

DIEL EMERGENCE PATTERNS OF SOME MAYFLIES (EPHEMEROPTERA) OF THE
ROSEAU RIVER (MANITOBA, CANADA)

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ABSTRACT

Emergence of mayflies was monitored at 2 h intervals throughout one 48 h period in each of June, July and August, 1976. In all three study periods most emergence occurred from mid-day until dark, with peak emergence at dusk. The main exceptions to these general trends were *Baetis intercalaris* whose peak emergence occurred at mid-day in June, and some females of *B. intercalaris* and *Tricorythodes* nr. *allectus* which emerged at dawn. The time of day of emergence was similar for most species from day to day and month to month. In species where considerable numbers of males and females emerged, peak emergence of both sexes tended to occur during the same 2 h periods.

INTRODUCTION

The Roseau River rises in the northern U.S.A. and flows north-west through southern Manitoba into the Red River system, which eventually drains into Hudson Bay (Fig. 1). The river, which runs through an area of glacial outwash, is of rather an unusual type on the Canadian prairies, since it is permanent, clear, fast and boulder strewn. Further descriptions of this river can be found in Flannagan (1978). Timing of emergence from the nymphal to the short-lived terrestrial stage of the mayfly is of utmost importance to ensure the simultaneous presence of adequate numbers of both sexes of the same species for successful reproduction. The present study investigated the diel emergence patterns of mayflies over three-48 h periods during the summer of 1976 - one each in June, July and August as part

of a phenological study of mayfly emergence throughout the open water season.

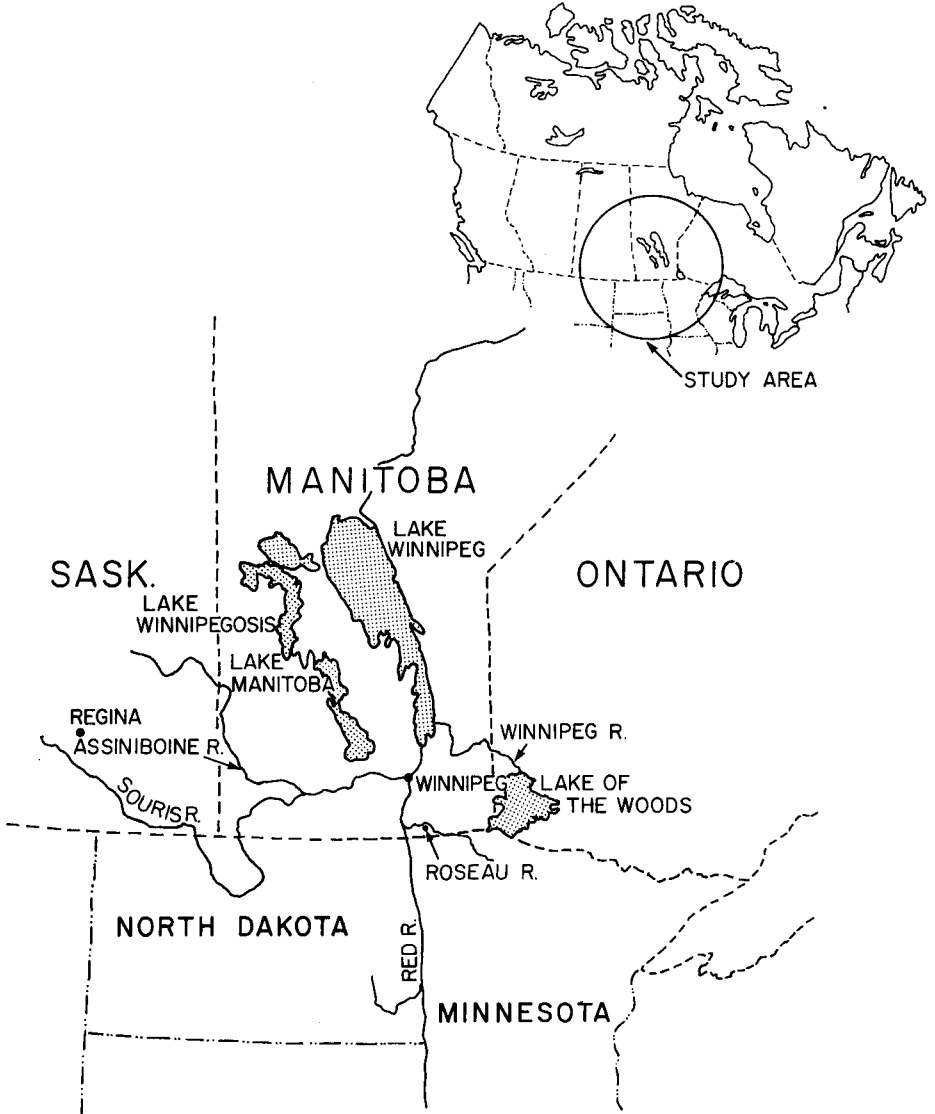


Figure 1. Location of the sampling site on the Roseau River, Manitoba.

MATERIALS AND METHODS

Four, 1 m³ box emergence traps, located on different substrates (Flannagan 1978) were emptied every 2 h throughout 48 h periods on 13, 14, 15 June; 12, 13, 14 July and 10, 11, 12 August, 1976. Mayflies were preserved in 75% ethanol. Dissolved oxygen (except in June), water temperature, surface light and pH were recorded every 2 h.

RESULTS

Percentage emergence during each 2 h period of total emergence for each sample period, along with the recorded physical and chemical parameters, are given in Figures 2, 3 and 4. In all three months, most emergence occurred from mid-day to the dark period, with peak emergence at dusk. Emergence at dawn, when it occurred, consisted mostly of females of *Baetis intercalaris* and *Tricorythodes* nr. *allectus*. Emergence of most species was considerably reduced towards the end of the study period in each month probably as a result of disturbance of the substrate while sampling. In general, emergence of different families, of congeneric species, and of both sexes of the same species tended to occur in the same 2 h periods (Fig. 5). The time period of greatest emergence in July differed somewhat between *B. intercalaris* and *B. pygmaeus*, and between *Pseudocloeon dubium* ? and *P. punctiventris*. Emergence times of most species did not change substantially from day to day or month to month. An exception was *B. intercalaris* in which most emergence in June occurred at mid-day, in July peak emergence occurred at sunset and sunrise, and in August peak emergence occurred at sunset (Fig. 5). Moonlight and cloud cover in July caused changes in light intensity (Fig. 2) which did not occur during the other sample times.

DISCUSSION

The emergence at dusk of large numbers of mayflies of various species is a well known phenomenon. It is likely a "safety in numbers" strategy evolved to maximize survival from predation at one of the most vulnerable periods in the life cycle of these organisms. Emergence at other times of the 24 h period has been recorded for other mayfly species, and may be in response to presence of certain favourable environmental conditions e.g. temperature, or have some other adaptive advantage. For example, emergence at dawn consisted mainly of females of *Baetis intercalaris* and *Tricorythodes* nr. *allectus*. It was not noted whether mating swarms of these species occurred at this time but emergence of females at dawn and subsequent mating have been recorded for other species (e.g. *T. atratus* McD. (Hall *et al.* 1975)). This type of behaviour would reduce the time females are exposed to predation before mating and

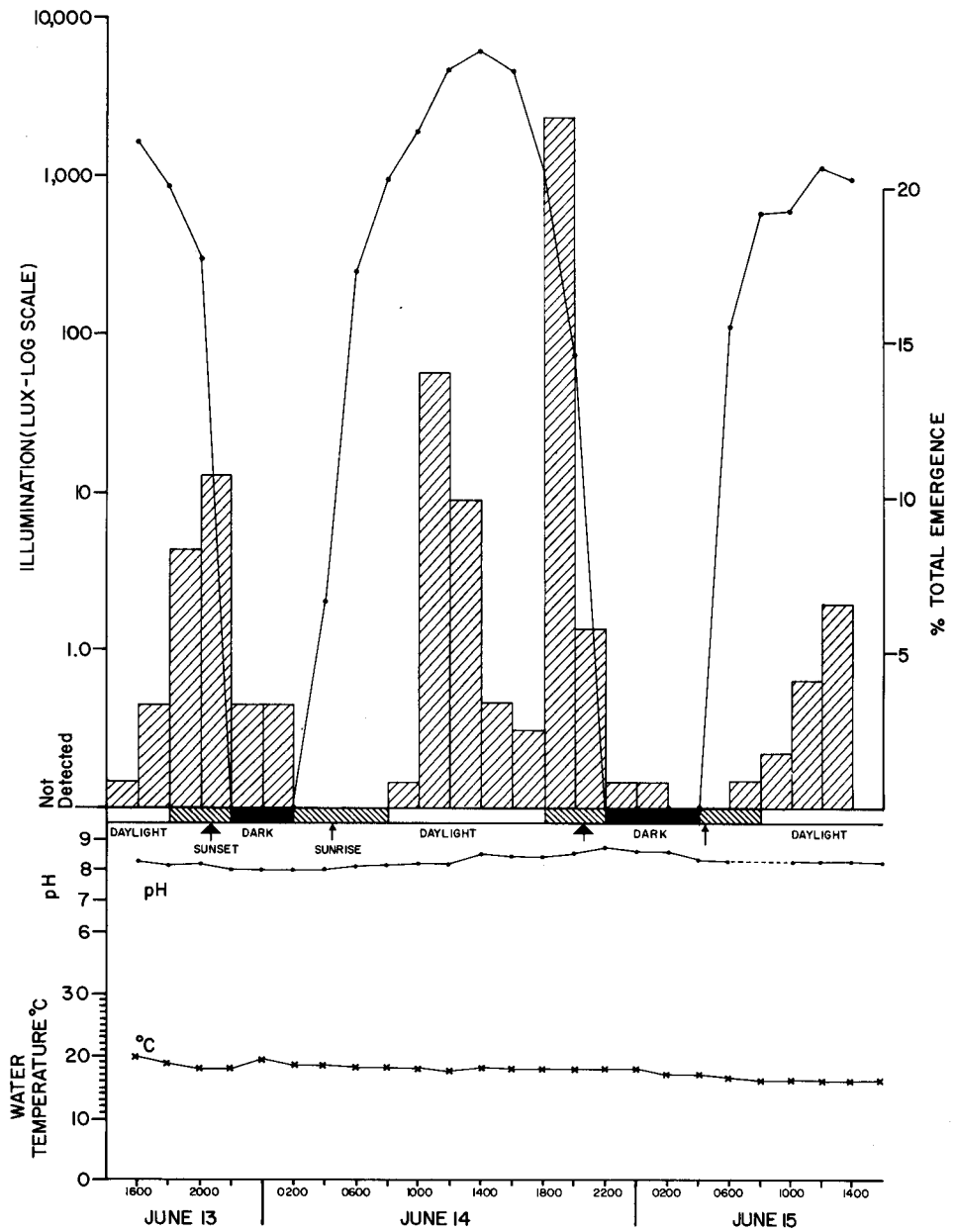


Figure 2. The relationship between emergence time of mayflies and various physical and chemical factors during the June, 48 h sample periods.

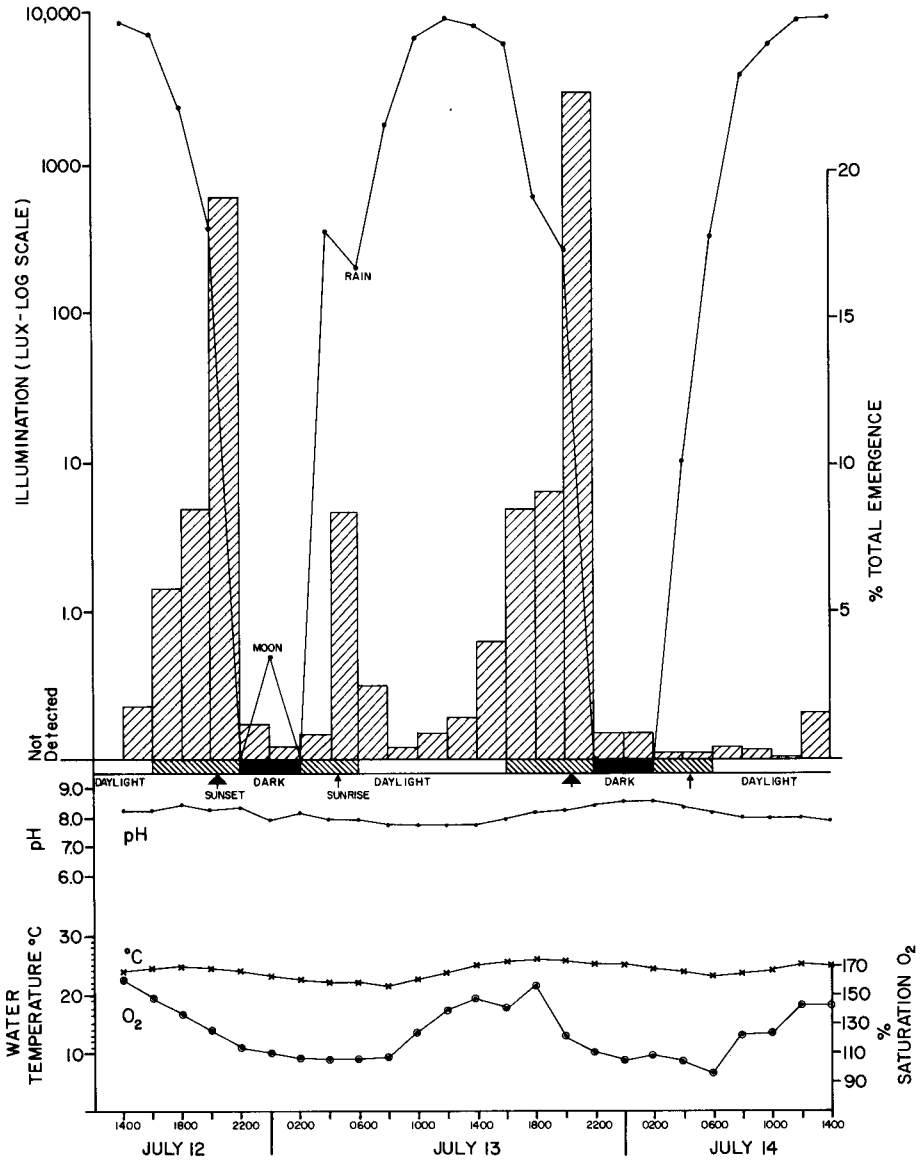


Figure 3. The relationship between emergence time of mayflies and various physical and chemical factors in the July 48 h sample periods.

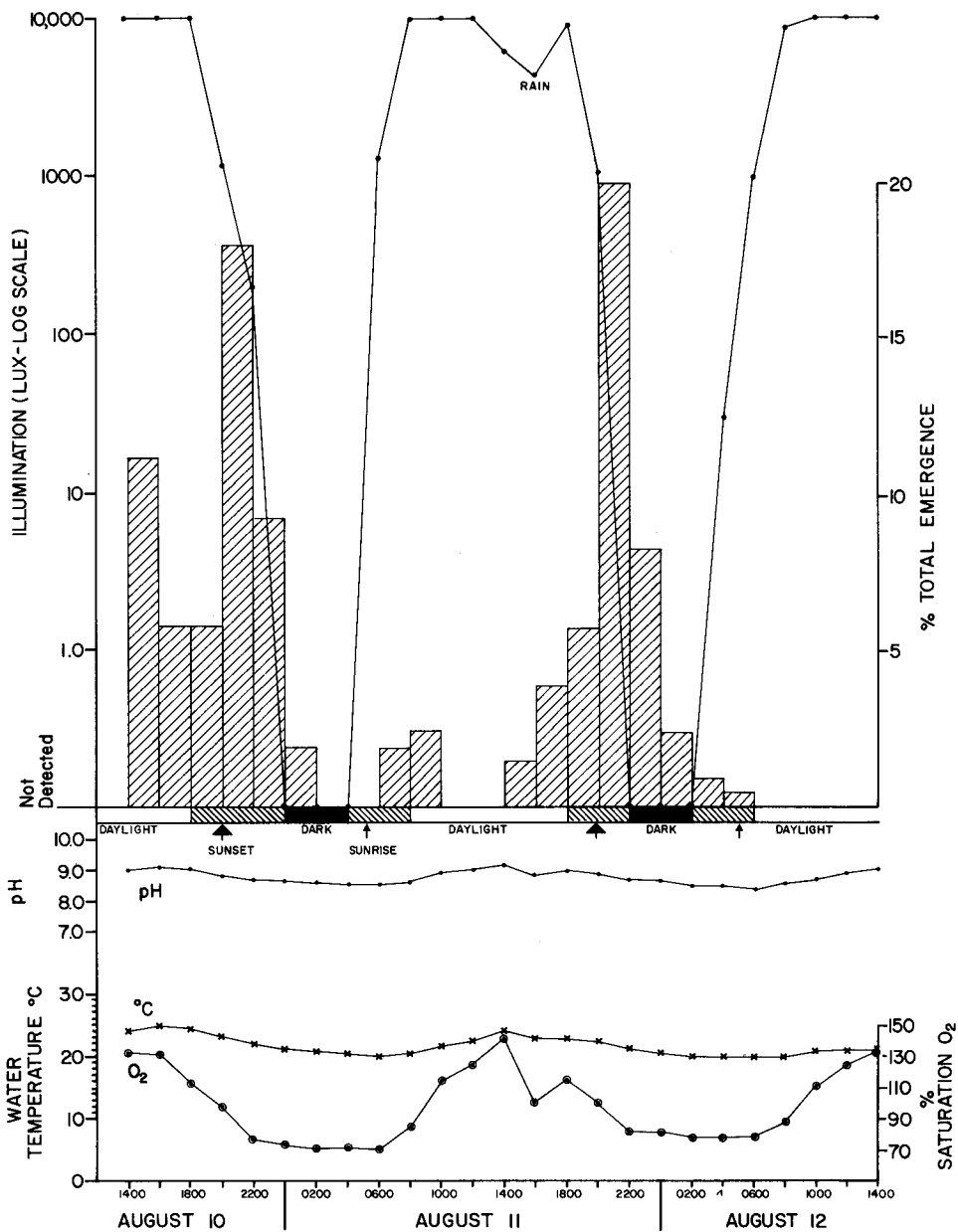


Figure 4. The relationship between emergence time of mayflies and various physical and chemical factors during the August 48 h sample periods.

egg-laying.

Temporal separation over the emergence season may serve to reproductively separate species. In the present study, there is no distinct temporal separation over a 24 h period between congeneric species or between families. Possible exceptions are males of *Baetis spinosus* and *Rhithrogena pellucida* which emerged at times quite different from most of the other species. However, the sample numbers are too low to draw any firm conclusions. There does seem to be a slight separation in time of emergence peaks between *B. intercalaris* and *B. pygmaeus*, and *Pseudocloeon dubium* ? and *P. punctiventris*, but whether this small difference is significant in terms of isolation of species cannot be determined from these data.

Boerger and Clifford (1975) found no difference in the daily mean time of emergence of male and female *Baetis tricaudatus* Dodds when sampled at hourly intervals over 24 h periods. Synchronous emergence of both sexes occurred in most species studied here and is an obvious selective advantage in ensuring the presence of both sexes and increasing the chances for intraspecific reproductive encounters.

Mayflies have evolved mechanisms which lead to the emergence of large numbers of the same species over brief time periods to ensure successful mating. The consistent emergence at dusk of the various species indicates light intensity as an important environmental cue, since it seems unlikely that other factors could act on the different species in a consistent, yet unique enough manner to lead to such a uniform response. The emergence of *B. intercalaris*, which coincides with sunset and sunrise in July and sunset in August also suggests a response related to light. Emergence at dawn in July may also have been influenced by presence of moonlight or cloud cover. Peak emergence of this species at mid-day in the June sample period indicates that if light is important, it is not the only influencing factor. The possibility exists that this shift in time of day of emergence is an adaptation to ensure that the adult emerges at a time of day at which the air temperatures are suitable for flight activity (see Flannagan 1978).

Emergence at a similar time of day of different mayfly species and synchronous emergence of sexes of the same species are probably important adaptations to ensure survival of adequate numbers of organisms for successful reproduction. The role of environmental factors, particularly, light, an initiating emergence needs further investigation and will probably require laboratory studies to fully elucidate this phenomenon.

Figure 5

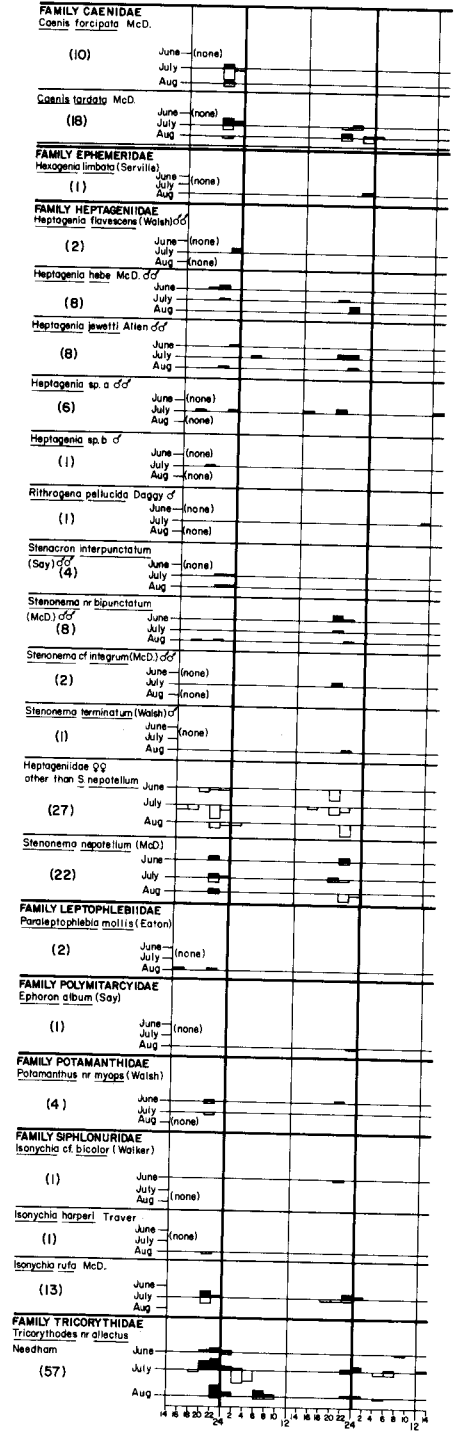
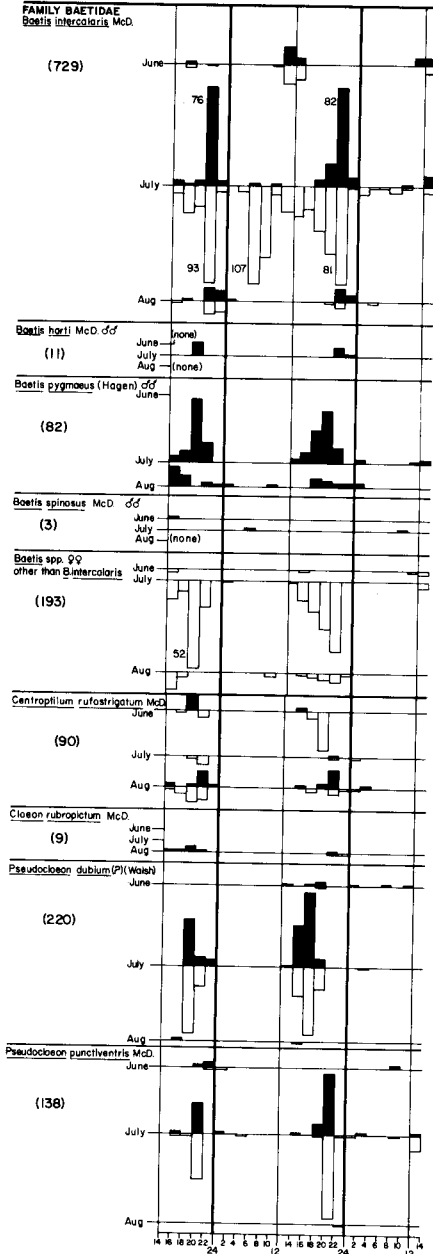


Figure 5. Diel emergence patterns of mayfly species for the 48 h sample periods in June, July and August. Numbers in parentheses indicate total number of animals collected. Histograms (black) above the line represent males and those below (white) indicate females. Numbers are given where the scale has been adjusted.

RESUME

Un contrôle de l'émergence des éphéméroptères a été effectué à des intervalles de 2 h durant des périodes de 48 h aux mois de juin, juillet et août 1976. On a constaté au cours de ces trois périodes d'observation que l'émergence des éphéméroptères avait lieu davantage de midi jusqu'à ce qu'il fasse noir et surtout au crépuscule. En général, les moments de la journée où elle s'est produite étaient les mêmes pour chacune des espèces de mois en mois. On a toutefois signalé trois exceptions importantes à ces tendances générales: le mâle adulte de l'espèce *Baetis intercalaris* émergeait au milieu de la journée en juin, tandis que la femelle adulte de la même espèce ainsi que la femelle de l'espèce *B. intercalaris* et *Tricorythodes* nr. *allectus* émergeaient à l'aube au cours de la période d'étude de juillet. Dans le cas des espèces dont une quantité considérable de mâles et de femelles se transformaient en adultes, l'émergence des représentants des deux sexes avait tendance à se produire au cours des mêmes périodes.

ZUSAMENFASSUNG

Zwischen Juni und August 1976 wurde das Auftreten von Eintagsfliegen über eine 48 Stunden Periode in zweistündigen Abständen jeden Monat überwacht. In allen drei Beobachtungsperioden kamen die Fliegen am häufigsten zwischen Mittag und Einbruch der Dunkelheit zum Vorschein. Dabei traten sie am zahlreichsten zur Zeit der Dämmerung auf. Im allgemeinen war die Tageszeit, zu der die Fliegen von Monat zu Monat auftraten, für alle Arten die gleiche. Eine Ausnahme zu diesem allgemeinen Trend machten zunächst *Baetis intercalaris*, die im Juni um die Mittagszeit zum Vorschein kamen, und dann die Weibchen von *Baetis intercalaris* und *Tricorythodes* nr. *allectus*, die im Juli zur Zeit der Morgendämmerung erschienen. Von Arten, bei denen eine beträchtliche Anzahl von männlichen und weiblichen Fliegen in Erscheinung traten, hielten sich beide Geschlechter an die gleichen Zeitabstände.

ACKNOWLEDGMENTS

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