25	3.2	19	0.4	26
T. amazonicus	18	1.3	20	1.6	32	2.3	38	11	1.1	33	4.2	41	11.2	110
Z. atrifus	46	3.4	41	3.2	6	0.4	10	8	0.8	4	0.5	6	0.2	10

palp is hypertrophied (figs. 19, 20), and the female epigynum bears numerous transverse striations (figs. 21, 22).

MALE: Total length 3.49. Carapace 1.60 long, 1.22 wide. Femur II 1.13 long. Eye sizes and interdistances: AME 0.12, ALE 0.09, PME 0.11, PLE 0.10; AME-AME 0.07, AME-ALE 0.03, PME-PME 0.07, PME-PLE 0.07, ALE-PLE 0.02; MOQ length 0.32, front width 0.31, back width 0.29. Palpal conductor extending proximad of remainder of bulb; retrolateral tibial apophysis enormous (figs. 19, 20). Leg spination (leg I missing): patella IV p0-0-0; tibiae: II p0-0-0, v1r-1r-1p; III v1p-2-2; IV p1-1-1, v2-2-2; metatarsi: III v2-0-1p; IV p1-2-2, v2-2-1p, r1-2-2.

FEMALE: Total length 5.36. Carapace 1.61 long, 1.23 wide. Femur II 1.05 long. Eye sizes and interdistances: AME 0.10, ALE 0.10, PME 0.09, PLE 0.10; AME-AME 0.06, AME-ALE 0.03, PME-PME 0.08, PME-PLE 0.06, ALE-PLE 0.02; MOQ length 0.26, front width 0.26, back width 0.26. Epigynum with numerous transverse striations (figs. 21, 22). Leg spination: femora: II d1-1-0; III p0-0-1; IV d1-1-0; patella IV p0-0-0; tibiae: I v0-0-0; II p0-0-0, v0-0-0; III p1-1-1, v0-1p-2; metatarsi: I v0-0-0; II v1p-0-0; III v1p-1r-1p; IV v1p-2-1p, r1-2-2.

OTHER MATERIAL EXAMINED: One female taken at the type locality on Aug. 4, 1976 by J. Adis (AMNH).

DISTRIBUTION: Known only from Amazonas, Brazil.

ECOLOGY

Four females of *Zimiromus boistus* were collected from inundated trees (Lecythidiaceae) on the edge of the study site in May 1987; a single female was also taken in the whitewater forest (várzea) on the island Ilha da Marchantaria. Four specimens of *Zimiromus cristus* were taken at the study site by Dr. J. Adis in arboreal photoeclectors in 1983 and 1984. The other three species were taken in all trap types and have also been observed alive.

Zimiromus atrifus is a slow-moving, litter-inhabiting species that was only sporadically caught in ground photoeclectors. In pitfall traps, the species accounted for 3.4 percent of all spiders captured (in the lower igapó; table 1). Activity on the ground (as indicated by pitfall trap captures) was high from October to December (figs. 23A, B). Males appeared only during those three months (together with females), so this time span is assumed to include the reproductive period. The species did not show any reaction (e.g., higher activity) to the flood event or any preference for the traps with an imitation tree trunk; very few individuals (mostly females) were caught in arboreal photoeclectors (table 1; figs. 24A, B). We suspect that juveniles of this species move to higher areas long before the water level reaches the site. At least some females survive, and may stay in the lower trunk region, during the inundation period. Spiders of the next generation mature at the beginning of the new emersion period (subadult females were taken in October). Comparison of day and night collections indicates that the species is active only at night.

Tricongius amazonicus males appeared immediately when the forest floor emerged in September and showed high activity on the surface (detected by pitfall catches) during this time (presumably the reproductive period). The only females were collected in October, and only a few weeks later the first juveniles appeared. Highest activity on the

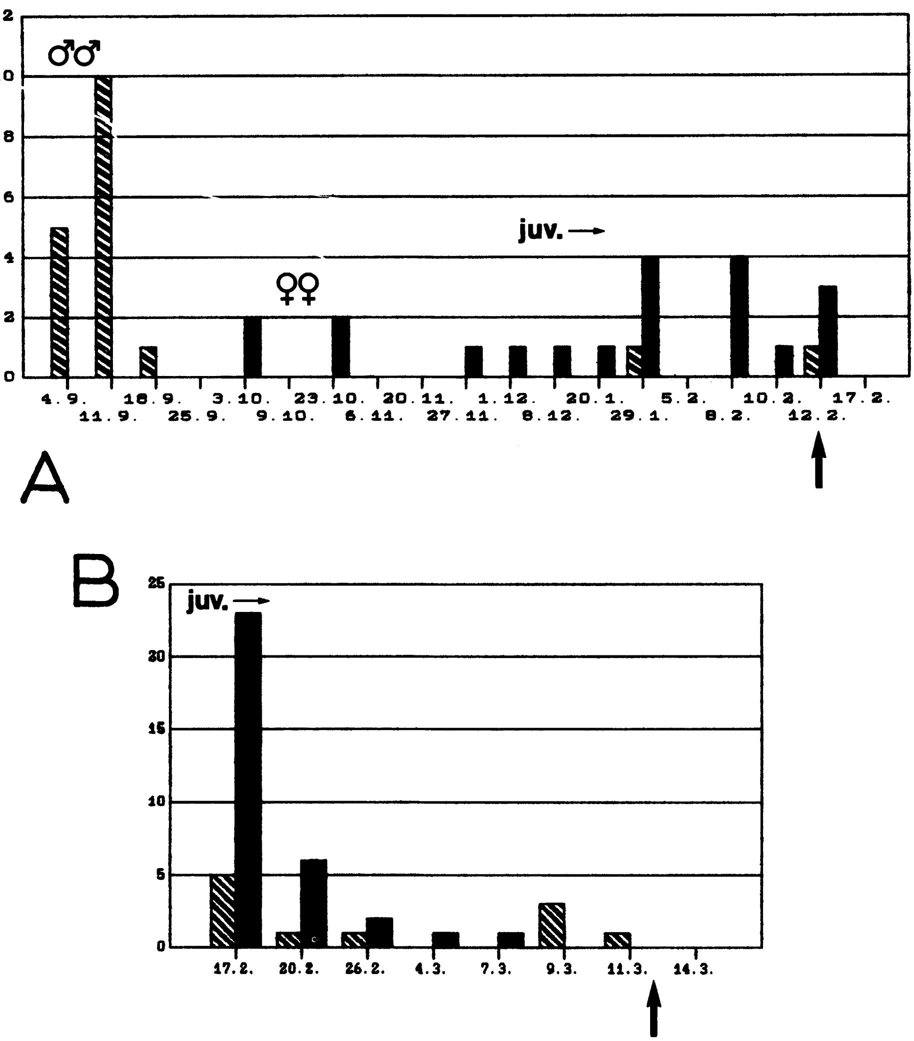


Fig. 25. Activity density of *Tricongius amazonicus*, new species, on the ground during the emergence period of September 1987–March 1988; hatched bars show the numbers of specimens captured in a circular pitfall trap without an imitation tree trunk, black bars show captures of the same trap type with an imitation trunk; arrows indicate the date of inundation of the forest floor around the trap. **A.** Lower igapó. **B.** Upper igapó.

ground was observed during February (figs. 25A, B). Total capture and dominance values (i.e., percent of total specimens collected) were higher for the traps equipped with imitation tree trunks, and trunk ascents were detected by captures in the arboreal photoeclectors (table 1; figs. 26A, B) and were observed in situ. The spiders were active both day and night; in the upper igapó only, there is higher activity in the sectors of the pitfall traps nearest the waterside.

Thus, *T. amazonicus* appears to mate, on the ground, at the beginning of the noninundated period; adults probably die afterward but the spiderlings respond directly to the actual inundation by vertical migration. During the last days before the floor was completely inundated, 10–38 individuals/m^2 were taken in ground photoeclectors and 9–22 individuals/trunk were taken in arboreal photoeclectors (the maximal values during the noninundated period were 0–1 individuals/

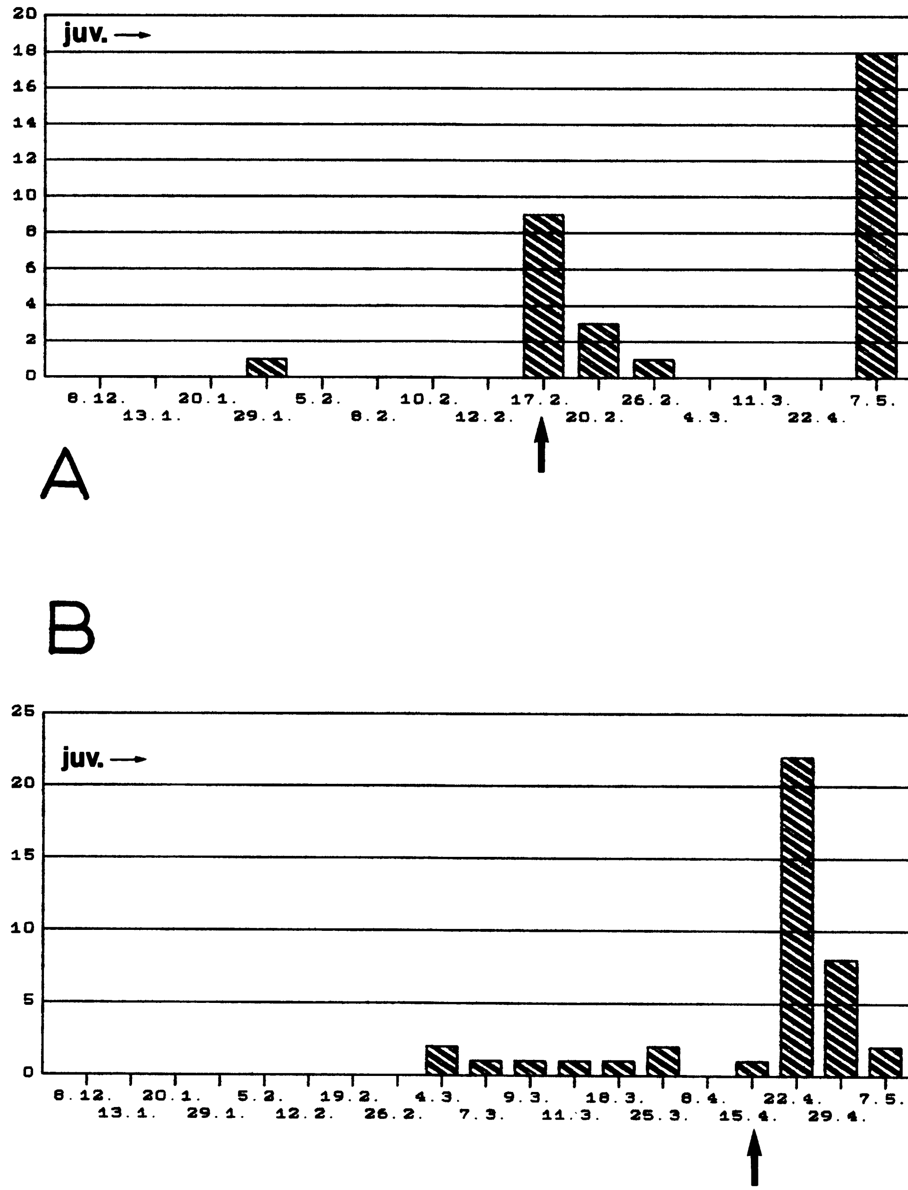


Fig. 26. Activity density of *Tricongius amazonicus*, new species, on tree trunks during the period of December 1987–May 1988, showing the numbers of upwardly migrating specimens captured in arboreal photoeclectors situated at a height of 3 m; arrows indicate the date of inundation of the trunk base. **A.** Lower igapó. **B.** Upper igapó.

m² and 1–2 individuals/trunk). Even higher numbers (40, and 90, individuals/trunk) were collected in arboreal photoeclectors by Dr. J. Adis in 1983 and 1984, respectively. Captures in a double arboreal photoeclector used in 1984 indicate that a considerable number of these spiders managed to surmount the lower trap, suggesting that the total number of spiders migrating is probably higher than these figures indicate.

Table 2 shows manual captures below a barrier of adhesive around the lower trunk

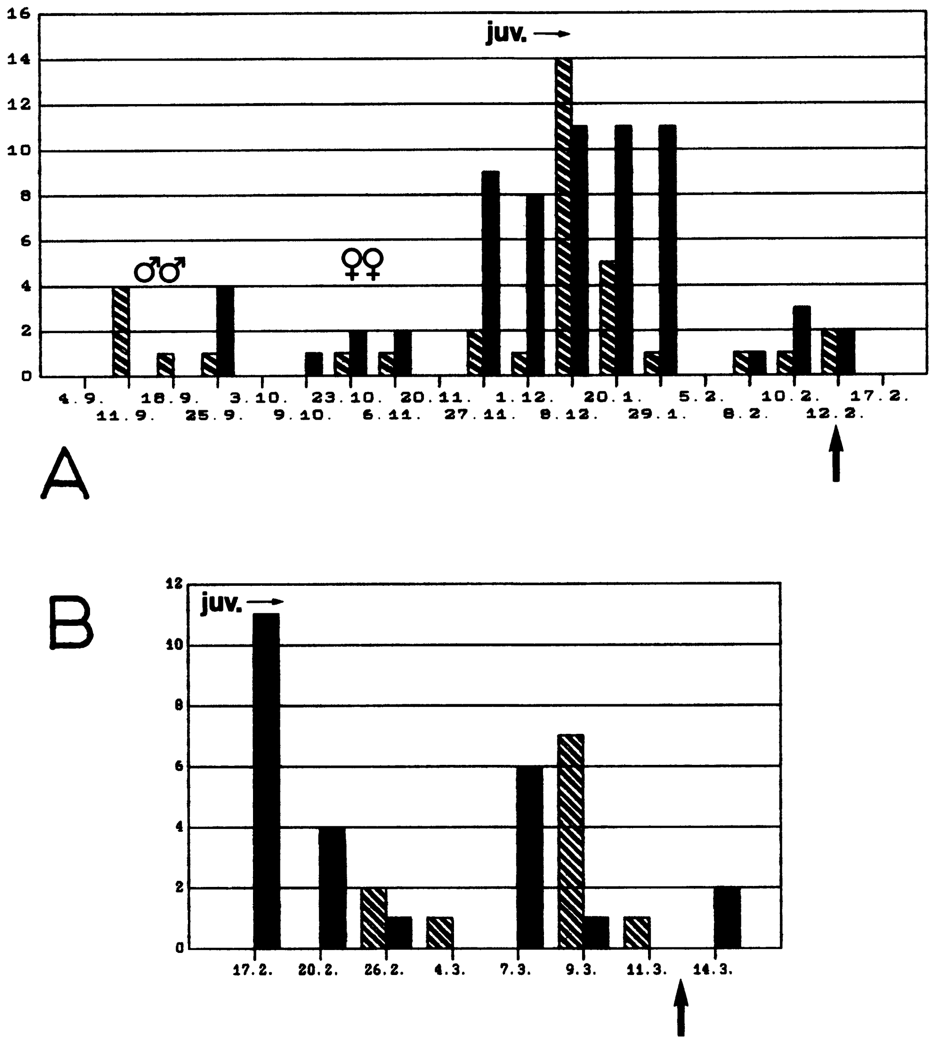


Fig. 27. Activity density of *Camillina taruma*, new species, on the ground during the emergence period of September 1987–March 1988; hatched bars show the numbers of specimens captured in a circular pitfall trap without an imitation tree trunk, black bars show captures of the same trap type with an imitation trunk; arrows indicate the date of inundation of the forest floor around the trap. **A.** Lower igapó. **B.** Upper igapó.

area of a tree just flooded at the base. Within one hour, up to 20 individuals of *T. amazonicus* migrated upward. Hence it appears that the spiders move out of the litter just before it is flooded; they often climb small structures such as leaves or branches and reach dry ground by ballooning (which was observed in this species). At least some of them remain in the lower trunk region until the water arrives (note the second peak in figure 26A, when the trap at 3 m height was flooded). Probably the juveniles mature in the trunk/canopy region and recolonize the ground in August or September; recolonization is probably initiated by high leaf-fall and strong insolation (Adis, 1984). Although various species of Pisauridae have been observed walking on the water surface, none of the gnaphosids have been seen doing so.

The phenology of *Camillina taruma* re-

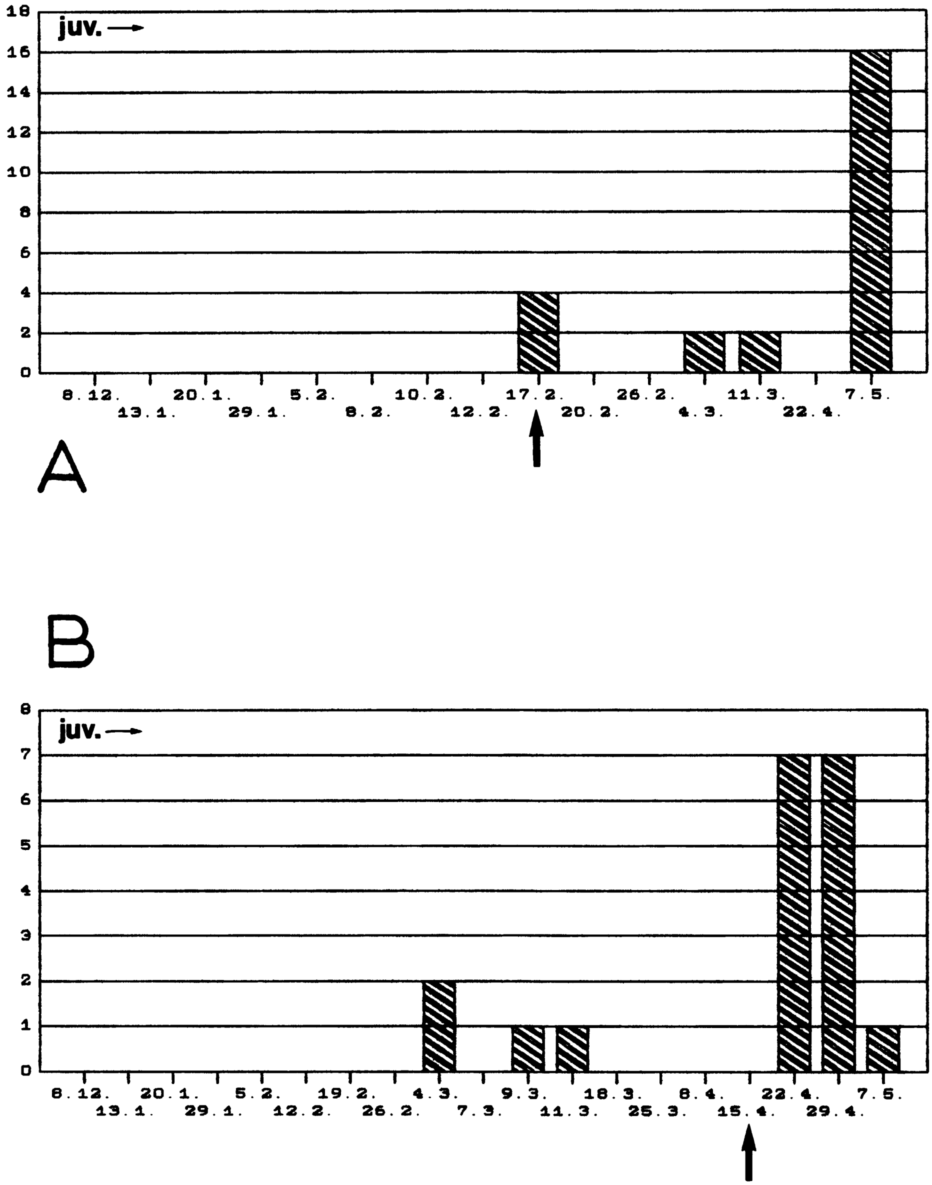


Fig. 28. Activity density of *Camillina taruma*, new species, on tree trunks during the period of December 1987–May 1988, showing the numbers of upwardly migrating specimens captured in arboreal photoeclectors situated at a height of 3 m; arrows indicate the date of inundation of the trunk base. **A.** Lower igapó. **B.** Upper igapó.

sembles that of *T. amazonicus*, showing the same reactions to the inundation. Reproduction takes place in September or October, on the ground. The highest activity of juveniles of the next generation appeared during December and January at the lower site and during February at the upper site (figs. 27, 28). The species was attracted by the imitation tree trunks (table 1) and was always captured in higher numbers in that part of the trap closest to the waterside. Hence we suppose that the juveniles start to move rela-

TABLE 2
Manually Collected Spiders
(Numbers collected in the lower trunk area of a small tree, girth 60 cm, immediately after inundation of its base.)

Date	Time	*C. taruma*	*T. amazonicus*	Other spiders
3.X.1987	11:50	2	4	5
	12:50	6	10	3
	14:00	11	22	4
3.XII.1987	10:30	20	7	7

tively early (two months before inundation) to the base of trunks, and climb higher when the water reaches those spaces. Like *T. amazonicus*, this species was observed and captured during both day and night, and the two species were seen together on trunks (table 2).

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