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Flight Activity of Belostomatidae in Central Ivory Coast

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Summary. Five species of Belostomatids were caught in a light trap placed in a tree savanna 3 km distant from a small artificial lake in central Ivory Coast. Only *Diplonychus nepoides* Fabr. was fairly abundant.

The flights of this species present a well-marked lunar rhytmicity: 79% of the catches occur during the fortnight around full moon. Rainfall does not seem to be an important factor. A highly significant, positive correlation has been found between the number of trapped bugs and nocturnal temperature.

The attractivity of light for Belostomatidae is well known but few data for catches by light trap are available. Southwood (1960) and Bowden (1964) in Ghana, and Cullen (1969) in Trinidad are the only authors to give a full description of their catches. During a3-year period, we have used a light trap in Ivory Coast (West Africa). Belostomatidae represented an important part of the catches of insects (up to 395 on December 1, 1971, and 400 on November 18, 1972, *Diplonychus nepoides* trapped in one night). Seasonal variations in flight activity, influence of phases of the moon, and influence of nocturnal temperature on flights are described for the commonest of the five species.

Locality

The light trap was set up on the territory of the I.R.C.T. experimental farm in Foro-foro (4°55 W, 7°55 N, height 290 m) in central Ivory Coast in a tree savanna area crossed by semi-deciduous gallery forests (Duviard, 1971). The regional climate is a transitional type between forest guinean type with two rainy seasons, and sudano-guinean type with a single rainy season (Romuald Robert and Bouchy, 1965; Duviard, 1973b). Rainfall data obtained from Foro-foro during the period in question (September 1970—August 1973) are given in Fig. 1. Duviard (1973a, b) and Duviard and Mercadier (1973) present more complete information on this subject.

Light Trap

A Jermy light trap (Gagnepain, 1969; Le Berre, 1969; Duviard, 1972, 1973a), with a Phillips HPL 125 bulb was illuminated from 18.30–06.30 h (local time) 2 nights each week for 3 years (electricity supplied by a generator). The trap was placed in the meterological station, situated in a recently cleared tree savanna on the upper part of a well-drained slope. The nearest thalweg was lined by a gallery forest. The nearest river (M'bé) runs eastwards, about 3 km south of the trap. A dam creates a permanent lake where Belostomatids have been found. The vegetation of such a biotope is described in Avenard *et al.* (1971). A few km to the west the valley of the M'bé is occupied by permanent, inundated rice fields.

Taxonomic Inventory

The catch comprised 2148 Belostomatidae belonging to 5 different species:
Diplonychus nepoides (Fabr. 1803): 2085 specimens
Diplonychus procera (Gerst. 1873): 49 specimens
Diplonychus ampliata (Bergr. 1890): 12 specimens
Hydrocyrius columbiae (Spinola, 1852): 1 specimen
Lethocerus cordofanus (Mayr., 1852): 1 specimen.

These data should be compared with those of Bowden (1964), trapping in Kwadaso (6°40 N), Ghana; in this locality, situated in the semi-deciduous rain forest belt, the author trapped only 2 species during his 2-year experiment:

Sphaerodema severinii (Melichar) = *Diplonychus procera* (Gerst.): 454 specimens

Lethocerus niloticus (Stål.): 33 specimens.

The relative importance of the species in the two localities is quite different. Table 1 shows the monthly distribution of catches during the 3-year trapping period: There is at least one important flight period during the year that cannot be associated with any particular season.

Table 1

	S	O	N	D	J	F	M	A	M	J	J	A	Total
D. nepoides													
1970–1971	95	3	65	64	21	141	224	2	23	41		3	682
1971–1972	188	32	46	430	34		10	24	29			23	814
1972–1973	2	68	481	9		5	7	5	3	5	2	1	589
D. procera													
1970–1971	1			1			4	3	6	2			17
1971–1972	2	4	12	2				2				1	23
1972–1973		7	1									1	9
D. ampliata													
1970–1971													0
1971–1972				2								1	3
1972–1973		7	2										9

H. columbiae =1 (XII.72).
L. cordofanus=1 (XII.72).

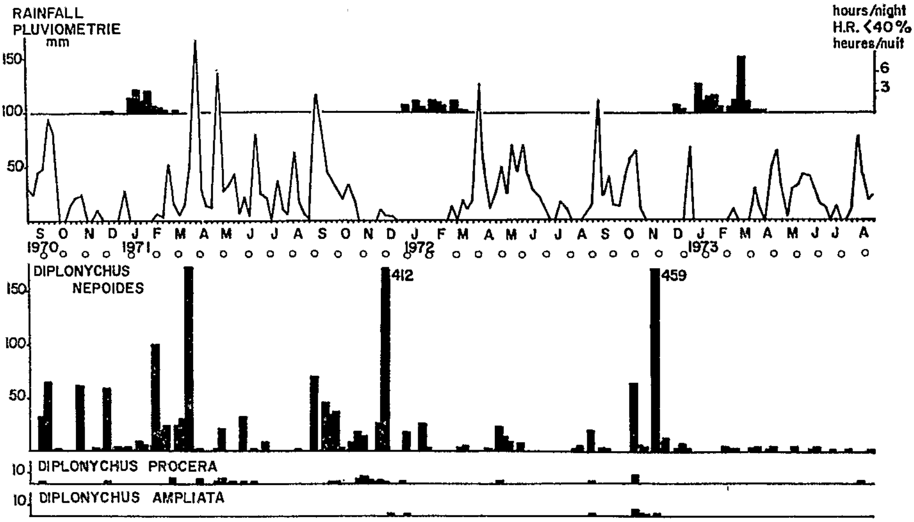

Fig. 1. Weekly catches of 3 species of Belostomatids in the light trap at Foro-foro and weather data: rainfall (mm/week) and relative humidity under 40% (h/night). Full moon periods (o) are indicated

Table 2

1 week before 1 week after	Full moon	New moon
Total of 3 years catches	79%	21%
Total of catches (excluding the week April 22–29, 1971)	86%	14%

Flight Activity of Diplonychus Nepoides

Influence of Moon Phases

Bowden (1964) and Cullen (1969) have shown the influence of full moon on the flight activity of Belostomatids, as well as the part played by rainfall. Dispersal flights occur mainly during the few nights that precede or follow the full moon and their importance then depends directly on rainfall. Weekly catches of the 3 *Diplonychus* species, as well as weekly rainfall and full moon periods are shown in Fig. 1. The moon-dependent activity rhythm is easily visible. For *D. nepoides*, the importance of catches around full or new moon is presented in Table 2: 79% of catches occur during the fortnight around full moon. Excluding the anomalous results of trapping during the new moon period of April 1971, the percentage of full moon catches is 86%. These values are very similar to those reported by Bowden and Cullen. Lunar periodicity of flights is thus quite clear for *D. nepoides*, and also seems evident for *D. procera* and *D. ampliata*, despite the much smaller catches.

Influence of Rainfall

Fig. 1 does not clearly show the influence of rainfall on flight activity of *D. nepoides*. We used Spearman's rank correlation test to correlate numbers of trapped bugs and rainfall during the 35 full-moon fortnights. Data and calculated are given in Table 3. Spearman's rank coefficient is calculated according to the formula:

$$R = 1 - \frac{6\,\Sigma\, d^2}{n^3 - n} = 0{,}19.$$

The significance of R has been assessed according to Student's distribution with $n - 2 = 33$ degrees of freedom according to the formula:

$$t = R\sqrt{\frac{n-2}{1-R}} = 1{,}12.$$

Table 3

Catches		Rainfall		Catches		Rainfall	
Number	Rank	mm	Rank	Number	Rank	mm	Rank
57	28.0	95	29.0	0	3.5	11	16.5
2	9.0	0	6.0	24	23.0	97	30.0
61	30.0	0	6.0	5	16.5	82	27.0
59	29.0	0	6.0	0	3.5	106	32.0
4	13.5	0	6.0	0	3.5	12	18.0
109	33.0	10	14.5	19	20.5	0	6.0
50	27.0	15	20.0	0	3.5	147	34.0
2	9.0	94	28.0	68	31.0	28	22.0
21	22.0	67	25.0	466	35.0	67	25.0
32	24.0	10	14.5	8	19.0	0	6.0
1	7.0	0	6.0	0	3.5	67	25.0
2	9.0	11	16.5	5	16.5	0	6.0
71	32.0	192	35.0	3	11.5	9	12.5
41	26.0	49	23.0	5	16.5	14	19.0
34	25.0	0	6.0	3	11.5	138	33.0
439	34.0	9	12.5	5	16.5	99	31.0
19	20.5	0	6.0	0	3.5	24	21.0
4	13.5	0	6.0				

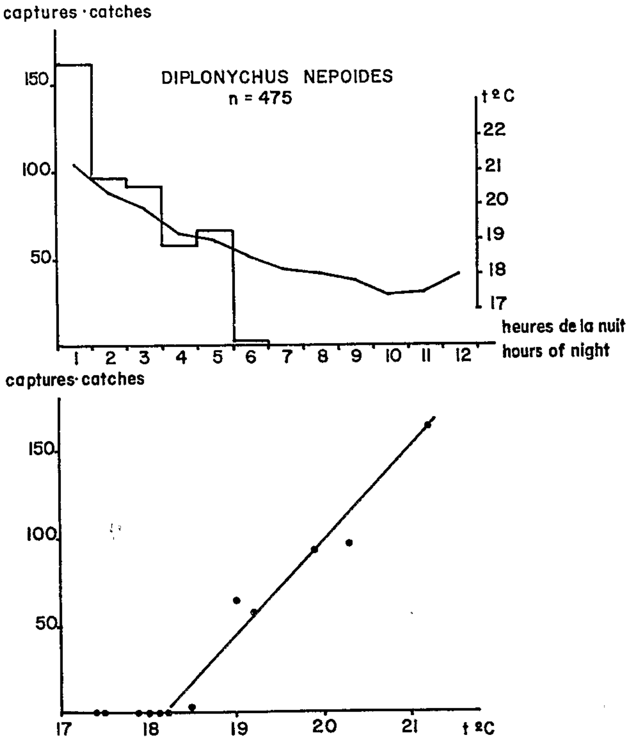

Fig. 2. Top: entry pattern of *D. nepoides* in the light trap and hourly mean temperature during trapping nights (Oct. 25, 1971-Dec. 6, 1971; all nights bulked). Bottom: influence of temperature on number of *D. nepoides* caught

There is a 20–30% chance of being mistaken in asserting the existence of a correlation between the number of catches and the importance of rainfall. This is in complete opposition to the results of Bowden and Cullen.

Influence of Temperature

From October 1971–April 1972 the Jermy light trap was replaced by a similar trap equipped with an apparatus to select the catches in hourly periods (see Duviard, 1973a). The trap operates, as before twice a week from 18.30–06.30 h but the bulb is illuminated for only 50 min in each hour. During the 10-min extinction period–to allow the dispersal of swarming insects (Siddorn and Brown, 1969)–the polyethylene bag in which catches are collected and killed is automatically changed. At the end of the night, 12 bags are available, each representing 1 h of trapping.

During the period from Oct. 25, 1971–Dec. 6, 1971, heavy flights of *D. nepoides* were intercepted by the trap. Fig. 2 shows hourly progress of catches (catches are bulked for all nights) and mean temperature during the trapping nights. During this period relative humidity was near saturation after 18.00 h.

Catches are fairly abundant between 18.30 and 19.30 h, then decrease and after 03.00 h no bugs are caught. The search for a correlation between temperature and number of catches (Fig. 2) shows that the correlation coefficient

$$r = \frac{\Sigma xy - \frac{\Sigma x \cdot \Sigma y}{n}}{\sqrt{\left(\Sigma x^2 - \left(\frac{\Sigma x}{n}\right)^2\right)\left(\Sigma y^2 - \left(\frac{\Sigma y}{n}\right)^2\right)}} = +0.9$$

is highly significant. For $n-2=10$ degrees of freedom Student's coefficient $t=6.7$ is significant at less than 1%. Hence, in the temperature interval considered (17°4–21°C) the flight activity of *D. nepoides* is strictly temperature dependent. Below about 18° flight is inhibited. These results are very close to those obtained by Duviard (1973) for *Dysdercus voelkeri* (Pyrrhocoridae) in Foro-foro and do not differ strongly from those of Southwood (1960), who studied the Heteroptera of temperate climates. Richards (1958) showed that the flight activity of *Lethocerus americanus* Leidy ceased at 10°C.

Discussion

Flight periodicity in *D. nepoides* depends mainly on two exogenous rhythms. The moon-induced rhythm gives the catch curve its typical oscillating appearance but its significance is not well understood. The hypothesis of Cullen (1969) seems the most probable: that the reflection of moonlight on water surfaces would help the flying bugs to find new biotopes. The nocturnal activity rhythm is strictly temperature-dependent. However, this does not account for the strong seasonal fluctuations shown by flight activity. In *D. nepoides* rainfall does not play a decisive part, contrary to what has been observed in other Belostomatid species. Annual rainfall in Foro-foro (about 1200 mm) is less than in Kwadaso (1500mm) or in Trinidad (2160 mm) but if, as Cullen (1969) states, these bugs are particularily responsive to atmospheric humidity, then flight activity at Foro-foro should be more rain-dependent because it is a drier locality. Large catches have been made during the dry season (November, December) but never during the period when the Harmattan wind is blowing. This dry, continental north-east trade wind brings the relative humidity for several hours per day down to below 40% or less (see Fig. 1 for low humidity at night). During these dry, cool nights few bugs are caught.

Nothing is known about the biology of *D. nepoides*, and the annual periodicity of flights is probably connected with the life history of the species. It seems reasonable to consider the flights of these bugs as a migratory dispersal phase (Johnson, 1969; Cullen, 1969), occurring at distinct periods in the life of the imago.

The ability of Belostomatids for long-range flights is confirmed by our results since the light trap is 3 km from the nearest possible biotope.

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