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OBSERVATIONS ON *CENTROPTILUM NOTABILE* KIMMINS (EPHEMEROPTERA) AT JINJA UGANDA

BY

AUDFINN TJØNNELAND
Zoological Laboratory
University of Bergen

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A.s John Grieg

ABSTRACT

Extensive light trap catches of imagines of the African mayfly *Centroptilum notabile* KIMMINS have shown that they show a flight activity peak shortly after sunset; the activity peak of the males slightly precedes that of the females.

The catch sex ratio (♂♂/♀♀) is very low in this species. Available data suggests, however, that the catch sex ratio is biased in favour of the females.

INTRODUCTION

The mayfly *Centroptilum notabile* KIMMINS is often met with in light trap catches at Jinja, Uganda. Although the adults of this species must be said to be common at Jinja, little is known concerning the biology of the species. The aquatic stages are assumed to inhabit rivers and CORBET (1964) mentions that the species appears to show a sporadic emergence.

TJØNNELAND (1960) recorded the flight activity of imagines of *C. notabile* from 1956—58, using a Robinson mercury vapour light trap. During the first year (Year I) the trap was run every seventh night and each of the resulting 52 sampling nights was divided into 10-minutes sampling periods. Thus, each sampling night during Year I yielded 72 sampling periods. During Year II (1957—58) the trap was run every night for nine synodic months. The trap was then emptied twice per night: the first time one hour after sunset and the second time at sunrise. The procedure has been described in detail in a previous paper (TJØNNELAND 1960).

Light trap catches of imagines generally reach a maximum from 30 to 40 minutes after sunset and the dawn peak is small and insignificant. The species is interesting in so far as the males only make up a small part of the total catches. During Year I, the males made up 2.3% of the total catch of *C. notabile*, whereas they made up 2.9% of the total catch in Year II (TJØNNELAND 1960).

The present paper gives a further analysis of the catches of *C. notabile*.

RESULTS

As seen from Tjønneland (1960) fig. 26, the catches of *C. notabile* vary considerably over the nine synodic months in Year II. A calculation of the $\bar{x}/M_W$ ratios (for explanation of symbols see Tjønneland, 1969) shows that the variation is especially noticeable for the females.

The fluctuation of the catches is no doubt caused partly by the strength of wind and it is well known that the catches of insects by a light trap are influenced by wind strength (Corbet & Tjønneland, 1955; Tjønneland, 1958). In the case of *C. notabile*, this is demonstrated in Fig. 1, where the nightly catches of *C. notabile* (expressed as log (n+1)) are compared with the wind strength (in kilometres per hour). The direction of the wind will also influence the catches, but reliable information is lacking as automatic instruments for recording wind directions at various levels were not available.

In the catches of *C. notabile*, males make up rather a small proportion of the total catch. Defining the sex ratio as ♂♂/♀♀, the catch ratio of Year I was 0.024, while it increased to 0.030 in Year II. It must be added that the figures for Year II are less reliable, as subsampling was resorted to in order to cope with the catches. Details of the method of subsampling employed are given by Tjønneland (1960).

It is obvious that catch sex ratios vary from night to night, and — as pointed out by Corbet (1966) — especially heavy catches may significantly influence the average catch sex ratio in an observation series. This is very true for the present species.

In Table 1 the number of nights (in Year II) when the given catch sex ratios have been met with, are shown against the size of the catch of the nights.

Table 1. *The number of nights (Year II) when the stated catch sex ratios have been observed, shown in relation to the size of the nightly catch of C. notabile. Nights when the total catch has not exceeded 10 individuals have been omitted from the table.*

Total nightly catch	Catch sex ratio											
	0.000 to 0.050	0.051 to 0.099	0.100 to 0.199	0.200 to 0.299	0.300 to 0.399	0.400 to 0.499	0.500 to 0.599	0.600 to 0.699	0.700 to 0.799	0.800 to 0.899	0.900 to 0.999	> 1.0
11 – 99 ..	51	6	12	5	2	1			1	1		3
100 – 249 ..	16	4	1	4							1	
250 – 499 ..	14	2	1						1			1
500 – 999 ..	4	1	2	2								
1,000–1,999 ..	8	2	2									
2,000–2,999 ..	3		2									
3,000–4,999 ..	3	1										
5,000–9,999 ..	2											
> 10,000 ..	1											

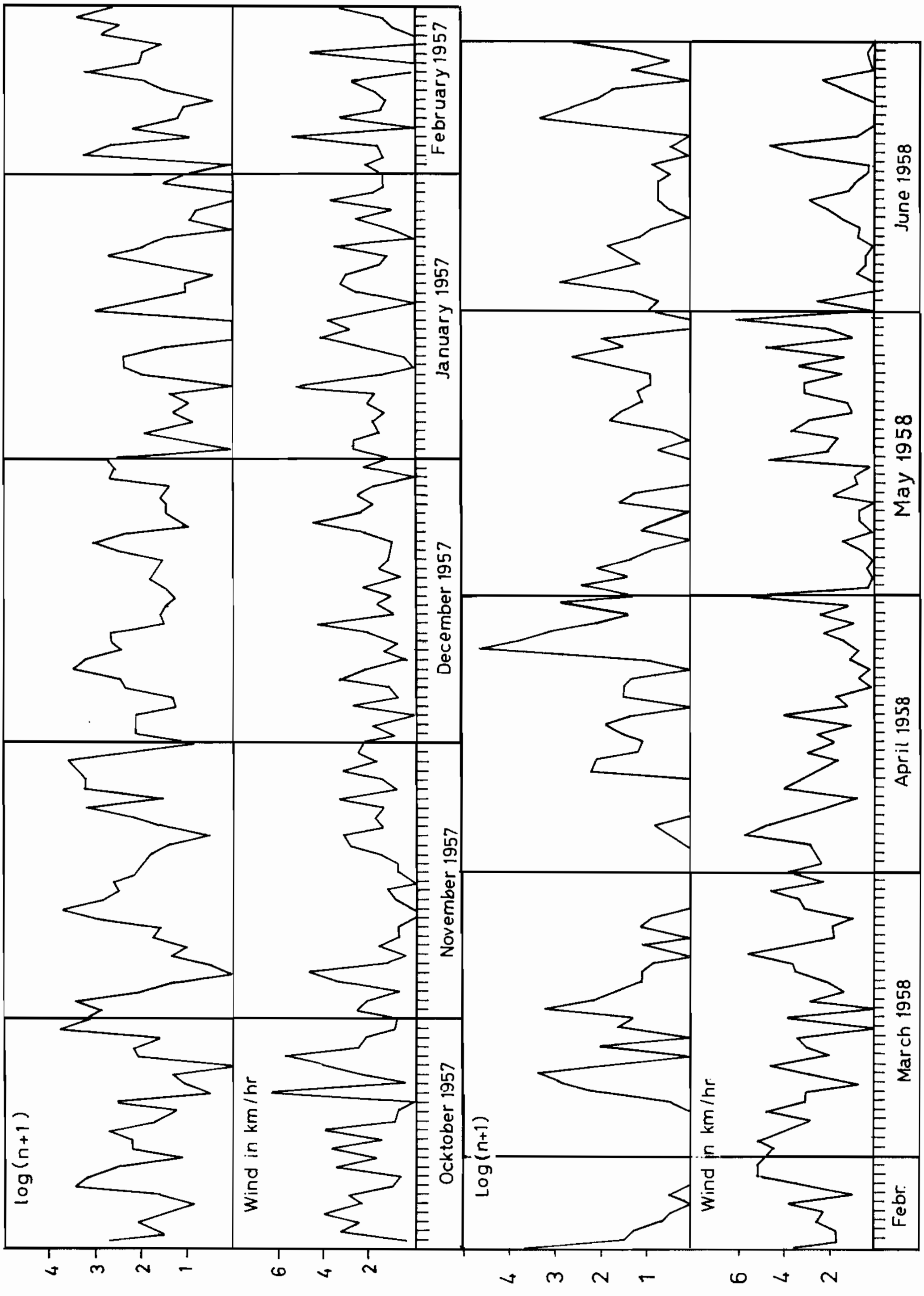

Fig. 1. Nightly light trap catches of *Centroptilum notabile* imagines (expressed as log (n+1)) compared with strength of wind during the first hour after sunset.

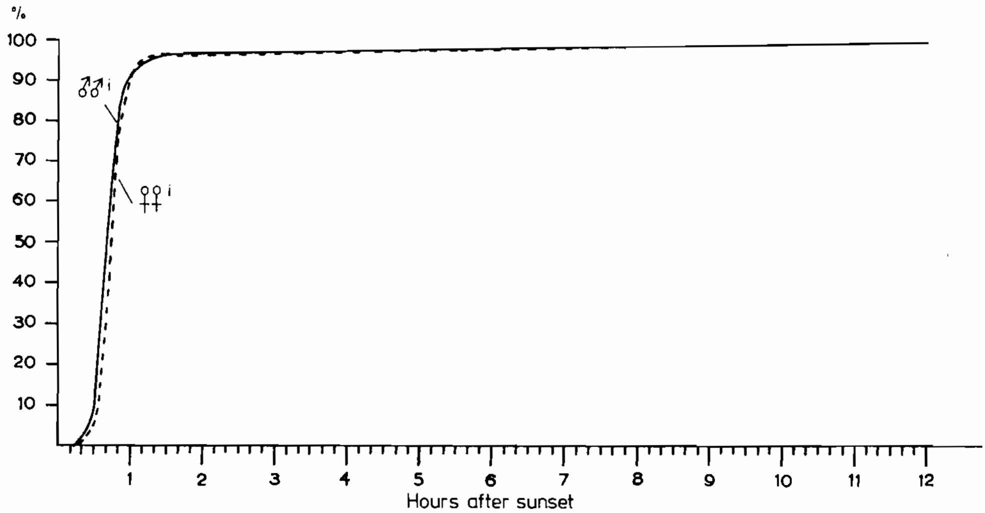

Fig. 2. Cumulative catches of *Centroptilum notabile* imagines in percents of the total catch made during the 52 nights in Year I. *Ordinate:* percent of a given sex caught so far during the 52 nights. *Abscissa:* successive periods during the night.

For most of the nights when *C. notabile* has been caught, the catches have been small and for some of these nights, the catch sex ratios have been rather high. It is interesting to note that the observed catch sex ratios have been rather high in some nights with fair catches. Table 1 strongly indicates that the males are under-represented in the total catches.

An under-representation of one of the sexes in light trap catches can come about in several ways, some of which have been discussed previously (Tjønneland, 1960; Tjønneland, 1969). In the case of *C. notabile* it seems that the males start to fly slightly before the females do. This is indicated in Fig. 2. In this figure the cumulative catches of *C. notabile,* in percents of the total catch made during the 52 nights in Year I, have been shown. This way fluctuations resulting from small numbers of *C. notabile* caught later in the night, are effectively smoothed (Corbet & Tjønneland, 1955). It is seen that the rise in the catches of males after sunset starts sooner than the rise in the catches of females. A similar trend has been discovered for imagines of another mayfly species: *Choroterpes curta* (Kimmins) flying before sunrise at Jinja (Tjønneland, 1969). In the evening a light trap will increase in efficiency from sunset till the end of the astronomical twilight, and as the males seem to start flying before the females, it is likely that the catch sex ratio is biased in favour of females. In other words, the catch sex ratio observed is likely to differ from the catch sex ratio that would have resulted had the activity of males and females been temporally identical.

In Fig. 3 the catch sex ratios have been plotted for the various 10-minutes'

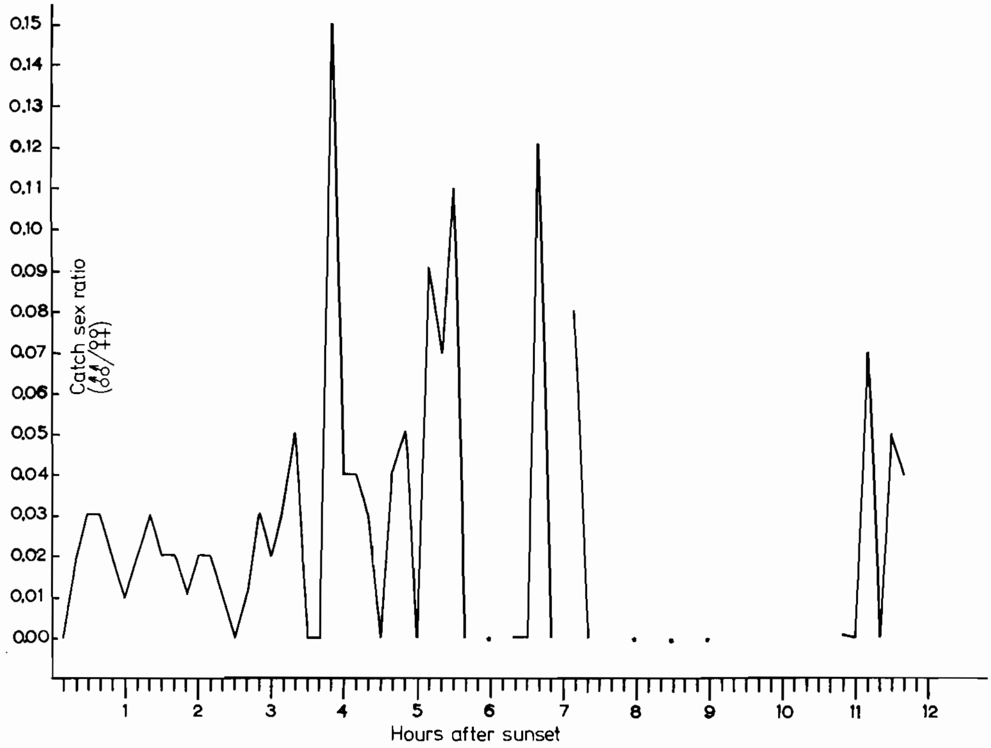

Fig. 3. Catch sex ratios for imagines of *Centroptilum notabile* for the various catching periods of the night. The figure is based on the catches made during the 52 nights in Year I and the catch sex ratios have only been calculated when the total catch of imagines in the 52 identical catching periods exceeded 10 individuals.

sampling periods for the 52 nights in Year I. The catch sex ratios have only been calculated when the total number of insects caught in the sampling period exceeded 10 in the 52 nights in question.

It is noticed that the catch sex ratio rises to 0.03 soon after sunset. This is followed by a period when the catch sex ratio shows a tendency to decrease. Later at night, the catch sex ratio fluctuates a great deal.

DISCUSSION

Corbet (1964) lists the following types of emergence: continuous, rhythmic, sporadic and seasonal, and he discusses the term sporadic emergence. He also points out that a study of emergence by indirect methods is difficult as so many environmental factors will influence the catches. Changes in the strength, time and direction of the wind all play a part.

The effect of wind strength on the light trap catches of *C. notabile* is clearly demonstrated in this paper. It is obvious that changes in the time and the direction of the wind will also influence the catches when the species caught emerges some distance from the trap. The exact extent of these factors on the catches cannot be stated as sufficient reliable information is lacking as far as these factors are concerned. Under the circumstances, little emphasis should be put on the exact size of the nightly catches.

CORBET (1964) mentions that *C. notabile* appears to show a sporadic emergence. The question remains if this could be a phenomenon brought about by environmental conditions such as wind.

An attempt to classify the emergence type of *C. notabile* was frustrated because the subimagines could not be identified. If the night to night variation in the catches of *C. notabile* imagines is compared with the night to night variation of catches of *Choroterpes bugandensis* (KIMMINS) (cf. TJØNNELAND, 1960, figs. 32—33), it is noticed that the peak catches of *C. notabile* imagines often coincide with peak catches of *C. bugandensis* imagines — and in some cases also with the peak catches of *C. bugandensis* subimagines. The flight activity of the imagines of these two species is rather similar (cf. TJØNNELAND, 1960, figs. 10 and 15 a & b), but this cannot in itself explain the close similarity in the nightly catches, as subimagines of *Choroterpes curta* (KIMMINS) show much the same flight activity, yet the night to night fluctuations in the catches of *C. curta* subimagines are completely different from the other two (TJØNNELAND, 1960, figs. 34—35).

The larva of *C. notabile* has not been described and the larval habitat is therefore unknown. CORBET (1958) assumes that the larvae live in rapid flowing water (at the Ripon Falls — then in existence — and in the Victoria Nile below the Owen Falls). The similarity in fluctuation in the catches of imagines of *C. notabile* and *C. bugandensis* may well reflect similarities as far as the breeding site and the emergence type of the two species are concerned. The larvae of *C. bugandensis* are known to breed in the Victoria Nile, but the possibility exists that the species also breeds in the Napoleon Gulf (CORBET, 1960). Subimagines have never been observed to emerge from the lake and the fact that GILLIES (1957) has reported that a number of *C. bugandensis* subimagines were caught at light at the Pangani River in Tanzania, also indicates that the species inhabits rivers.

As seen from Fig. 2, the rise in the catches of males starts slightly sooner than it does in the case of females. A similar thing has been observed for imagines of *C. curta*, although the flight of the imagines takes place before dawn in this species (TJØNNELAND, 1960).

The observed catch sex ratio of *C. notabile* is very low. Since the main flight activity is in the evening and since the catches of males slightly precedes the catches of females, the catch sex ratio must be assumed to be slightly biased in favour of females (TJØNNELAND, 1969). The crucial question is whether the low catch sex ratio is differing strongly from the sex ratio of the imaginal population.

Table 1 rather indicates that this may be the case. Because of the low catch sex ratio experienced in this species, TJØNNELAND (1960) mentioned the possibility that parthenogenesis may exist within the population. Parthenogenesis has been described in *Centroptilum* by DEGRANGE (1954).

TJØNNELAND (1970) has proposed that obligatory parthenogenesis may lead to a "decay" of the temporal flight activity patterns in species of *Trichoptera* and *Ephemeroptera* in the tropics. No such "decay" of the temporal activity pattern is discernible in *C. notabile.* If this species reproduces by parthenogenesis, it is unlikely to show an obligatory parthenogenesis at Jinja as males are still found.

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