Odonatologica 5 (4): 323-329 *December 1, 1976*

STUDIES ON THE ROOSTING BEHAVIOUR OF *PALPOPLEURA LUCIA LUCIA* (DRURY) AND *ACISOMA PANORPOIDES INFLATUM* SELYS (ANISOPTERA: *LIBELLULIDAE*)

A.T. HASSAN

Entomology Research Laboratory, Department of Zoology,
University of Ibadan, Ibadan, Nigeria

Received March 4, 1975 / Revised and Accepted May 13, 1976

Roosting behaviour was studied in *P. l. lucia* and *A. panorpoides inflatum* between October, 1972 and March, 1974. The roosting postures of the two species were described and compared with their normal perching postures at water. Measurements of the bearings of the insects during roosting indicated that there were no orientational preferences. The dragonflies roosted within the same locality but were not restricted to definite plants. The duration of roosting was slightly longer than the night hours at Ibadan, Nigeria, for all months of the year. It was concluded that light intensity was the overriding factor initiating roosting and the first flight of the day.

INTRODUCTION

Odonate roosting has been described in the U.S.A. by RAU & RAU (1916) and PENN (1950), in Australia by O'FARRELL (1971), and in Nigeria by PARR & PARR (1974), HASSAN (1974) and GAMBLES (1971). Gambles introduced the term "odonate dormitories" when referring to roosting sites. In the present paper, roosting activities are defined as the series of actions which occur from the time when males abandon the aquatic sites for roosting sites until they make the initial flight the next day. These series of actions include (1) flight over water seized, (2) roosting initiation, (3) breaking of roosting with or without pre-flight activities, and (4) the initial daily flight.

Studies on the roosting activities of *Palpopleura lucia lucia* (Drury) and *Acisoma panorpoides inflatum* Selys were carried out at three roosting sites along the Oba stream and dam at the University of Ibadan, Ibadan, Nigeria. Ten

observations were made each month from October, 1972 to March, 1974, except for February, 1974, on at least 25 individuals within the populations under study. Observations were from 16.00 to 19.30 hours on one day and from 06.00 to 08.30 hours on the following day. On each occasion, an activity was performed, air temperature and light intensity were measured; the odonate activities were timed, their compass orientation, distance from water and height at roosting were measured, and the plants used for roosting were recorded.

OBSERVATIONS

PRE-ROOSTING ACTIVITIES

P. lucia lucia left water between 16.20 and 16.46 hours, *A. panorpoides inflatum* between 16.21 and 16.44 hours. At these times light intensities (5274-6243 lux, *lucia*; 5274-6168 lux, *inflatum*) were similar and temperatures were identical (29-32°C) for both species (Tab. I). Referring to odonates of Nigeria in general, HASSAN (1974) stated that the time of leaving water is about 17.00 hours, and PARR & PARR (1974) stated that in Northern Nigeria *Nesciothemis nigeriensis* Gambles left between 15.20 and 16.15 hours.

At the roosting sites, the odonates usually shifted from perch to perch, made occasional feeding flights, and sometimes groomed their heads with their legs and shook their bodies. An occupant reacted to an intruding "late comer" by elevating all 4 wings rather than flying towards the intruder. In 247 of these encounters, occupant *lucia* was displaced in only 5%, *inflatum* in 3% of 174. This contrasts with PARR & PARR's (1974) observation that males of *Nesciothemis nigeriensis* exhibited aggression toward each other at their roosting sites. Mating at the roosting site, recorded by Parr & Parr, was not observed in the present study.

ROOSTING

After a suitable perch had been obtained, slight body movement usually resulted in the assumption of the roosting posture which differed from daytime perching. Moreover, roosting postures differed in the two species (Figs. 1-2). In the roosting *lucia*, the head was held uppermost, the body was at an angle with the perch, and the abdomen drooped downward slightly, the position of the abdomen in relation to the thorax ranged from 119°-154° (mean 135°). In contrast, the abdomen of *inflatum* did not droop.

For perching, both species seemed to prefer a plant with spaces around it, but neither was plant specific. *P. lucia lucia* commonly roosted on: *Sida* spp., *Synedrella nodiflora*, Tridax procumbens *and Eupatorium odoratum*, and on the tendrils of climbers: *Combretum zenkeri, C. peniculatum, Centrosoma pubescens, Pergularia daemia*. Differently, *inflatum* was most commonly associated

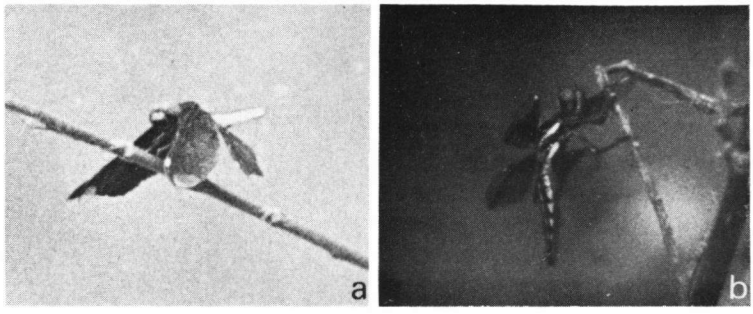

Fig. 1. *Palpopleura lucia lucia* (Drury): (a) perching posture; – (b) roosting posture.

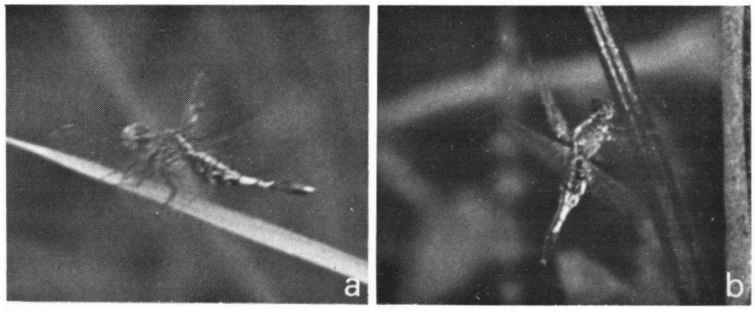

Fig. 2. *Acisoma panorpoides inflatum* Selys: (a) perching posture; – (b) roosting posture.

with grasses: *Cynodon* spp., *Mariscus longibracteatus, Paspalum conjugatum, Panicum maximum* and *Andropogon tectorum*.

The distances from water where roosting occurred varied greatly, 1.2-109.0 metres for *lucia* and 0.4-64.8 metres for *inflatum* (Tab. I). Rarely, a few individuals of both species roosted at the water's edge. Most often, individuals roosted at medium distances from water. The two species also showed no preference for particular roosting heights below 240 cm (Tab. I).

P. lucia lucia began roosting between 18.05 and 18.44 hours, *A. panorpoides inflatum* between 18.14 and 18.48 hours. At these times, light intensities (388-538 lux, *lucia*; 237-527 lux, *inflatum*) were similar and temperatures were identical (24-29°C) for both species (Tab. I). Roosting lasted 11.51 to 13.45 hours in *lucia*, 11.42 to 13.27 hours in *inflatum*. Table II shows that there was no preferred directional orientation for either species at the roosting site.

Table I

The time and duration of roosting activities in *Palpopleura lucia lucia* and *Acisoma panorpoides inflatum* and the temperatures and light intensities at which they occurred

Activities	*lucia*	*inflatum*
Pre-roosting		
Time of leaving water	16.20 - 16.46	16.21 - 16.44
Light intensity (lux)	5274 - 6243	5274 - 6168
Temperature (°C)	29.3 - 32.4	28.6 - 32.4
Roosting		
Time roosting began	18.05 - 18.44	18.14 - 18.48
Duration (hours)	11.51 - 13.45	11.42 - 13.27
Light intensity (lux)	388 - 538	237 - 527
Temperature (°C)	24.0 - 28.6	23.8 - 29.0
Distance from water (m)	1.2 - 109.0	0.4 - 64.8
Height (cm)	20.7 - 237	14.8 - 119.9
Pre-flight activities		
Time	06.27 - 07.12	06.23 - 07.06
Duration (min)	11 - 70	11 - 65
Light intensity (lux)	11 - 258	0 - 183
Temperature (°C)	15.0 - 21.7	14.8 - 21.9
First flight of day		
Time	06.32 - 08.00	06.27 - 07.44
Light intensity when no pre-flight activity occurred (lux)	0 - 32	0 - 21
Light intensity when pre-flight activity occurred (lux)	- 1690	- 1152
Temperature (°C)	17.3 - 25.6	17.1 - 25.2

Table II

Orientation of *Palpopleura lucia lucia* and *Acisoma panorpoides inflatum* during roosting

Species	Number of specimens in the direction								Total
	NNW/NNE	*NNE/ENE*	*ENE/ESE*	*ESE/SSE*	*SSE/SSW*	*SSW/WSW*	*WSW/WNW*	*WNW/NNW*	
lucia	14	15	10	16	16	11	12	16	*110*
inflatum	18	15	17	14	15	12	16	18	*125*

PRE-FLIGHT ACTIVITIES

P. lucia lucia began pre-flight activities between 06.27 and 07.12 hours, *inflatum* between 06.23 and 07.06 hours. At these times light intensities (11-258 lux, *lucia*; 0-183 lux, *inflatum*) were similar and temperatures were identical (15-22°C) for both species.

Pre-flight activities included body shaking, sideways shaking of the head and grooming of the head with the legs, and wing whirling, each interspersed with brief rest periods. These activities removed droplets of dew from the body and probably elevated body temperature in preparation for flight. Pre-flight activities were observed only in dry seasons (Nov.-Dec., 1972 and Nov., 1973-Jan., 1974) when dew formation was common and nights were cool, sometimes below 21°C. Pre-flight activities are undoubtedly adaptations to these atmospheric conditions. In months when pre-flight activities were observed, touching the roosting odonates resulted in either a passive response or a slight flexing of the abdomen, whereas at other periods the odonates flew before they could be touched.

FIRST FLIGHT OF THE DAY

This was always before sunrise. *P. lucia lucia* began the first flight of the day between 06.32 and 08.00 hours, *inflatum* between 06.27 and 07.44 hours. At these times light intensities (0-32 lux, *lucia*; 0-21 lux, *inflatum*) were similar and temperatures were identical (17-25°C) in both species (Tab. I). However, when nights were cool and dew was common, the first flight was delayed by pre-flight activities and occurred at higher light intensities (up to 1690 lux for *lucia* and 1152 lux for *inflatum*). After the first flight, the insects remained within their roosting sites, flying from perch to perch, until they went to water at about 09.00 hours. In northern Nigeria, PARR & PARR (1974) state that *Nesciothemis nigeriensis* first comes to water between 10.00 and 11.00 hours whereas males of *Brachythemis wilsoni* Pinhey were observed at water as early as 06.30 hours.

DISCUSSION

According to CORBET (1960), light intensity and temperature are likely to influence rhythmical and circadian roosting behaviour in dragonflies. In the present study, field observations and laboratory experiments indicate that light intensity is more important. Although there was no appreciable drop in temperature from pre-roosting to roosting periods, early individuals did not roost immediately upon obtaining a suitable perch but late individuals did. O'FARRELL (1971) observed the same behaviour in *Austrolestes annulosus* (Selys) and *A. leda* (Selys); GAMBLES (1971) also observed this behaviour in *Lestes virgatus* (Burmeister). In the laboratory, roosting *lucia*, kept in a glass cage at 25-30°C, began to fly about as soon as the laboratory lights were switched on; electronic camera flashes also caused spontaneous disturbance of roosting postures in 17 out of 22 *lucia* and in 9 out of 15 *inflatum*. PENN (1950), working with *Libellula needhami* Westfall and *Pachydiplax longipennis*

(Burmeister), concluded that light is the primary factor determining the nocturnal behaviour of odonates. His conclusion contrasts with the findings of RAU & RAU (1916) that odonates are indifferent to strong light after roosting.

If no other factor intervenes, it seems that light intensity is the overriding factor determining the time roosting is initiated and perhaps the time daily initial flight occurs. When pre-flight activities did not precede initial daily flight, the latter occurred when light intensities were very low (Tab. I). CLOUDSLEY-THOMPSON (1960) stated that light acts as a "master factor" in arthropods and only when it rises above, or falls below, certain threshold values do other factors such as temperature and humidity exert an effect.

Dew must be removed from the body of *Austrolestes annulosus* before flight can occur (O'FARRELL, 1971) and pre-flight activities are essential to the first flight of each day in *Libellula quadrimaculata* L. (Moore, *in* CORBET, LONGFIELD & MOORE, 1960). In both cases the ambient temperatures were low. In the humid tropics where dew formation occurs mostly during the dry season, pre-flight activities during this season were essential to the first flight each day in *lucia* and *inflatum*.

The duration of roosting was always slightly longer than the average monthly night hours at Ibadan (Tab. III). Furthermore, the duration was longer in the dry season (11.53-13.45 hours for *lucia*, 11.51-13.23 hours for *inflatum*) than in the wet season (11.51-11.58 hours for *lucia*, 11.42-11.56 hours for *inflatum*). Roosting began earlier in the dry season (18.05-18.22 hours, *lucia*, 18.14-18.22

Table III

Night hours at Ibadan and total hours[1] of roosting in *Palpopleura lucia lucia* and *Acisoma panorpoides inflatum*

Month	Night hours[2] at Ibadan	Total hours of roosting in	
		lucia	*inflatum*
January	12.4	12.38, 13.70	12.22, 13.38
February	12.2	12.17, -	12.07, -
March	12.0	12.07, 12.08	11.98, 11.95
April	11.8	11.88	11.90
May	11.5	11.95	11.90
June	11.3	11.85	11.77
July	11.4	11.88	11.70
August	11.6	11.93	11.81
September	11.9	11.97	11.93
October	12.1	11.98, 12.23	12.05, 11.93
November	12.4	12.35, 12.40	12.32, 12.27
December	12.5	13.52, 13.75	13.27, 13.45

[1] Minutes calculated as percentage of an hour.
[2] Night hours were calculated from day-length data, cf. OGUNTOYINBO, 1972.

hours, *inflatum*) than in the wet season (18.36-18.44, hours, *lucia*, 18.36-18.48, hours, *inflatum*), and light intensities were slightly higher in the dry season. This may be related to the shorter dusk and dawn periods occurring during the dry season.

When in roosting postures, the bodies of both species formed acute angles with the perches, heads uppermost. On the other hand, O'FARRELL (1971) observed that in *Austrolestes annulosus* and *A. leda* the head is downward, buried in the cushion of *Juncus* sp. inflorescence, its roosting perch, and the body is tilted upward to form an obtuse angle with the perch. GAMBLES (1971) reported that *Lestes virgatus* roosted in associations, night after night on one particular plant for about two weeks. In contrast, both *lucia* and *inflatum* roosted individually, and were not restricted to any one particular plant or spot. Although Moore (*in* CORBET, LONGFIELD & MOORE, 1960) stated that *quadrimaculata* maintains a directional orientation to the sun, neither *lucia* nor *inflatum* maintained any one compass orientation.

ACKNOWLEDGEMENTS

The author is indebted to Professor S. AFOLABI TOYE, Department of Zoology, University of Ibadan, Nigeria who supervised this project. Many thanks to Professor G.H. BICK, Biology Department, St. Mary College, Notre Dame, Indiana, U.S.A. for his valuable criticism of the original manuscript.

REFERENCES

CLOUDSLEY-THOMPSON, J.L., 1960. Adaptive functions of circadian rhythm. *Cold Spring Harbor Symp. quant. Biol.* 25: 345-355.

CORBET, P.S., 1960. Patterns of circadian rhythms in insects. *Cold Spring Harbor Symp. quant. Biol.* 25: 357-360.

CORBET, P.S., C. LONGFIELD & N.W. MOORE, 1960. Dragonflies. Collins, London.

GAMBLES, R.M., 1971. Dragonfly dormitories. *Niger. Fld.* 36 (4): 166-170.

HASSAN, A.T., 1974. Studies on the ecology, behaviour and life-history of libelluline dragonflies. Ph.D. Thesis, Univ. of Ibadan.

O'FARRELL, A.F., 1971. Roosting and related activities in some Australian zygoptera. *J. Ent.* (A) 46 (1): 79-87.

OGUNTOYINBO, J.S., 1972. The radiation balance over natural and agricultural vegetation surfaces in Nigeria. Ph.D. Thesis, Univ. of Ibadan.

PARR, M.J. & M. PARR, 1974. Studies on the behaviour and ecology of Nesciothemis nigeriensis Gambles (Anisoptera: Libellulidae). *Odonatologica* 3 (1): 21-47.

PENN, G.H., 1950. Observations on the nocturnal habits of adult dragonflies. *Proc. ent Soc. Wash.* 52: 88-90.

RAI, P. & N. RAU, 1916. The sleep of insects. An ecological study. *Ann. ent. Soc. Am.* 9: 227-274.