

PRELIMINARY RESEARCH NOTE

**MACROMIA ILLINOIENSIS WALSH MALES
USE SHADE BOUNDARIES AS LANDMARKS
(ANISOPTERA: MACROMIIDAE)**

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M. illinoiensis ♂♂ were most actively engaged in territory patrolling during noon. They were observed to avoid areas on the water surface that were shaded. Areas on the water surface that were not avoided by ♂♂ were artificially shaded upon which such areas were avoided. It is concluded that ♂♂ of *M. illinoiensis* may use the shade-sun boundary on the water surface as a cue of its territory boundary.

INTRODUCTION

Many odonate species are territorial and among those males of several species patrol within their territories. One of the suggested functions of patrol flight is “probably to monitor the distribution of neighboring conspecifics” (PARR, 1983; CORBET 1999). If neighbouring conspecific males would determine the size of the patrolled area, i.e. the territory size, territory size would, and indeed does, decrease with increasing population density (e.g. CORBET, 1999) (but see CORBET 1999 for a review of a fixed territory parameter: size). However, in many cases, males patrol spatially distinct areas even if no neighbouring conspecifics are present. This suggests that males use cues other than conspecific males to define the boundary of their territory. There seems to be little information on what cues males use to recognize the boundary of their territory if conspecifics are absent. In the following I present observations suggesting that *Macromia illinoiensis* males use the boundary of a shaded area as such a cue.

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METHODS

Observations were carried out during several days in June and July of 2001 at Timber Creek in the Funk's Grove area (40°21'30"N, 89°06'52"W), between road no. 600E and 700E, Mc Lean County, Illinois, USA. The stream was 3 to 7 m wide and the water level varied between 30 and 70 cm above a sandy substrate. The observer either stood in the stream bed or on a bridge circa 5 metres above the water and observed *Macromia* individuals using a binocular. Three *Macromia* individuals were captured and identified as *M. illinoensis* using NEEDHAM et al. (2000). I, therefore, assume that all observations of *Macromia* apply to *M. illinoensis*.

I studied at what time of day *M. illinoensis* were most active: Once in every minute I was present at the stream I recorded the number of *M. illinoensis* individuals. All times are given as local times.

At various days and various times of the day I sketched the flight path of flying males in relation to the shadow boundaries from the surrounding trees or the bridge. I attempted to quantify whether males use shadows as borders for their patrolling flights. I chose three adjacent 1 m-wide strips situated in a row of 3 m length. The area nearest to the bridge (A1) was situated just in the bridge shade bordered by the central area (A2) and the area farthest from the bridge (A3). At the time of highest *Macromia* activity (i.e. between 11 and 14 h – see Results) I counted the number of times males returned on their patrol flights in each of the areas during a period of three hours on 17 June. On 24 June I repeated these observations for about two hours. Immediately thereafter I enlarged the shade on the water surface from A1 to A2 for about one hour using a rod with attached curtains. Again I counted the number of returns in each of the areas.

If male *M. illinoensis* use shadow lines as a landmark for their patrolling flight paths as appeared from the route of the flight paths (see Results) I expected males to return in front of, rather than in, the shadow thrown by the bridge. I also expected a similar proportion of returns on either side of the shade-sun boundary before and after the shade manipulation. In other words, if males used a fixed boundary as a landmark (e.g. the bridge itself) similar return ratios should be observed in the areas A1 to A3 before and after artificial shading. If shade boundaries were used as a landmark for patrolling flights the return ratio in A1:A2 before the shading should be similar to the return ratio in A3:A2.

RESULTS

FLIGHT ACTIVITY

During 258 minutes in which I recorded the presence of *M. illinoensis*, males were present during 0%, 7%, 40% and 0% of my observation time in the periods 8-10 h, 10-12 h, 12-14 h, and 14-16 h local time (total time *M. illinoensis* observed: 70 min.), respectively. Only during the 12-14 h period were two or three males simultaneously present. Out of 46 flying insects that were approached by patrolling males eight were heterospecific: a large wasp, gomphids, *Calopteryx maculata* males and *Plathemis lydia*. Coenagrionidae and *Epitheca princeps* were never seen to be approached. In the 38 flights towards other *M. illinoensis* males (83%) the approaching individual was never seen to physically clash with the approached one. If two males would face each other an upwards spiralling flight was observed in which, however, the contestants did not touch each other (N = 3 observations).

PATROL FLIGHTS IN RELATION TO SHADE

The patrol flight took place ca 15–30 cm above the water surface. Its path was in the middle of the stream and shadows on the water surface were largely avoided (Fig. 1).

For two days, Figure 2 reports the number of flight returns. Natural A1:A2:A3 return ratios were 10%:83%:7%, 9%:68%:23% and 89%:11%:0% and, therefore, relative inconsistent to one another. By contrast, the return ratios of A2:A3 before shading (93%, 75%) were similar compared to A1:A2 after experimental shading (83%) (Fig. 2).

DISCUSSION

The present observations show several characteristics that suggest that I indeed observed a patrol flight rather than any other flight type: low flight, the large size of river stretches covered, abrupt returns, hovering periods (not quantified in the present study), and high aggression towards con- and heterospecific individuals (for *Macromia* see e.g. LIEFTINCK, 1965; SCHUTTE & SUHLING, 1997; REINHARDT & SAMIETZ, 2003; see CORBET, 1999 for general characteristics). The present observations showed that male *M. illinoensis* largely avoided entering the shade during such patrol flights.

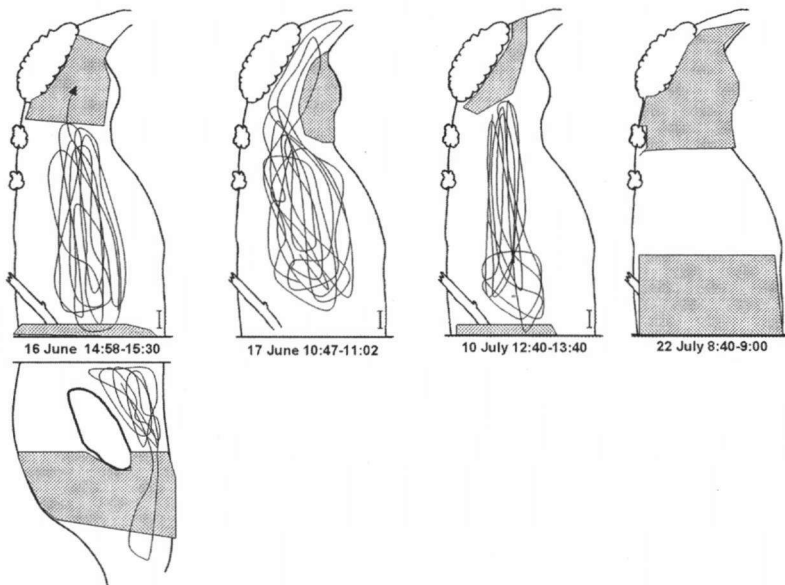


Fig. 1. Summary of flight paths of *Macromia illinoensis* males at four days and different times of day in 2001. Grey areas denote shaded areas. The scale bar is 1 m. The top of the drawing is north. Only on 16 June were patrolling male *M. illinoensis* observed south of the bridge.

A1	ca.5	2	8
A2	40	15	1
A3	3	5	0
	17 June	24 June	24 June

Fig. 2. Flight returns in relation to shading on two days in 2001. Shaded areas are grey. Area A3 represents the natural bridge shade, area A2 was artificially shaded. Each area was approximately 1m \times 3m.

The return ratios in the A2:A3 fields were all similar and no conclusion could be drawn upon any site preference. However, I also recorded the number of returns in A1. If A2 was artificially shaded the number of A1:A2 returns were much more similar to the unmanipulated A2:A3 returns. Because of the avoidance of previously unavaoided areas it may be concluded that the shade itself rather than other habitat cues alter male return flights, even within a short time. I conclude that such shade avoidance is responsible for the different flight paths during different times of day.

I have not found many previous records on boundary cues that odonate males use in their territory. CORBET (1999) lists several species defending sun spots in forests. Because such sun spots were moving with the course of the sun this indicates that odonates can recognize boundaries between shade and sun in forests. With regard to such boundaries on the water surface, MILLER & MILLER (1985 and references therein) found that *Boyeria irene* males were hovering in front of shaded parts of the river bank. However, it was not clear whether indeed the shade boundary was used because such shaded parts of the river banks are the sites where females oviposit and which have a host of other characteristics (WILDERMUTH, 2000). It is noteworthy, that in a European representative of the same genus, *Macromia splendens*, males avoid shaded areas during their patrol flights (SCHÜTTE & SUHLING, 1997). It is possible that in *Macromia*, and by extension perhaps in other Anisoptera, the boundary between light and shade generally represent a landmark for patrolling males.

My observations suffered a major shortcoming and should be considered preliminary for two reasons. First, I was unable to reveal exactly how many males contributed to the counts of the flight returns, Second, I was unable to demonstrate that the manipulation of shade boundaries was effective within an individual. The males I collected were rapidly replaced by others indicating a certain degree of inspection between territories (see also KENNEDY, 1915 for a similar observation in *Macromia magnifica*). If for some reason I had observed a certain group of males before the experimental shading but another group of males after it, my observations may merely reflect differences between males in the distance by which males return before the shade boundary rather than responses to shade. While this scenario seems less likely because the two unmanipulated counts were similar to each other it is presently impossible to exclude such a possibility.

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