

Diel dynamics of feeding and locomotor activities in the large pine weevil, *Hylobius abietis*

ENNO MERIVEE, IVAR SIBUL, ANNE LUIK

Institute of Plant Protection

Estonian Agricultural University

Kreutzwaldi street 64, Tartu, EE2400, Estonia

Merivee E., Sibul I., Luik A. 1998. Diel dynamics of feeding and locomotor activities in the large pine weevil, *Hylobius abietis*. *Baltic Forestry*, 2: 59-62.

Diel locomotor and feeding activity of the large pine weevil *Hylobius abietis* was studied in laboratory conditions using video recordings. The weevils showed a well-defined peak of locomotor activity during several hours of scotophase. In the daytime the beetles were relatively inactive. These rhythms appears to be of an endogenous origin. Clearly expressed periods of high and low activity were not observed in feeding of the beetles. The female beetles spent relatively more time on feeding than the male beetles did.

Key words: *Hylobius abietis*, *Curculionidae*, *Coleoptera*, locomotor activity, feeding activity, diel periodicity.

Introduction

The large pine weevil, *Hylobius abietis* L. is one of the most destructive forest insect pests in many parts of Europe where clear-cutting and reforestation by planting is practised (Heritage *et al.*, 1989; Wilson and Day, 1994). Active spring movement of weevils starts generally in the second half of May when temperatures are around 18°C (Christiansen and Bakke, 1968; Långström, 1982). Usually in Northern European conditions mass flight occurs from the middle of May till the second half of June (Eidmann, 1974; Solbreck and Gyldberg, 1979; Lekander *et al.*, 1985). At this time weevils concentrate by olfaction to fresh clear cut areas where they are looking for maturation feeding on the cambial layers of young conifer tree stems and shoots and for oviposition on the roots of the stumps in recently felled conifer trees or in the logging slash mixed with soil and ground litter (Nordlander, 1987; Nordenhem and Eidmann, 1991; Nordlander, 1991; Zumr and Sary, 1993; Wilson and Day, 1995).

To apply a successful pest-management strategy, sound knowledge is required concerning the ecology and behaviour of the large pine weevil. A number of works has been published on the seasonal activities of *H. abietis*, for example, on seasonal migrations (Nordenhem, 1989; Zumr and Sary, 1993; Zumr and Sary, 1994; Leather *et al.*, 1995) and on oviposition (Lekander *et al.*, 1985). The adult feeding preferences and consumption rates of *H. abietis* have been tested with three different

host plants, *Pinus sylvestris*, *Picea abies* and *Fraxinus excelsior* (Leather *et al.*, 1995), however, no investigations on the diel rhythm of feeding and locomotion have been reported earlier. Better knowledge about these activity patterns and how they are influenced by environmental factors may be of practical value, e. g. in connection with the development of silvicultural methods aiming at reducing pine weevil damage on planted conifer seedlings. The objective of the current work was to obtain new information on the diel periodicity of the locomotor and feeding activities in the large pine weevil. This research is a prerequisite for future electrophysiological and behavioural studies on the olfactory orientation mechanisms and tactics in this weevil species.

Material and methods

In late May 1996, *H. abietis* adults were collected from an area in South Estonia which had been clear-cut for mixed conifers a few months before. The weevils were stored in glass boxes with moistened filter paper and placed in a dark room at +10° C for 1-2 days. Pine twigs were provided as food.

The weevils to be used in the experiments were moved under the cover of small Petri dishes (height 5 mm, i. d. 42 mm) mounted at the height of 2 mm from the surface of 30x40 cm transparent plexiglass plate in order to guarantee air circulation between the chambers and the room. Fresh pine twigs (42x5 mm) were provided as food.

The plate was placed in a 1x1x1.5 m box made of black cardboard, in order to prevent influence of outdoor light and visual cues. Prior to the experiments the beetles were adjusted to experiment conditions (temperature $20 \pm 1^\circ \text{C}$, RH=57 %) in a period of 4 h. The activities of the beetles (females and males) were videorecorded continuously within 24 hours over two periods, on May 22-23 and on May 29-30, 1996, for females and males respectively. Light intensity of 2100 lux was used to simulate daylight conditions. The low intensity (20 lux) illumination of the background simulated nocturnal conditions for the test beetles, while providing a sharp silhouette of the beetles on TV screen. Experimental dark periods from 5 to 7 hours more or less coincided with natural dark period at this geographical latitude. Due to the using of daylight lamps of low production of warmth the temperature and humidity in the experimental chambers remained constant. The start and end of the feeding and locomotor activities were determined visually on TV screen later. A t-test was used (P-levels were calculated) to evaluate differences between the mean activities (min/h).

Results and discussion

Locomotor activity

The diel locomotor activity of male and female beetles was in principle similar. The beetles of both sexes showed a well-defined peak of the activity during several hours of scotophase. At noon the beetles were relatively inactive (Fig. 1A, B). Walking activity of both females and males increased prior to the scotophase and decreased a few hours after the end of scotophase which allows us to presume that changes in the activity of the weevils were not determined by external factors such as light intensity, room temperature or relative humidity. Obviously, the diel periodicity in locomotor activity of the large pine weevil is of endogenous origin. Eidmann (1974) has also reported that pine weevils have low locomotor activity during midday. In the field the beetles fly mainly in the afternoon and evening

The male beetles were more active than females, i. e. the activity measured for males on average was 14.7 min/h as compared to 11.9 min/h for females. In accordance with t-test the difference was statistically significant ($P=0.0105$).

Feeding activity

The average feeding activity of the beetles varied between 5.5 to 18.4 min/h in females and 3.5 to 9.9 min/h

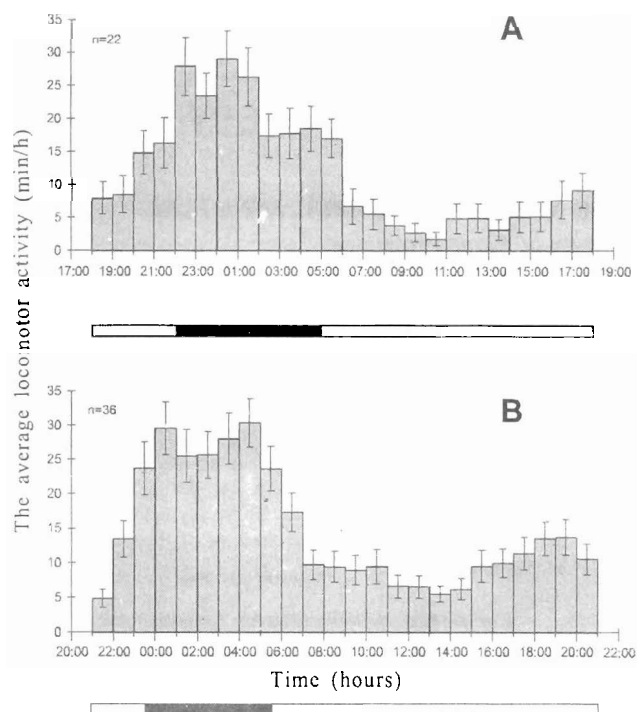


Fig. 1. Diel locomotor activity (min/h) of female (A) and male (B) pine weevils *Hylobius abietis*. Vertical lines indicate standard errors. Horizontal white and black bars indicates the experimental light and dark periods, respectively

h in males (Fig. 2A, B), however in most cases the differences were statistically not significant ($P>0.05$). Although a certain rise in the activity was observed during several hours in the evening and early at night in both sexes, the differences of the average feeding activities were statistically significant only in the case of male beetles ($P<0.05$). In contrast to male beetles, the level of the activity of female beetles was relatively low during the period of 6 a.m. to 6 p.m. (during this period seven smallest values of the average activities of one hour were recorded), however, only at noon the difference was significant. As there seems to be no connection between the level of the activity of the beetles and light intensity, it is presumed, that the periodicity of the activity is of endogenous origin.

When the average feeding activities of females and males were compared, it became evident, that the female beetles spent relatively more time on feeding than the male beetles did, 10,2 and 7,2 min/h ($P=0.0003$), respectively. The females which emerged and started feeding in autumn before hibernation need additional feeding also in spring for their complete maturation. However, physiological tests have shown that maturation of female's

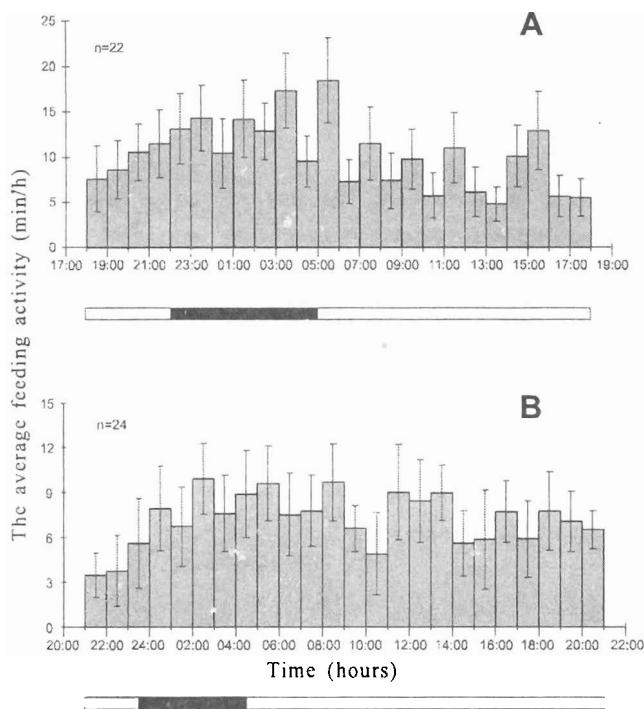


Fig. 2. Diel feeding activity (min/h) of female (A) and male (B) pine weevils *Hylobius abietis*. Vertical lines indicate standard errors. Horizontal white and black bars indicate the experimental light and dark periods, respectively

generative organs depends mainly on fat body reserves (reviewed by Eidmann, 1974).

Conclusions

The large pine weevils showed a well-defined peak of locomotor activity during several hours of scotophase. In the daytime the beetles were relatively inactive. These rhythms appear to be of an endogenous origin. Significant peak activity periods were not observed in feeding of the beetles. The female beetles spent relatively more time on feeding than the male beetles did.

Acknowledgement

We thank Ms Reesi Lepa for helping to translate the manuscript into English.

References

- Christiansen E., Bakke A. 1968. Temperature preference in adults of *Hylobius abietis* L. (*Col., Curculionidae*) during feeding and oviposition. *Z. ang. Ent.* 62: 83-89.
- Eidmann H. H. 1974. *Hylobius* Schönh. In: W. Schwenke (Editor), *Die Forstschädlinge Europas*, 2. Band (Käfer). Verlag Paul Parey, Hamburg, Berlin, pp. 272-293.
- Heritage S. G., Collins S., Evans H. F. 1989. A survey of damage by *Hylobius abietis* and *Hylastes* spp. in Britain. In: R. I. Alfaro and S. G. Glover (Editors), *Insects Affecting Reforestation: Biology and Damages*. Forestry Canada, Pacific and Yukon Region, Victoria, Canada, pp. 28-33.
- Långström B. 1982. Abundance and seasonal activity of adult *Hylobius*-weevils in reforestation areas during first years following felling. *Comm. Inst. For. Fenn.* 106: 1-3.
- Leather S. R., Ahmed S. I., Hogan L. 1994. Adult feeding preferences of the large pine weevil *Hylobius abietis*. *Eur. J. Ent.*, 91: 385-389.
- Leather S. R., Small A. A., Bogh S. 1995. Seasonal variation in local abundance of adults of the large pine weevil, *Hylobius abietis* L. (*Col., Curculionidae*). *J. Appl. Ent.*, 119: 511-513.
- Lekander B., Eidmann H. H., Bejer B., Kangas E. 1985. Time of oviposition and its influence on the development of *Hylobius abietis* (L.) (*Col., Curculionidae*). *Z. ang. Ent.*, 100: 417-421.
- Nordenhem H. 1989. Age, sexual development, and seasonal occurrence of the pine weevil *Hylobius abietis* (L.). *J. Appl. Ent.*, 108: 260-270.
- Nordenhem H., Eidmann H. H. 1991. Response of the pine weevil *Hylobius abietis* L. (*Col., Curculionidae*) to host volatiles in different phases of its adult life cycle. *J. Appl. Ent.*, 112: 353-358.
- Nordlander G. 1987. A method for trapping *Hylobius abietis* (L.) with a standardized bait and its potential for forecasting seedling damage. *Scand. J. For. Res.*, 2: 199-213.
- Nordlander G. 1991. Host finding in the pine weevil *Hylobius abietis*: effects of conifer volatiles and added limonene. *Entomol. Exp. Appl.*, 59: 229-237.
- Solbreck C., Gyldberg B. 1979. Temporal flight pattern of the large pine weevil, *Hylobius abietis* L. (*Col., Curculionidae*), with special reference to the influence of weather. *Z. ang. Ent.* 88: 532-536.
- Wilson W. L., Day K. R. 1994. Spatial variation in damage dispersion, and the relationship between damage intensity and abundance of the pine weevil (*Hylobius abietis* L.). *Int. J. Pest Managem.*, 40: 46-49.
- Wilson W. L., Day K. R. 1995. The comparative effectiveness of chemical traps, and fir, spruce and larch billets, for the estimations of pine weevil (*Hylobius abietis* L.) (*Col., Curculionidae*) density indices. *J. Appl. Ent.*, 119: 157-160.
- Zumr V., Stary P. 1993. Baited pitfall and flight traps in monitoring *Hylobius abietis* (L.) (*Col., Curculionidae*). *J. Appl. Ent.*, 115: 454-461.
- Zumr V., Stary P. 1994. Monitoring of seasonal occurrence of *Hylobius abietis* (L.) (*Col., Curculionidae*) in different forest environments of a model area. *J. Appl. Ent.*, 118: 361-364.

Received 06 March 1998

СУТОЧНАЯ ДИНАМИКА АКТИВНОСТИ ПИТАНИЯ И ЛОКОМОЦИИ БОЛЬШОГО СОСНОВОГО СЛОНИКА, *HYLOBIUS ABIETIS*

Э. Меривеэ, И. Сибул, А. Луйк

Резюме

В лабораторных условиях методом непрерывной видеозаписи в течение от одного до двух суток изучали суточную активность локомоции и питания большого соснового слоника, *Hylobius abietis*. Четко выраженный пик локомоторной активности жуков обоих полов регистрировали в течение нескольких часов скотофазы. Днём жуки были относительно неактивны. Предполагается, что эти суточные ритмы активности являются эндогенными. В питании жуков ясно выраженные периоды высокой и низкой активности не наблюдались. Средняя суточная активность питания самок была существенно выше, чем у самцов.

Ключевые слова: *Hylobius abietis*, *Curculionidae*, *Coleoptera*, локомоторная активность, активность питания, суточная динамика.