

PRELIMINARY RESEARCH NOTE

**A PRELIMINARY STUDY OF THE POPULATION DYNAMICS OF  
*ORTHETRUM J. JAPONICUM* (UHLER) IN PADDY FIELDS  
(ANISOPTERA: LIBELLULIDAE)**

M. WATANABE

Department of Biology, Faculty of Education, Mie University,  
Tsu, Mie 514, Japan

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The mark-and-recapture method was applied. Both males and females left the study area immediately after emergence. They stayed along the periphery of the forests in the hills until they attained the reproductive stages. When they became mature, they returned to the paddy fields. The mean longevity of males was considered to be at least 20 days. In the paddy fields, mature males showed territorial behaviour, whereas mature females remained in adjacent bushes. The extent of the territory was calculated as about 5 X 5 m by the estimated density. Movements between hills and paddy fields were considered to be important for the life history in this species.

INTRODUCTION

The Japanese skimmer, *Orthetrum j. japonicum*, is a univoltine dragonfly inhabiting mainly paddy fields of the warm-temperate zone of Japan. It overwinters in the last instar stage of larvae. The imagoes are found from April and disappear in June in central Japan. Except for tentative life history studies and occasional observations (e.g. ROKUYAMA, 1966; ISHIDA, 1976; MIZUTA, 1982), little is known about this skimmer, though *Orthetrum* spp. seem to be important predators of insect pests in paddy fields (BAN & KIRITANI, 1980).

This paper reports some results of a preliminary mark-and-recapture study made on the adults in 1984.

## STUDY AREA AND METHODS

The study area (ca 20 ha) was located in Chisato, Tsu, Mie Prefecture. There are paddy fields surrounded by hills of secondary forests. Ten study plots were chosen: five were in the paddy fields and the others were in the hills, in order to take into account topographic factors.

The censuses were made at intervals of 3 days from 27th April to 5th July. At each sampling, all the adults found during one hour at a plot in a day were captured by a net, anesthetized by carbon dioxide, and then, marked individually on their hind wing with a felt pen. The degree of worn wing conditions as well as the colour of the abdomen was recorded in order to obtain information on ageing. The colour of the abdomen in mature individuals has been described by ISHIDA (1976). Every skimmer captured was released at the same study plot immediately after recording. The skimmers wounded by marking, if any, were treated as dead individuals in this study. The total number of adults captured was about 200 and the number of adults released was 115 in males and 81 in females.

## RESULTS AND DISCUSSION

The emergence of *O. japonicum* was observed in the study paddy fields from 27th April, 1984. No discrepancy of the emergence period between the sexes was found (Fig. 1). The emergence lasted to early May. They seemed to leave the paddy fields immediately after emergence, because teneral individuals were not recaptured in the same paddy fields. Instead, they tended to stay along the periphery of the forests in the hills, where they did not show any territorial behaviour. They seemed to attack exclusively small insects there, though LARSEN (1981) described the behaviour of *O. austeni*, as a predator of butterflies away from water. The proportions of mature individuals captured in the hills gradually increased with time. When they attained sexual maturity, they returned to the paddy fields for repro-

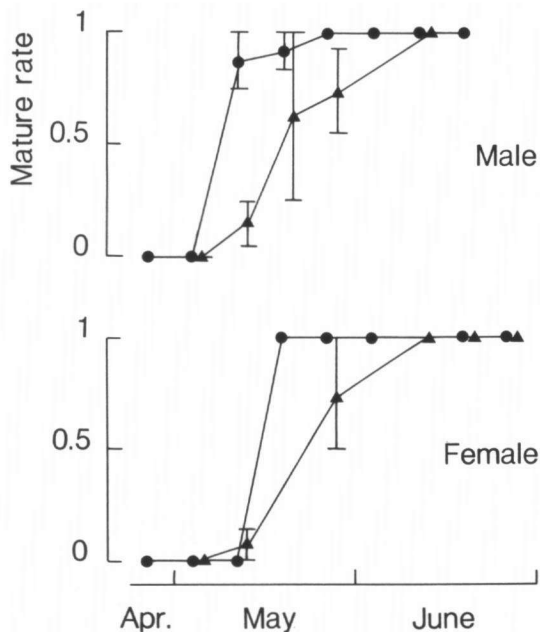


Fig. 1. Change in the proportions of mature individuals to the total number of captures. A circle represents the rate in the paddy fields and a triangle represents the rate in the hills ( $\pm$  s.e.).

duction. However, the paddy fields were occupied mainly by mature males which showed territorial behaviour, because mature females spent much time in the bush adjacent to the paddy fields. The proportions of mature individuals in the paddy fields abruptly changed from zero to unity, when adults returned after maturation.

Although I did not recapture the teneral individuals which moved from the paddy fields to the hills, 4 out of 42 immature males marked in the hills were found in the paddy fields after they became mature. No immature female marked in the hills was recaptured in any paddy fields.

Survival rates of the males were estimated by the Manly & Parr method (MANLY, 1971). The mean daily survival rate ( $S$ ) was 0.953, assuming a constant rate of survival throughout the stages. Then, the mean longevity of the male ( $L$ ) was 21.3 days by the equation:  $L = 1/(1-S)$ . On the other hand, the mean duration between the first and the last capture days were calculated from the individuals recaptured at least twice in the study area. The durations were estimated as  $9.0 \pm 4.0$  days and  $11.2 \pm 2.2$  days in immature and mature stages of the males, respectively, while  $9.5 \pm 5.5$  days in mature females. If the number of elapsed days in each stage was used as an estimate of life span, the average life span of the male was considered to be at least about 20 days, which was similar to the former value.

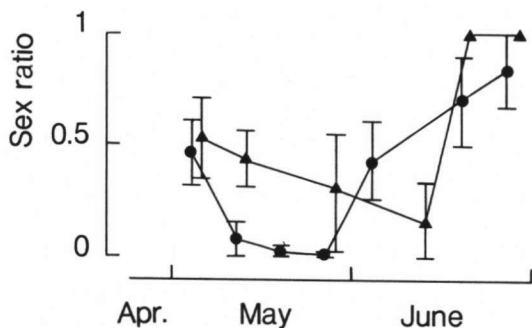


Fig. 2. Sex ratios ( $\text{♀}/\text{♂}+\text{♀}$ ) calculated from the total number of captures. A circle represents the ratio in the paddy fields and a triangle represents the ratio in the hills ( $\pm$  s.e.).

Male population density at one study plot (ca 4200 m<sup>2</sup>) in the study paddy fields was also estimated as 1-2, 7-15, 19-22, 14 and 14-1, in early May, mid May, late May, early June and mid June, respectively, by the Manly & Parr method. The variances were not always calculated for each sampling time because of their high activities of movements between the study plot and the other plots in the paddy fields. The density of about

20 males was similar to the daily number of males directly counted at the plot during 10 days in late May, when the highest territorial activity was observed, and after then the density and the degree of territorial activity decreased.

MILLER (1984) stated that *O. chrysostigma* spend many hours holding a territory at the stream on each of several successive days. However, the territorial boundaries of *O. japonicum* were relatively unstable, as suggested by MIZUTA (1982) and the territories of mature males were found not at the centre but along

the margins of the paddy fields. Males usually perched on a ridge between the paddy fields and the streams. Then, as this study plot was about 600 m<sup>2</sup>, excluding the centre area of the paddy field, the extent of the territory of a male was estimated as about 5 X 5 m. MOORE (1953) recorded that the highest density of *O. cancellatum* males was about 9 per 100 yd of a stream.

The discrepancy of behaviour between the sexes seemed to result in the biased sex ratio (so-called an operational sex ratio), as shown in Figure 2, though it was about 1:1 at emergence time or in their immature stages in each area. Therefore, in the paddy fields, low sex ratios were found in May, when high territorial activities were observed. However, the male/female sex ratio increased toward the end of their reproductive season, due to females' invasion of the paddy fields from bushes because of low territorial activities of males. In the hills, contrarily, most adults emigrated when they matured. Particularly, few mature females remained, and then the sex ratio decreased. In the late flight season (mid and late June in the study area), all of the females found were regarded to be overmature ones whose wings were worn and colours were dull, while few males survived in both the hills and the paddy fields. Consequently, the sex ratios seemingly increased. Thus, it seems that the hills might be regarded as a nursing area for maturation of this species while the paddy fields as a reproductive area.

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