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BIO-ECOLOGICAL OBSERVATIONS OF *SIMULIUM* (*EUSIMULIUM*) *AUREOHIRTUM* BRUNETTI (DIPTERA : SIMULIIDAE)

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ABSTRACT

The present paper deals with the oviposition, hibernation, voltinism, habitat preference, larval feeding and cannibalism, and depredation of *Simulium* (*Eusimulium*) *aureohirtum* Brunetti studied in Shillong, and at and around Jowai and Garompani of Meghalaya ; Gulzang, Lamzang, Pengzang and Kangvai of Manipur ; Kolasib and Chhiatlang of Mizoram ; and Sapargiri and Mara of Arunachal Pradesh in the North-East India. Oviposition occurred in water with currents of about 0.2-0.5 m/sec. but never in water with high velocity (i) by tapping the abdomen through the water while hovering, and (ii) by crawling under the water, from the forenoon to the late afternoon with a pause at mid-day. This was a univoltine species overwintering in the larval stage. The population of larvae and pupae of this species showed an evolutionary sequence from almost quiet water to rapid water. The larvae were found to feed on algae and hardly to show cannibalistic nature on one hand, and to fall as prey to ants on the other.

INTRODUCTION

Simulium (*Eusimulium*) *aureohirtum* Brunetti is widely distributed in India (Datta, Dey, Paul and Pal, 1976) and this is one of the very few species in India to occur as an exotic species in Pakistan (Puri, 1933 ; Lewis, 1973), Japan (Ogata and Sasa, 1955) and Ryukyu Islands (Ogata, 1956). Despite its wide distribution and abundance, information on the bio-ecology of this species appears lacking, mostly because of its apparent non-bloodsucking habit. Datta *et al.* (1975, 1976) have briefly indicated some aspects of the ecology of this species. Further details of the bio-ecology of this species from the North-East India are presented here.

NATURE OF HABITATS

Observations on the bio-ecology of *S.* (*E.*) *aureohirtum* were mainly made in Shillong (1380-1450 m) of Meghalaya, and data from places at and around Jowai (200-250 m) and Garompani (150 m) of Meghalaya ; Gulzang (800 m), Lamzang (800 m), Pengzang (875 m) and Kangvai (875 m) of Manipur ; Kolasib (715 m) and Chhiatlang (925 m) of Mizoram ; and Sapargiri (175 m) and Mara (360 m) of Arunachal Pradesh were also associated. The main site of investigation was the Botanical Garden near the Ward Lake in Shillong. The outlet for the excess water from the lake was found to form a semi-permanent stream of moderate current and of nearly two metres'

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PLATE I

1. Collection of immature stages of *S.* (*E.*) *aureohirtum* Brunetti from tributaries at a place near Jowai, Meghalaya.
2. The cultivatable paddy fields at Garompani, Meghalaya, harbouring innumerable larvae of *S.* (*E.*) *aureohirtum* Brunetti.
3. A semi-permanent stream at Gulzang, Manipur, harbouring immature stages of *S.* (*E.*) *aureohirtum* Brunetti.
4. A man-made irrigating channel at Kangvai, Manipur, harbouring immature stages of *S.* (*E.*) *aureohirtum* Brunetti.

width. The stream-bed generally had soil cover over rocks and mainly decaying twigs and leaves were the substrata for oviposition. The site almost always remained dark due to the presence of hardwood forest canopy. The small tributaries resulting from a water fall at a place near Jowai (Pl. I, fig. 1) were not even each a foot wide had moderate current. These trickles of water were rock-bottomed and margined by floating grasses. The cultivatable paddy fields at Garompani (Pl. I, fig. 2) were surprisingly found to have tremendous growth of larval population of this species on stubbles submerged in water. The water was almost stagnant and remained exposed to direct sunlight throughout the day because of absence of tall trees nearby. A semi-permanent stream at Gulzang (Pl. I, fig. 3) was another breeding site of this species. The stream-bed was muddy in nature but the scattered stones and decaying twigs or leaves were used as substrata. In many places like Kangvai (Pl. I, fig. 4) this species was found to breed in man-made irrigating channels with moderate or rapid current. In other places of Manipur, Mizoram and Arunachal Pradesh there were many trickles of water with feeble water current or with almost stagnant water inhabited by the immature stages of this species on trailing vegetation or decaying leaves.

Oviposition

Females of this species mainly oviposited in water with currents of about 0.2-0.5 m/sec. but never in water with high velocity. Two methods of oviposition were observed in this species. Firstly, females at the time of oviposition, singly or in groups crawled under the water and reached the undersurface of the substratum to lay their eggs. After oviposition they simply floated themselves on the water surface and being held up by any kind of obstruction they got off. Lastly, females were observed to hover over the substratum constantly splashed with water or over-lain by a thin film of flowing water with very slow current and to deposit eggs on the surface by tapping the abdomen gently through the layer of water. An egg was roughly triangular in shape approximately being 0.25 mm × 0.15 mm in size. A female laid nearly 225 eggs. Oviposition was observed to begin in the forenoon at the shady places and to end with the fall of darkness by a pause at mid-day only if the place was full of sunlight throughout the day.

Hibernation and Voltinism

Eggs of this species were observed to hatch with the advent of autumn and to continue till early winter. Larvae developed probably during winter and hibernated in this stage. Pupae began to appear in the late winter with the rise of temperature. The occurrence of pupal exuviae in the field from the early spring led to believe that adults began to emerge from that time, although no adults could be collected in the field before the month of May when considerable emergence was evidenced, implying its univoltine nature particularly in high altitude areas. In lowland areas, a comparatively steady synchronization of the larval and pupal developments with the emergence of adults appeared difficult to conceive.

Habitat Preference

This species seemed to prefer smooth surfaces of dead or decaying leaves for oviposition. It also laid eggs on trailing vegetation or floating grasses but avoided the hairy or rough surfaces. Occasionally, however, when the abovementioned substrata were lacking, it deposited eggs on stubbles of paddy fields. Larvae of this species were found to

occur in higher numbers and more often on decaying leaves or grasses in small streams or trickles of water with very slow current. They, however, preferred clear water but could tolerate suspensoids to a certain degree. They were generally crowded together in extraordinary dense masses on a substratum but pupae were found to spread out. Pupae almost always occurred in situations free from full force of the current but the pupal respiratory filaments must have a constant change of water.

LARVAL FEEDING AND CANNIBALISM

The contents of the alimentary tract of some larvae from different localities were examined. Various algae especially diatoms, sand grains and vegetable debris could be identified from the tract. A specimen from Shillong was also found to contain a deformed and indigested simuliid larva in the tract.

DEPREDATION

While collecting the immature forms of this species from a paddy field at Garompani, aphids were found associated with ants to infest grass-blades above the water surface but the portions under the water were found to frequent with the larvae of this species. Surprisingly, an ant was observed to attack a larva remained just at the water level, and to seize the opportunity to catch the larva.

DISCUSSION

The species under investigation bred in almost all sorts of watercourses having very slow to medium flow of water. The methods of oviposition of this species (i) by tapping the abdomen through the water while hovering ; and (ii) by crawling under the water, were basically in conformity with those followed by *S.* (*E.*) *praelargum* Datta and *S.* (*E.*) *gracilis* Datta, as reported by Datta, Dey, Paul and Pal (1975), but these latter species oviposited while alighting. The practice of alighting or of crawling might have come up only in the water with slower current without much disturbance (Grenier, 1949). The period of ovipositon was also earlier when the place of oviposition was naturally dark. Other meteorological factors also might have impact on oviposition (Davies and Peterson, 1956).

In a high altitude place like Shillong, this species was univoltine. The larvae began to appear with the advent of autumn and overwintered in the same stage. Whether or not was there a single generation per year in low altitude places was yet to be established, for a steady synchronization of developments consequent upon the complex physico-chemical changes of the ecological niches was not clear. However, according to Davies (1961) this synchronization might have been achieved by the higher temperature thresold for pupation than that for larval development.

The choice of substrata by females of this species during oviposition indicated partial selectivity towards the nature and texture of the same. Larvae mostly frequented on the decaying leaves or grasses in small streams or trickles of water as a result of migration. Their distribution appeared to depend mainly on the availability of food and oxygen made by the speed of current of water and presence of a substratum suitable for attachment.

In an earlier report (Datta, 1975) the colonization by this species in relation to the velocity of water current had already been indicated. This investigation also revealed that the species successfully colonized the area where the immature stages were mainly the

inhabitants of watercourses with very slow current. Notwithstanding a small fraction of the population of larvae and pupae was found in rapid water, presumably with more suitable environs. Thus, this species appeared to have been passing through an evolutionary sequence from almost quiet water to rapid water wherein the immature stages might eventually be shown to have adapted well. Not only the current provided the larvae with mechanical force for attachment to suitable substrata (Hocking and Pickering, 1952) but also assured an abundant supply of food and oxygen (Wolfe and Peterson, 1959) which were uncertain in the very slow current of water. Thus, the adaptation to the habitat preferred by larvae was the most important factor in the life of the insect since the first ovarian cycle was supposedly dependant upon the level of nutrition of the larval stage (see Davies, 1961).

The food material recovered from the alimentary tract suggested that the larvae were mainly herbivorous. This nature was also pointed out by Davies and Syme (1958) in cases of *Prosimulium fuscum* Syme and Davies, and *P. mixtum* Syme and Davies. The cannibalistic nature of black fly larvae was observed in captivity by Peterson and Davies (1960), and Wu (1931), but this investigation confirmed this habit in nature. Peterson and Davies (*op. cit.*) observed ants to prey upon adult black flies and Crisp (1956) reported ants to attack exposed eggs, larvae and pupae of *Simulium damnosum* Theobald. This investigation also recorded an attack of ant to a larva of this species in the field.

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