

OVIPOSITION BEHAVIOR IN TWO SPECIES OF DRAGONFLIES¹

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ABSTRACT

A comparative study of oviposition behavior of the dragonflies, *Anax junius* and *Tramea onusta*, was undertaken for two successive years in Tinley Park, Illinois. It was found that females of both species use tandem position and oviposit in close association with males. In *A. junius*, however, the male is physically attached to (tandem with) the ovipositing female during the actual act of oviposition, while in *T. onusta*, the female leaves the male to oviposit while the male hovers in close proximity.

Immediately prior to the moment of oviposition, tandem pairs of both species fly about, presumably in search of suitable oviposition sites. At this time and at the time of oviposition, single males of both species assault pairs, presumably in attempts to copulate with females. In *T. onusta*, at the moment of oviposition, when the pairs separate, single conspecific males are repeatedly successful in arresting oviposition. This is not true for *A. junius*, where, due to the attachment of the male, assaults on ovipositing pairs by single conspecific males are not successful in arresting oviposition.

It is possible that such arrested oviposition may play a part in local dispersal of adults, but additional studies, preferably with a species more easily marked and captured, would be necessary to demonstrate this hypothesis.

INTRODUCTION

Two main types of behavior occur in adult Odonata: breeding behavior and dispersal behavior (Corbet et al., 1960). Regarding the former, interactions between sexes during breeding may be further subdivided into behavioral movements associated with copulation and those associated with oviposition. Dispersal behavior consists of maiden flight, migration, and establishment of territory (Corbet et al., 1960). Behavior during oviposition also varies.

During oviposition, in some odonate species, the male is usually absent; in others, the male usually maintains close proximity to the female; in still others, the male is usually physically attached to (tandem with) the female (Moore, 1952; Walker, 1953; Kormondy, 1959; Corbet et al., 1960; Bick and Bick, 1961, 1963, 1965; Johnson, 1961, 1962; Bick, 1963; Currie, 1963; Gower and Kormondy, 1963; Young, 1965; Bick and Sulzbach, 1966). Young (1965) observed tandem oviposition in *Anax junius* and states that this form of behavior may function to prevent interference of oviposition caused by conspecific single males. Currie (1963) found that multiple male interference of oviposition decreases the frequency of oviposition in *Erythemis simplicicollis*, a species in which the male remains in close proximity (hovering) to the female. These studies and others reveal species differences of oviposition behavior in the Odonata, which leads to the interesting question—do different types of odonate oviposition behavior provide an advantage to some species by ensuring deposition of an adequate number of eggs while possibly acting as dispersal mechanisms of adults? This paper reports a comparative study of oviposition behavior in two different dragonflies, pointing up the affects of male-male interactions in relationship to male-female reproductive behavior.

METHODS

During the spring and early summer of 1965 and 1966, observations of oviposition behavior of the large dragonflies *Anax junius* (Odonata: Aeshnidae) and *Tramea onusta* (Odonata: Libellulidae) were made from middle April until late July at a small pond in Tinley Park, Illinois. The pond was rectangular, about

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140 feet by 125 feet, with cattails bordering the edges being the dominant form of emergent vegetation. The surface was covered with algae. The land area immediately surrounding the pond consisted of dense swamp grass and, beyond this, a deciduous forest. Other small ponds were also located in this vicinity, the closest one being one-half mile from the pond studied. *Anax junius* and *T. onusta* were the only dragonflies present during the study periods. At various times, exuviae of both species were found on cattails. The adults of each species were easy to distinguish and, because abdominal coloration is markedly different in adults, sexes could also be identified.

Observations were made on sunny days from 10:00 AM to 2:00 PM. Daily recordings were made, for each species, of the maximum frequency of single males and non-ovipositing single females, females ovipositing with no apparent association with males, and females ovipositing in association (close proximity or tandem) with males. The mean values of these results are presented by months in tables 1 and 2. Observations were also made on the actual movements during oviposition for each species.

RESULTS AND DISCUSSION

It is evident from tables 1 and 2 that females of both species oviposit in close association with males. When single males of *Anax junius* were present, they flew repeatedly in large, circular paths; male-male clashes were observed, which suggests territorial behavior, known to be exhibited by males of this species (Young, 1965). Table 2 shows that 6 single males of *Tramea onusta* were usually present when this species was seen. These males flew in short, linear paths over the cattails with occasional periods of hovering. Paths of 2 or 3 males often criss-crossed and the points of intersection were sites of clashes, also strongly suggestive of territorial behavior.

Pairs of *Anax junius* in tandem flew near the water along the cattails, where they often perched on mats of algae and shedded cattail sheaths; in each instance the female depressed the anterior portion of her abdomen below the water surface in a probing manner. This process lasted from 1 to 2 minutes and was indicative of oviposition in submerged plant tissue. In all such instances, the male remained attached to the female. This behavior was observed 126 times. Sometimes when pairs were in flight, a single male followed close behind and suddenly darted at the pair, presumably in a vain attempt to copulate with the female. After failing to disengage the pair, the single male would fly off to a different part of the pond. There were no instances observed where the male actually left the pond after clashing with a pair. Disturbed pairs resumed normal oviposition behavior. The 105 observations of disturbance of pairs in tandem while flying suggest that single males of this species, while repeatedly attempting to mate with a female already joined to another male, usually fail due to the presence of the attached male. Single males were never observed to pursue perched pairs.

No single females of *Tramea onusta* were seen, although single females of *A. junius* were present. The single female seen for 8 successive days during May, 1965, did not oviposit. The June, 1966, entry in table 1 refers to a single female whose presence, when detected by a single male, resulted in a tandem ovipositing pair; this pair-formation procedure was observed for 12 successive days.

Pairs in tandem of *Tramea onusta* flew near the cattails a few inches above the water. These pairs flew rapidly, with frequent brief periods of hovering during which the female separated from the male, dropped beneath him, and hovered momentarily in this free position dipping the tip of her abdomen in the water. This lasted no more than 25 seconds and was followed by the female's rejoining the waiting male and flying off with him to repeat this behavior over and over again. This behavior was observed 146 times and reveals that, in this case, oviposition was accompanied by a close proximity of the male. There were no

instances of the male remaining attached to an ovipositing female. Frequently a single male darted swiftly at an ovipositing female and waiting male, resulting in a scattering of the three dragonflies. Presumably the close proximity of the waiting male resulted in a clash with the invading male, but the latter, while not successful in uniting with the female, did arrest oviposition. Single males never clashed with flying pairs in tandem; all clashes occurred during the intervals when the sexes separated. Such interference of oviposition by single males was observed 115 times. It was also noted that males involved in these situations

TABLE 1
Mean daily occurrence of A. junius during successive months

Year	Month	Single males	Non-ovipositing single females	Ovipositing single females	Ovipositing pairs
1965	April	2	0	0	3
	May	4	1	0	7
	June	6	0	0	5
	July	4	0	0	5
1966	April	1	0	0	2
	May	5	0	0	6
	June	6	0	1	4
	July	3	0	0	2

TABLE 2
Means daily occurrence of T. onusta during successive months

Year	Month	Single males	Non-ovipositing single females	Ovipositing single females	Ovipositing pairs
1965	April	5	0	0	3
	May	5	0	0	3
	June	6	0	0	4
	July	6	0	0	3
1966	April	6	0	0	2
	May	6	0	0	4
	June	4	0	0	4
	July	6	0	0	2

returned rapidly to the pond after flying off into the swamp grass, whereas females returned less frequently and only in tandem. As an apparent result of the frequent break-ups of pairs, there was either only one or no ovipositing pairs present by 2:00 PM.

After early August both species were no longer seen, although some individuals of *Tramea onusta* were seen at other nearby ponds after this date.

It is evident that, although *Anax junius* and *Tramea onusta* both use tandem position in the oviposition process, the fact that the female *T. onusta* becomes detached from the male is significant. Oviposition of the latter is more susceptible to interruption, resulting in scattering of paired individuals, as a result of aerial assault by conspecific single males. It would be interesting to study the adult dispersal of both species, following these assaults, to evaluate the role, if any, of oviposition behavior in this dispersal. There may be a definite dispersal tendency

associated with the scattering of the individuals following attack by single males on ovipositing *T. onusta*, lacking in *A. junius*. Dispersal, in this context, refers to local movements between adjacent ponds and does not necessarily have any bearing on geographical range. To effectively show that a dispersal tendency is associated with a given type of oviposition behavior and not with another would demand studies involving capture, marking, and recapture, studies not easy to accomplish with these species of insects; such studies might be feasible using damselflies.

SUMMARY

The oviposition behavior of two dragonfly species, *Anax junius* and *Tramea onusta*, was observed in Tinley Park, Illinois. In both species, oviposition involves tandem position, but in *T. onusta*, the male disengages from the female at the moment of oviposition, though it maintains close proximity. Because of this detachment, aerial assaults by conspecific males are often successful in arresting oviposition. It is possible that this difference in oviposition behavior between the two species has a significant effect on local dispersal of adults of this species.

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