

From "Circadian clocks" - 1965

Ed. J. Aschoff, North-Holland

**FIELD EXPERIMENTS ON PERIODICITY OF FRESHWATER INVERTEBRATES** *Publ. Comp.*

K. MÜLLER

*Max-Planck-Institut für Verhaltensphysiologie,  
Seewiesen und Erling-Andechs, Germany*

PRIVATE LIBRARY  
OF WILLIAM L. PETERS

1. INTRODUCTION

Tanaka [1960], Waters [1962] and Müller [1963a-c] investigated the problem of organic drift in current waters in order to get information on the locomotor activity of organisms living in current waters. During a two

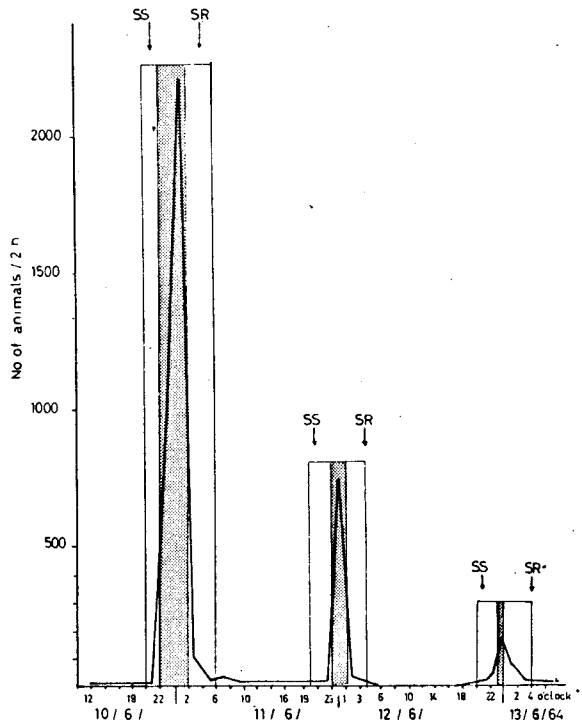


Fig. 1. Activity pattern of nymphs of *Baetis* in artificially shortened nights. Dotted areas indicate times of darkness. Intensity of artificial light 14 000 lux. SS = sunset, SR = sunrise.

years period we studied the daily cycle of activity of freshwater invertebrates by measuring their daily drift. The working method is given in detail in Müller [1964].

Here I shall report investigations on the daily cycle of nymphs of *Baetis vernus* and *Baetis rhodani* under natural and artificial light conditions. Basic patterns of activity of *Baetis vernus* and *Baetis rhodani* were similar. The principal peak, observed in the second half of night is preceded by a secondary peak some time after dusk, in line with the "Alternans" scheme for night-active organisms. In short summer nights there is no secondary peak, whereas during wintertime a secondary doublet can be observed.

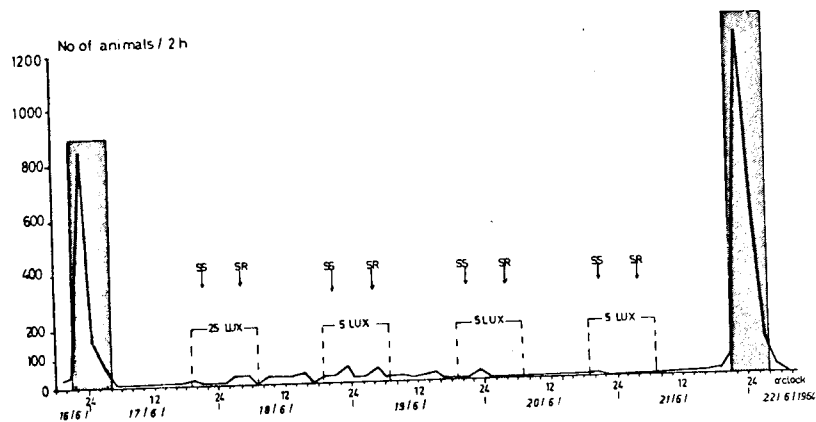


Fig. 2. Activity pattern of nymphs of *Baetis* under natural LD conditions with different light intensities during the dark-time. SS = sunset, SR = sunrise. Hatched areas indicate natural night, without artificial illumination.

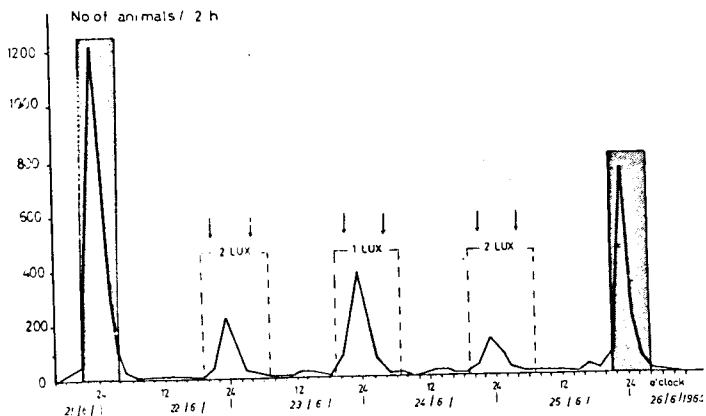


Fig. 3. Activity pattern of nymphs of *Baetis* under natural LD conditions with different light intensities during the dark-time (for further explanations, see fig. 2).

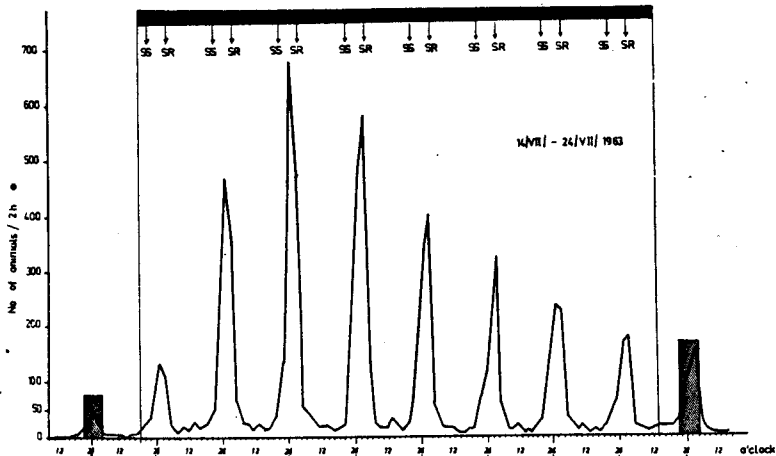


Fig. 4. Activity pattern of nymphs of *Baetis* under DD conditions after natural LD. Time of DD indicated by dotted area (for further explanations see fig. 2).

served. In the permanent light of polar regions nymphs of *Baetis vernus* did not show a rhythmic activity cycle (Müller, 1964).

Experiments were performed with an illuminated test range extending 42 meters from the catcher device up the creek. A blackout arrangement made it possible to eliminate normal daylight.

## 2. RESULTS

2.1. When the nights were gradually shortened activity of the *Baetis* nymphs could be observed even in LD 23:1. With such extremely short dark-times the peak of drift activity was minimal (see fig. 1). In permanent light, there is almost no drift activity. A diurnal rhythm was not observed. The minimum light intensity in D which can influence the larval cycle of activity is 5 lux (as measured at the water surface). Smaller light intensities (1 or 2 lux) were not able to interfere with the activity cycle. The peak height of drift, however, is extremely reduced in correlation with the light intensity. That is to say, the reduction is greater for 2 lux than for 1 lux (see figs. 2, 3).

The original basic pattern remains constant, if the light conditions for the nymphs of *Baetis* are changed from LD to DD. The drift activity reaches a maximum range 54 hr after the beginning of DD, it drops continuously after this time (see fig. 4).

### 3. CONCLUSION

Based on her own experiments Harker [1953] pointed out that nymphs of *Baetis rhodani* possess an endogenous rhythm of locomotor activity. Our results do not contradict this interpretation; it is most likely, however, that the pattern of activity for nymphs of *Baetis* is influenced to a high degree by the action of light.

I wish to thank Professor Dr. H. Sioli for assigning the working place and for leaving the equipment at my disposal.

### REFERENCES

- Harker, J. E., 1953, J. Exptl. Biol. 30, 525.  
Müller, K., 1963a, Naturwiss. 50, 161.  
Müller, K., 1963b, Naturwiss. 50, 410.  
Müller, K., 1963c, Nature 198, 806.  
Müller, K., 1964, Die Tagesperiodik der Fliesswasserorganismen (in press).  
Tanaka, H., 1960, Bull. Freshwater Fisheries Res. Lab. Tokyo 9, 13.  
Waters, Th., 1962, Ecology 43, 316.