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A POSSIBLE EFFECT OF OBLIGATORY PARTHENOGENESIS ON THE FLIGHT ACTIVITY OF SOME TROPICAL LARVO-AQUATIC INSECTS

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ABSTRACT

It is suggested that obligatory parthenogenesis may lead to a "decay" of the flight activity patterns in tropical species of *Trichoptera* and *Ephemeroptera*.

Most species of *Trichoptera* and *Ephemeroptera* at Jinja, Uganda, fly between sunset and sunrise. CORBET and TJØNNELAND (1955) and TJØNNELAND (1960) have shown that, with a few exceptions, these species have their flight activity peaks at twilight. Some species are eocrepuscular, showing a bimodal activity pattern, while others fly only at dusk or at dawn. Common to most species studied is that the periods of flight activity, as judged by the catches in light traps, are very restricted in time.

CORBET & TJØNNELAND (1955) have discussed the biological significance of a crepuscular activity in the tropics and they proposed that (*loc. cit.*, p. 20): "In insects with a short adult life, flight behaviour is probably closely connected with the need for the sexes to meet. On this basis it is reasonable to assume that synchronisation of activity in the *Trichoptera* is of importance in this respect." And further (*loc. cit.*, p. 21).» Whether such acute synchronisation is biologically necessary can only be elucidated by further work, but it is interesting to note in this connection that insects responding to crepuscular light intensities will have shorter periods of activity in tropic than in temperate regions, twilight being more protracted in the latter".

An acute synchronisation is also evident in species which are not crepuscular in their flight activity. The mayfly *Povilla adusta* NAVÁS, which shows a lunar rhythm of emergence in Lake Victoria (HARTLAND-ROWE 1955, CORBET 1958a, TJØNNELAND 1960), emerges between 1930 hrs. to 2100 hrs. (East African Standard Time), the individuals exuviate on the wing and the adults survive for about an hour only (HARTLAND-ROWE 1955, 1958). The flight activity of this species is accordingly limited to a few hours every lunar month. In the mayfly *Trichorythus tinctus* KIMMINS, another species which cannot be said to be crepuscular in its flight activity, conditions are less well known. Extensive light trap data are, however, available for the species (TJØNNELAND 1960) and these seem to indicate

that the species shows a sporadic emergence (CORBET 1964). The species is torrential, having been reported from the Ripon Falls and from the Owen Falls (CORBET 1958b). The synchronisation of activity is rather unusual. Observations carried out at Owen Falls indicated that the male subimagines started to emerge shortly after sunset but female subimagines were not seen at the time. The male subimagines settled immediately after emergence, which explains the fact that male subimagines were not caught by the trap at the time—the trap being situated approximately 1.3 km from the Ripon Falls and approximately 3.5 km from the Owen Falls. The main catches of *Tricorythus tinctus* in the light trap were made from two hours before solar midnight till two hours after solar midnight. The males were all imagines whereas all females caught by the trap were subimagines. It is likely that the females emerge later than the males at a time when the males have completed exuviation, and it is furthermore likely that the females are mated in their subimaginal stage (TJØNNELAND 1960).

Among the caddisflies studied at Jinja, *Amphipsyche senegalense* (BRAUER) differed considerably from the rest. First of all, males have not been found at Jinja and the flight activity pattern of the females was far more diffuse than the flight activity pattern of other species, excluding a couple of species of minute size where the catches were shown to be heavily dependent on the wind conditions (CORBET & TJØNNELAND 1955). Also, *Amphipsyche senegalense* has been noted to fly in large numbers (again all females) at about 1030 hrs. (East African Standard Time)—that is hours after sunrise—at Owen Falls. CORBET & TJØNNELAND (1955) concluded that this species could well turn out to differ significantly from other species of caddisflies in its general ecology. As only females have been found at Jinja, obligatory parthenogenesis was suspected and CORBET (1966) has shown that the species is able to reproduce by parthenogenesis there.

The fact that *Amphipsyche senegalense* reproduces by parthenogenesis at Jinja, may well explain the diffuse flight activity pattern observed in this species.

It is not possible to arrive at conclusions as to the nature of the periodicities shown by the various species of *Trichoptera* and *Ephemeroptera* studied at Jinja, as controlled laboratory experiments were not carried out. These species lend themselves poorly to such experiments as the adult life is very short. But from what is presently known about periodicities in general (ASCHOFF 1964 & 1966, BECK 1968), it must be assumed that the periodicities observed are the resultants of both endogenous and exogenous factors.

Irrespective of the nature of the periodicities, the sexes must meet if a sexually reproducing species is to survive. In insects showing a mating flight, the mating flights of the sexes must be synchronised. It has been demonstrated (TJØNNELAND 1960) that in the individual life of several species of *Ephemeroptera*, the mating flight is not a recurrent event. Only in a few of the species studied do the individuals live long enough to repeat the mating flight. As far as the *Trichoptera* studied

at Jinja are concerned, CORBET & TJØNNELAND (1955) assumes that the adults only live for two days under natural conditions. In both groups the reproductive stage is thus of a very short duration, and with the exceptions stated, all species studied has shown a synchronised and temporally very restricted flight activity. In insects such as these, where the mating is initiated, if not necessarily completed, while the insects are on the wings this type of flight activity was to be expected. It leads to an increase of the density of a species in the air, or to swarm formations, increasing the chances of successful encounter of the sexes. Stray individuals, showing a flight activity out of phase with the rest of the flying population, would stand a much smaller chance of engaging in matings, even if other forces of selection (such as predation, wind strength, prevalent wind directions and other climatic factors) were identical for both the "in-phase" individuals and the "out of phase" individuals. The contribution of such "out of phase" individuals to the next generation would therefore be small—if any.

In populations of *Trichoptera* and *Ephemeroptera* reproducing exclusively by parthenogenesis in the tropics, conditions are different. Here the problem of mating does not apply and parthenogenetic females showing a flight activity out of phase with the remaining flying population (due to aberrant endogenous rhythms and/or aberrant reactions to external stimuli) would stand a better chance of reproducing than would "out of phase" sexually reproducing females. Obligatory parthenogenesis may thus introduce a tendency towards a temporal dispersal of the diel activity pattern of the population. Put in other words, obligatory parthenogenesis may in fact introduce a tendency towards a "decay" of a temporally restricted diel activity pattern.

It is not possible to state to what extent such a tendency towards "decay" of the flight activity pattern will be expressed in an obligatory parthenogenetic population. This would obviously depend on a great many factors and vary with the species and locality and the forces of selection. Predation, wind strength, prevailing wind conditions and other forces of selection may well set strict diel limits for both the emergence and the flight activity of such a parthenogenetic population, in which case the "decay" phenomenon may not be clearly expressed. There is also a time factor involved, a population would not be expected to show a "decay" of synchronised activity in its initial stages of parthenogenesis.

The diffuse flight activity pattern observed in *Amphipsyche senegalense* at Jinja may well be interpreted as being a result of a "decay" of a formerly synchronised and temporally very restricted diel activity. A study of the emergence pattern of the population would be of considerable interest, since the flight activity of an individual may well be temporally related to the time of its emergence. While it is true to say that little definite information exists at present concerning the emergence patterns of tropical larvo-aquatic insects in general, as so few have been studied in detail, the information available suggests that the emergence of most species of *Trichoptera* and *Ephemeroptera* at Jinja is limited to short periods of

time within the diel period, and in some (*Povilla adusta* and probably *Caenis*/*Caenodes* spp.) the individuals engage on their mating flight immediately after emergence. A population reproducing by obligatory parthenogenesis, showing a diffuse diel flight activity pattern, may well show a diffuse diel emergence pattern as well. A tendency towards continuous emergence may well exist in such populations.

The mayfly *Centroptilum notabile* KIMMINS is quite common at Jinja and it is suspected of reproducing at least partly by parthenogenesis as the males make up less than 3% of the total catches in the light trap (TJØNNELAND 1960). As yet, the suspicion has not been confirmed. In this species the flight activity is well synchronised. The possibility that the light trap catches give a very biased sex ratio cannot be discounted at present, as the catches of males have been found to equal the catches of females, or even to outnumber them — on some of the nights when the catches have been small. If parthenogenetic, it must be pointed out that males are found in *Centroptilum notabile* at Jinja, and it is feasible that the population sampled is in an initial stage, a stage when the "decay" of synchronisation has not become discernible.

The possible existence of a tendency towards a "decay" of the diel flight activity pattern (and possibly also of the diel emergence and oviposition pattern) in certain tropical larvo-aquatic insects reproducing by obligatory parthenogenesis, has been pointed out in the present note. To what extend such a hypothesis is valid, can only be tested as other parthenogenetic populations of *Trichoptera* and *Ephemeroptera* are discovered and studied.

No attempts have been made to discuss the possible effect of obligatory parthenogenesis on the diel activity of populations outside the tropic region. It is felt that studies of the diel activity of species showing obligatory parthenogenesis may well prove rewarding both in the tropics and elsewhere.

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