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Changes in the abundance of *Melolontha hippocastani* Fabr. and *Melolontha melolontha* (L.) (Coleoptera: Scarabeidae) in the Czech Republic in the period 2003–2009

M. Švestka

Forestry and Game Management Research Institute, Strnady, Jíloviště, Czech Republic

ABSTRACT: In the period between 2003 and 2009 we evaluated the abundance of adults of *Melolontha hippocastani* Fabr. and *Melolontha melolontha* (L.) cockchafers in four forest regions of the Czech Republic. During this period each of the evaluated localities was hit twice by heavy swarming. The course of swarming, species composition, abundance of the respective tribe, sex ratio during swarming and the correlation between the course of swarming and average daily temperature were monitored by means of a light trap, an automatic meteorological station and observations in the open space; the data were represented in the form of graphs. We evaluated how the trend of the abundance of the particular species developed in the respective localities in order to work out a more specific prediction of the occurrence of the cockchafer in subsequent years and the extent of damage caused by the grubs to forest plantations. Research will continue in 2010–2011.

Keywords: abundance; light trap; *Melolontha hippocastani* Fabr.; *Melolontha melolontha* (L.); sex ratio

Three species of the genus *Melolontha* Fabr. occur in the Czech Republic; but only two species, *Melolontha melolontha* (L.) and *Melolontha hippocastani* Fabr., are of economic importance for agriculture and forestry. Of the greatest importance for forestry is the species *M. hippocastani* Fabr., which is widespread in several forest areas in warm locations on sandy soil. Mass outbreaks of the species *M. melolontha* (L.) on forest soil occur to a limited extent only. The third species, *Melolontha pectoralis* Germ., appears sporadically and is not economically important.

The species *M. hippocastani* Fabr. occurs in the forest and forest-steppe regions of Russia from the Primorije westward all the way to central and northern Europe (Lisov 1984). In central Europe the species *M. melolontha* (L.) is more abundant while the habitat of *M. hippocastani* Fabr. is the bounded forest localities with sandy soil (Hase 1984). In the territory of Poland these two species of cockchafers appear alternately (Sierpińska 2008); five major *M. melolontha* (L.) tribes were discovered there, of which four tribes appear in four-year cycles and one tribe in a five-year developmental cycle; nine tribes of *M. hippocastani* Fabr. occur, of which four appear in four-year cycles and five in five-year developmental cycles. Similarly in Denmark, northern Germany and Sweden both species of cockchafers appear in four to five year cycles (Christensen 1986). In southerner parts of Europe (south Germany, Austria, Switzerland) both species of cockchafers appear in four or three-year developmental cycles (Bulmer 1977).

Kratochvíl et al. (1953) and Muška (1975) explored the periodicity of the incidence of cockcha-

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fers and the cockchafer tribes in the territory of the Czech Republic. They discovered the incidence of four four-year cycle tribes and three three-year cycle tribes of *M. melolontha* (L.). In the past the incidence of cockchafers and the damage they caused were not differentiated according to the individual species. In the past nobody in the Czech Republic systematically differentiated the *M. hippocastani* Fabr. tribes. Since 2003 the individual *M. hippocastani* Fabr. tribes have been monitored in the forest regions of the Czech Republic. The hitherto known information is presented in this study. Evaluations will continue in 2010–2011.

The objective of the study and studied regions

Research was launched in 2003. The objective was to explore the species composition and characteristics of the individual tribes in selected localities with strong tribes of cockchafers of the genus *Melolontha*. At the same time to monitor and evaluate the course of temperatures with regard to the bionomics of the species. Investigations were focused on four forest localities with predominantly sandy soil where the forest plantations were damaged by grubs and where trees were defoliated due to maturation feeding of the adults. In the past two decades the grubs of *M. hippocastani* Fabr. seriously hindered the regeneration of forest stands in some regions. The results of evaluations of the abundance of cockchafers and the extent of damage to the plantations will be processed in a separate study.

M. hippocastani Fabr. is more important for forestry of the Czech Republic at the present time; mass outbreaks of the insect in southeast Moravia and central Bohemia endanger the forests. In these two relatively distant areas the cockchafer is abundant and the tribe appears in a cycle of every four years. By feeding on roots of forest seedlings, particularly pine, oak, linden etc., the grubs cause heavy losses; locally the losses may be to an extent of 100% (annual reports of forest administrators). In these two localities there are more than 25,000 ha of forests suitable for outbreaks of this insect. At the present time on forest soil we see the gradation of the species *M. melolontha* (L.) only in one locality of south Moravia (Muška 1975).

MATERIAL AND METHODS

The localities Vracov and Bulhary are situated in south-east and south Moravia, respectively, where the long-term average air temperature is 9.3°C. The localities Kluk and Lipník lie in central Bohemia, where the long-term average air temperature is 8.9°C. The localities are the warmest regions of the Czech Republic; annual precipitation ranges around 450 mm (Tolasz et al. 2007).

In 2003 to 2009 we monitored the course of swarming in four localities using light traps with a HQL 125 W discharge lamp. In the particular years, from April to the first half of June, the numbers of trapped cockchafers and the sex ratio were recorded. Swarming was monitored by means of light traps since 2003 in Vracov and Lipník and since 2004 in Bulhary and Kluk. All the time the light traps were placed at permanent posts selected on the basis of their connection to the electric network (Table 1).

In 2003 to 2009 maximal, minimal and average daily temperatures were recorded in the Vracov locality during vegetation and interpreted by means of an automatic meteorological station of the 431 B type. The data were processed as monthly surveys using daily data and annual surveys using 10-day data. Subsequently the correlation between the swarming of cockchafers and average daily temperatures was interpreted.

In forest stands in Lipník in 2004 and in Vracov in 2007 the sex ratio was evaluated on a given date during swarming in forest stands and compared

Table 1. Survey of the studied localities

Locality	Property of Forest district	Dominant cockchafer species	Coordinates	Altitude (m)	Checked in
Vracov	Strážnice	*M. hippocastani* Fabr.	48°58'6"N, 17°13'14"E	193	2003–2009
Bulhary	Židlochovice	*M. melolontha* (L.)	48°49'13"N, 16°43'44"E	220	2004–2009
Kluk	Nymburk	*M. hippocastani* Fabr.	50°6'19"N, 15°7'12"E	191	2004–2009
Lipník	Mimoň	*M. hippocastani* Fabr. *M. melolontha* (L.)	50°14'54"N, 14°55'50"E	250	2004–2009

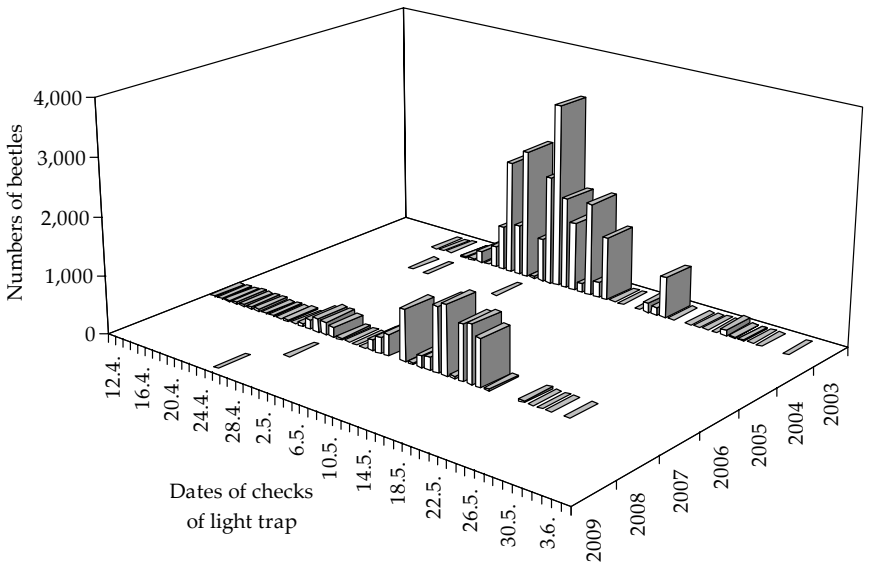

Fig. 1. Course of *Melolontha hippocastani* Fabr. swarming, Vracov 2003–2009

with the sex ratio discovered on the same date in the light trap. The objective was to estimate if the intensity of attraction of the light traps was the same for the males and females. Regression analysis as well as χ^2-test were performed by Statistica 8.

In all the four localities we evaluated data on the intensity of cockchafer swarming and interpreted the trend of development of the abundance of cockchafer tribes in the particular forest regions and then we estimated the assumed extent of damage to forest plantations in the subsequent period.

RESULTS AND DISCUSSION

Vracov locality

The locality lies in southeast Moravia. The locality is heavily populated with one strong *M. hippocastani* Fabr. tribe appearing in a cycle of every 4 years. Heavy swarming occurred in 2003 (Švestka 2006) and in 2007. In the in-between years adults appeared only sporadically (Fig. 1). Grubs of one instar and sporadically grubs of other instars appear in the soil. On the basis of literary data on mass swarming in the past there is an evidence (Muška 1975) that this tribe has appeared in a cycle of four years on a regular basis for many decades.

On 7 and 9 May 2003 a defence aerial spraying was undertaken on a total area of 508 ha in selected stands of this locality against the swarming adults. With the Hughes 369 E helicopter 0.15 l·ha^{-1} of the Decis EW 50 product was applied in a mixture with the Dedal 90 EC (vegetable oil) carrier substance at 3.3 l·ha^{-1} and water at 6.55 l·ha^{-1}. The date for the intervention was selected in the period when the swarming of adults with a high proportion of

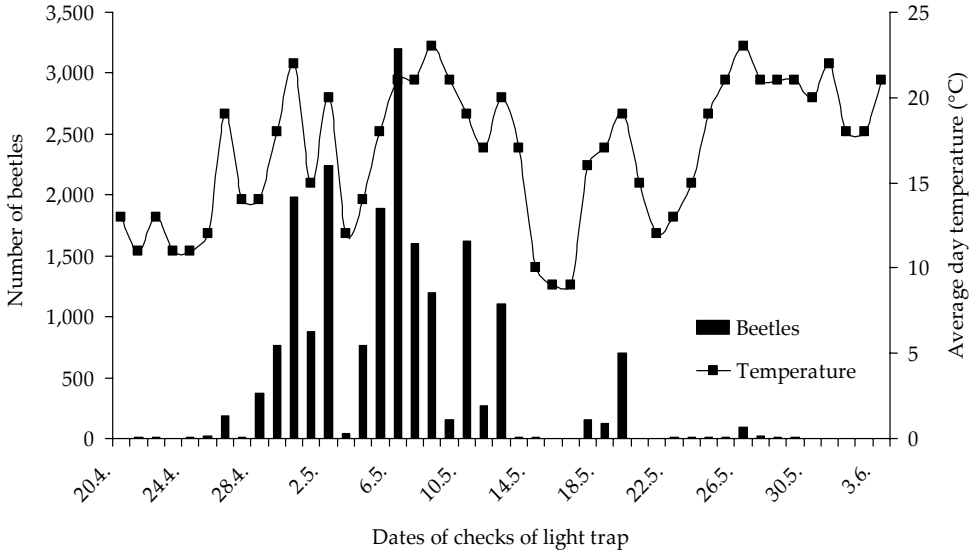

Fig. 2. Course of daily temperature and flight activity of *Melontha hippocastani* Fabr., Vracov 2003

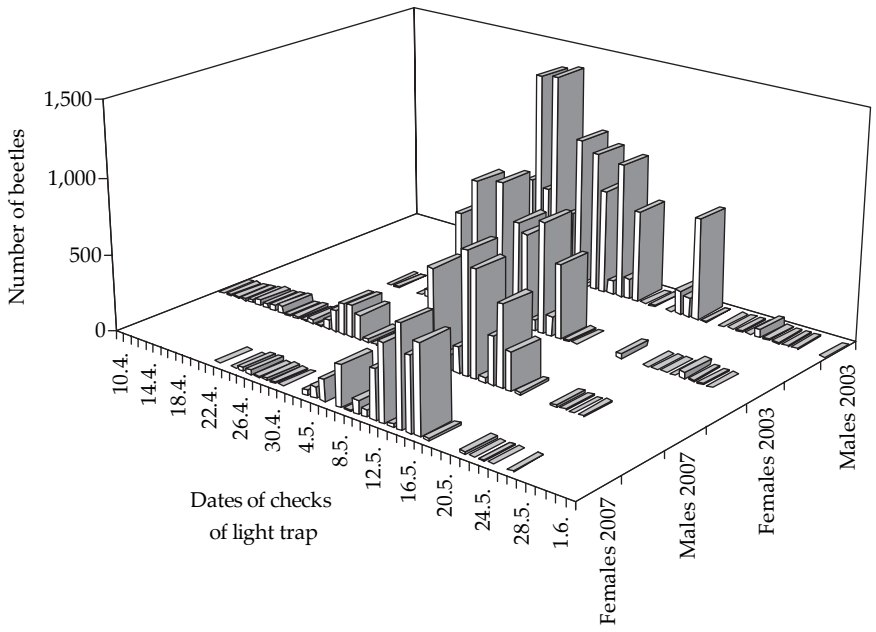

Fig. 3. Swarming of males and females of *Melolontha hippocastani* Fabr., Vracov 2003, 2007

females culminated. The insects died within three days after application.

During swarming in 2003 a total of 19,510 cockchafers were caught in the light traps, of which 12,054 (62%) were males and 7,456 (38%) were females. The first sporadic insects began to appear in the forest stands from 16 April 2003. The first arrival in the light trap was reported on 20 April, when the average daily temperatures reached 12–13°C. The intensity of swarming increased during the subsequent days when the temperatures increased and culminated on 6 May, when the average daily temperature reached 21°C; during the subsequent days the intensity of swarming gradually decreased. The last arrival in the light trap was reported on 2 June. Most of the insects swarmed between 28 April and 12 May, when 1,000–3,000 insects were caught in the trap every day; prevalent average daily temperatures were from 15 to 23°C (Figs. 1 and 2). The daily temperature in May 2003 averaged 17.4°C; during 15 days of the period when swarming culminated, i.e. from 28 April to 12 May, the temperature averaged 18.2°C and during 4 days of this period the maximal temperature rose over 30°C. In Vracov we compared the temperatures in May 2003 with the 10-year average May temperature and we discovered that in May 2003 the average temperature was by 2.3°C higher than the 10-year average. In a 5-day period from 6 to 10 May 2003, i.e. in the period of absolute culmination of

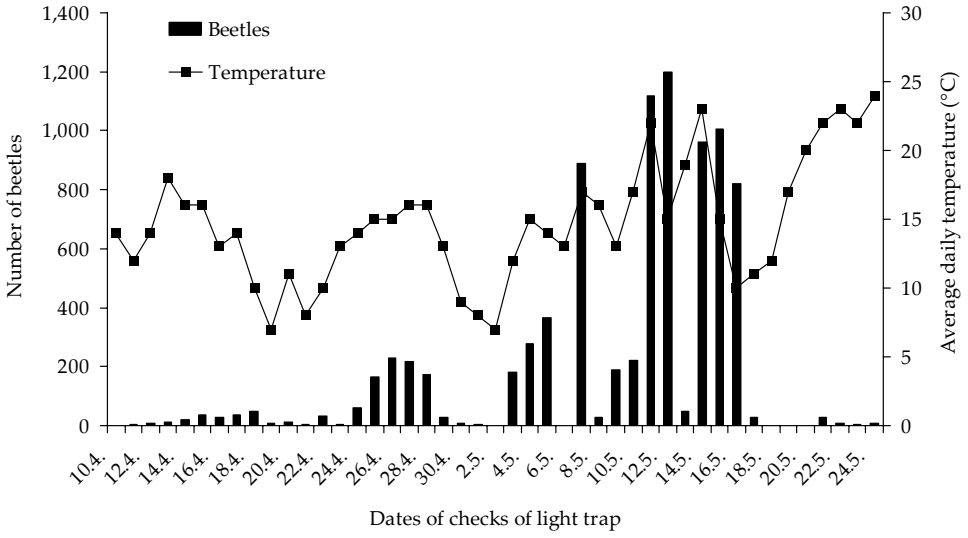

Fig. 4. Course of daily temperatures and flight activity of *Melolontha hippocastani* Fabr., Vracov 2007

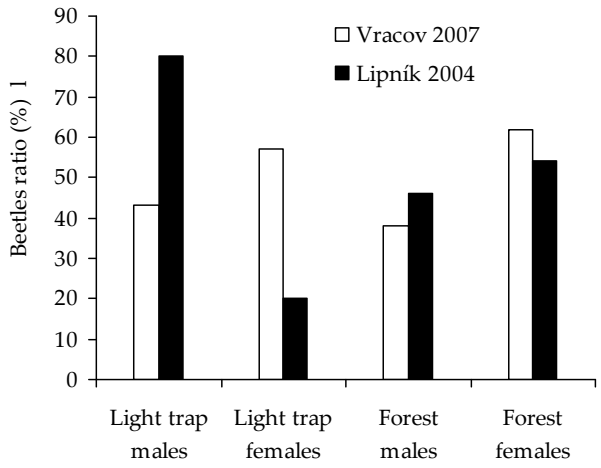

Fig. 5. Comparison of the *Melolontha hippocastani* Fabr. male/female ratio in the light trap and in the open space

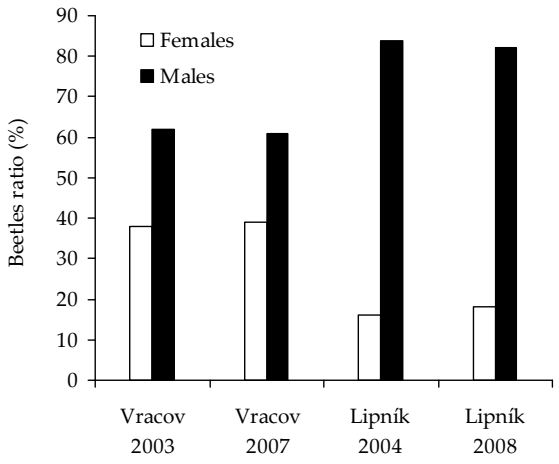

Fig. 6. The *Melolontha hippocastani* Fabr. male/female ratio in the light trap over the entire period of swarming

swarming when the females most frequently laid eggs, the weather was tropical, the average temperature reaching 21°C, i.e. by 6.6°C higher than the 10-year average (Švestka 2007). The great fluctuations in the intensity of swarming were due to low evening and night temperatures (rain). During the entire period of swarming the males outnumbered the females (Fig. 3).

In the subsequent year 2004 only 6 cockchafers were caught in the light trap during the entire period of swarming; in 2005 and 2006 no cockchafers were caught (Fig. 1).

The next swarming took place in 2007; a total of 8,534 cockchafers were caught in the light trap, of which 5,199 were males (61%) and 3,336 were females (39%). The first insects started to appear in the trap from 10 April 2007 when the average daily temperatures reached 12–13°C and the last arrival in the trap was reported on 26 May. Swarming reached its peak between 25 April and 16 May when as many as 1,200 insects were caught in the trap every day and the average daily temperatures ranged predominantly between 15 and 23°C (Figs. 1 and 4). The average temperature in May 2007 reached 16.9°C; on 21 days in the period of peak swarming from 25 April to 16 May the temperature averaged 15.3°C and on 2 days of this period the maximal temperature exceeded 30°C. Comparisons of temperatures from May 2007 in Vracov with the 10-year average temperature in May showed that the average temperature on the experimental plot in May 2007 was by 1.8°C higher than the 10-year average. Within a 10-day period from 6 to 15 May 2007, i.e. in the period of the absolute peak of swarming when the females most frequently laid eggs, the average temperature was 17.1°C, i.e. 2.5°C above the 10-year average. The males outnumbered the females until 15 May; later, at the end of swarming the females outnumbered the males (Fig. 3). In the subsequent years 2008 and 2009 adults were found only sporadically (Fig. 1).

Based on comparisons of the numbers of caught adults of *M. hippocastani* Fabr. in the light trap in 2003 (19,510 specimens) and 2007 (8,534 specimens) it is evident (Fig. 1) that the population density of the species in the Vracov locality in 2007 decreased to ca 48% against 2003. The reduced numbers of this species can be connected with the defence aerial intervention conducted in 2003.

Evaluations of air temperatures during the period of swarming in 2003 and 2007 imply that the swarming of *M. hippocastani* Fabr. adults began in the period when the average daily temperatures reached 12–13°C and that swarming culminated when the average daily temperatures increased to 15–23°C. In 2007 the higher temperatures came sooner and accordingly swarming also began sooner (10 April) than in 2003 (20 April); in 2007 swarming ended sooner (26 May) than in 2003 (2 June). In both years peak swarming took place approximately at the same time; from 28 April to 12 May in 2003 and from 25 April to 16 May in 2007 (Figs. 2 and 4).

Although the temperatures in both years were generally above the average, in 2003 the tempera-

Table 2. The *Melolontha hippocastani* Fabr. male/female ratio in the light trap and in the open space (in %)

	Vracov 2007	Lipník 2004
Light trap-males	43	80
Light trap-females	57	20
Forest-males	38	46
Forest-females	62	54

Table 3. The *Melolontha hippocastani* Fabr. male/female ratio in the light trap over the entire period of swarming (in %)

	Vracov		Lipník	
	2003	2007	2004	2008
Males	62	61	84	82
Females	38	39	16	18

ture during peak swarming and egg-laying was considerably higher (+6.6°C above the average temperature); in 2007 the extreme temperatures were not so marked (+2.5°C above the average temperature). It is possible that this fact influenced the females when they selected a place to lay eggs; this issue will be the subject of further investigations.

On 14 May 2007, 5,383 insects were collected in the forest stands of the Vracov locality, of which 2,025 were males (38%) and 3,358 were females (62%). During the same period (13–15 May) 2,016 insects were caught in the light traps, of which 871 were males (43%) and 1145 were females (57%) (Table 2 and Fig. 5).

Of the total number of cockchafers caught in the light trap in Vracov during the whole period of swarming in 2003 62% were males and 38% were females and in 2007 61% were males and 39% were females – see Table 3 and Fig. 6. No large differences between the males and females were observed in the time of swarming.

In both cases, males significantly prevailed in samplings (2003: $\chi^2 = 1031.7$; $P < 0.00001$; 2007: $\chi^2 = 405.7$; $P < 0.0001$). Significant linear correlations were found between the numbers of caught males and females (2003: $r = 0.93$; $P < 0.0001$; 2007: $r = 0.71$; $P < 0.0001$).

Lipník locality

Lipník lies in the northeastern part of central Bohemia. In the past (1996 and 2000) mass swarming of cockchafers in this area was reported (report of the forest district administrator). In this locality *M. hippocastani* Fabr., which appeared in a cycle of every four years, was represented by one very abundant tribe (swarming in 2004–2008) and two weak tribes (swarming in 2003–2007 and 2006–2010) – see Fig. 7. In the case of the *M. melolontha* (L.) species, which appears in a cycle of every four years, two weak tribes were present (swarming in 2003–2007 and 2004–2008). Swarming of the strong *M. hippocastani* Fabr. tribe caused extensive total defoliation in stands of broadleaved species (2004–2008); in other years defoliation was negligible.

In 2004 during swarming of *M. hippocastani* Fabr. a total of 1,651 adults were caught in the light trap, of which 1,423 were males (86%) and 228 were females (14%) (Švestka 2006). The flight of beetles was monitored from 22 April to 10 June 2004 and heavy swarming with several culminations between 26 April and 20 May were observed; swarming was heaviest on 5 May (Fig. 8). During the entire period of swarming the males considerably outnumbered the females (Fig. 9).

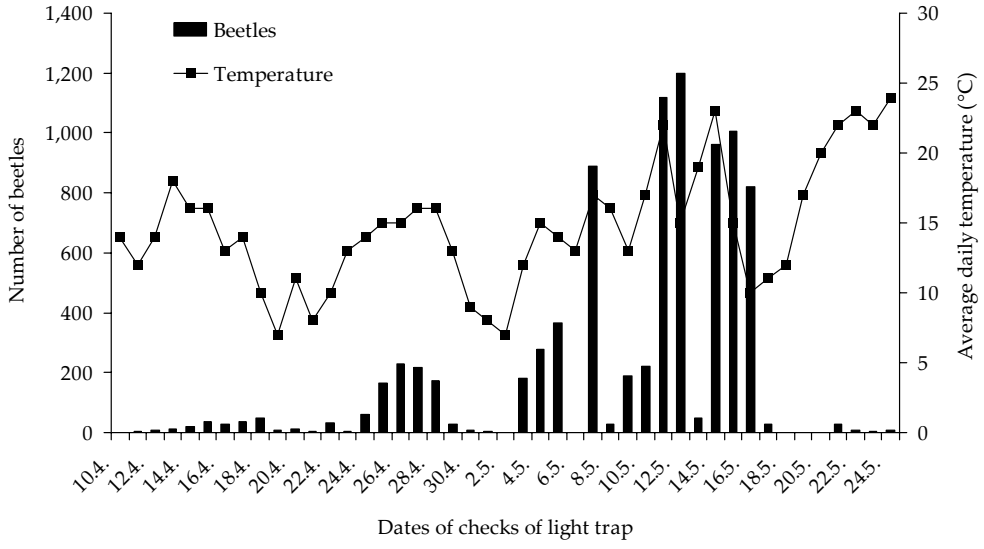

Fig. 4. Course of daily temperatures and flight activity of *Melolontha hippocastani* Fabr., Vracov 2007

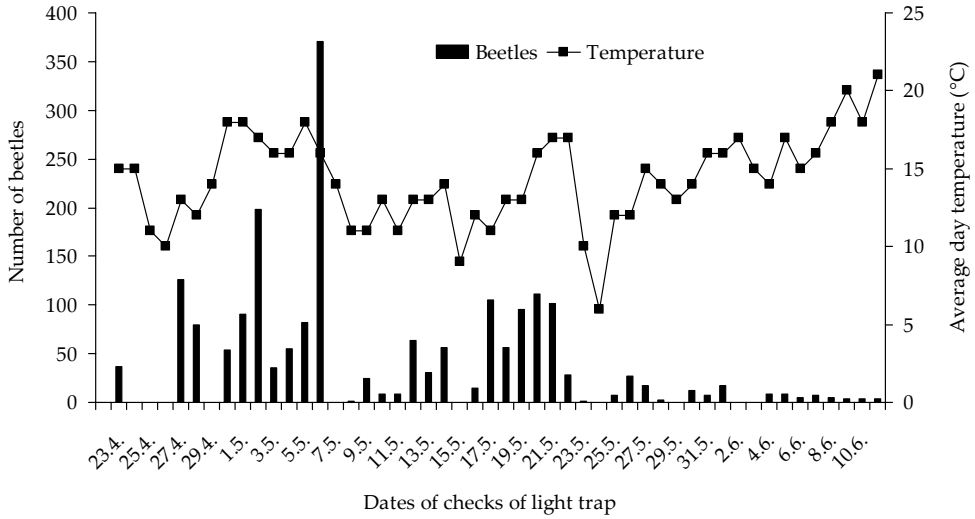

Fig. 8. Course of daily temperatures and flight activity of *Melolontha hippocastani* Fabr., Lipník 2004

In 2008, the next swarming of *M. hippocastani* Fabr., 1,021 adults were caught in the light trap; i.e. 970 males (82%) and 209 females (18%). The flight of beetles proceeded from 26 April to 1 June 2008 and heavy swarming with several culminations was monitored between 28 April and 18 May (Fig. 10). During the entire period of swarming the males considerably outnumbered the females (Fig. 9).

In 2003, 2006 and 2007 the weak tribes of *M. hippocastani* Fabr. and *M. melolontha* (L.) swarmed. In 2003, 299 cockchafers were caught in the light trap, in 2006 only 124 and in 2007 72 cockchafers. In 2005 and 2009 only individual adults appeared.

The proportions of adult *M. hippocastani* F. out of the total number of adults of both species caught in the light trap were 34% in 2003, 84% in 2004, 81% in 2006, 68% in 2007 and 95% in 2008.

On the basis of comparisons of the numbers of *M. hippocastani* Fabr. adults caught in the light trap in 2004 (1,651 specimens) and 2008 (1,021 specimens) it is evident (Fig. 7) that the population density of the species in the Lipník locality in 2008 decreased to ca 62% against 2004. The reduction in numbers of the beetle species was connected with the application of the soil insecticide to the roots of seedlings during planting.

At the time of heavy swarming between 9 May and 26 May 2004 in the forest stands of the Lipník locality we collected 1,249 specimens of *M. hippocastani* Fabr., of which 576 were males (46%) and 673 were females (54%). At the same time 596 specimens of *M. hippocastani* Fabr. were caught in the light trap, of which 478 were males (80%) and 118 were females (20%) – see Table 2 and Fig. 5.

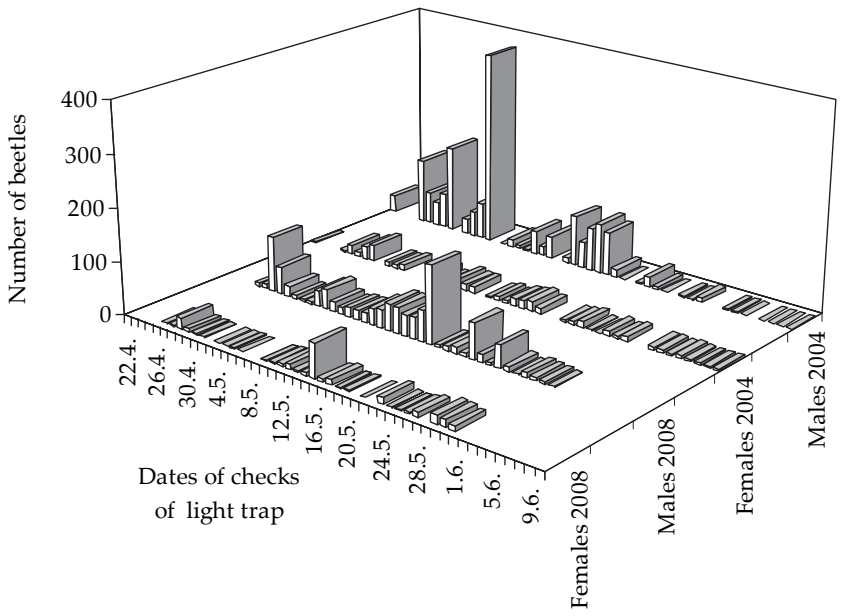

Fig. 9. Swarming of males and females of *Melolontha hippocastani* Fabr., Lipník 2004, 2008

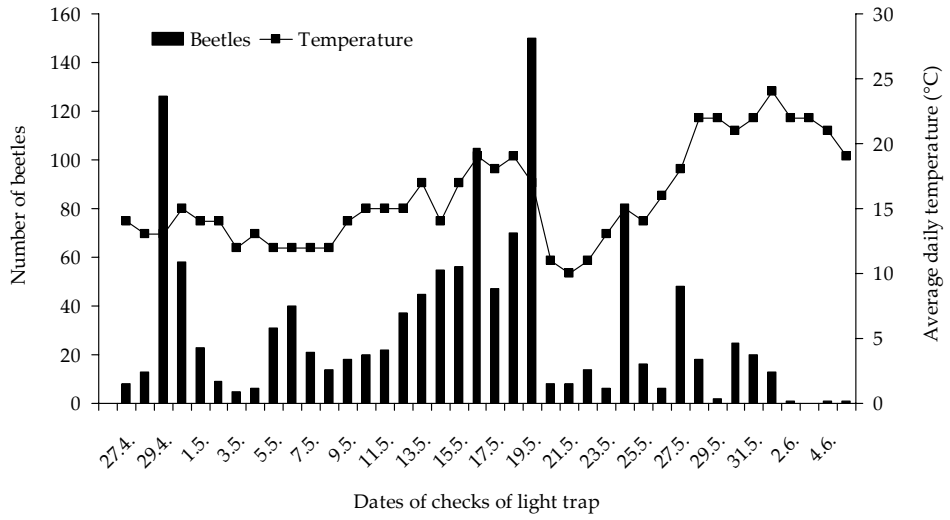

Fig. 10. Course of daily temperatures and flight activity of *Melolontha hippocastani* Fabr., Lipník 2008

Of the total number of beetles caught in the light trap in the Lipník locality during the entire period of swarming in 2004 84% were males and 16% were females; in 2008 82% were males and 18% were females – see Table 3 and Fig. 6. There was no difference in the time of swarming between the males and females.

In both cases, males significantly prevailed in samplings (2004: $\chi^2 = 863.1$; $P < 0.00001$; 2008: $\chi^2 = 513.6$; $P < 0.0001$). Significant linear correlations were found between the numbers of caught males and females (2004: $r = 0.5$; $P < 0.0001$; 2008: $r = 0.38$; $P < 0.0001$).

Kluk locality

Kluk lies in central Bohemia in the warm region of the Labe River basin where an abundant *M. hippocastani* Fabr. tribe appearing in a cycle of every four years is located (Švestka 2006). The beetles swarmed for the last time in 2004 and 2008. In the years 2005, 2006 and 2007, no adults were found (Fig. 11).

In 2004 the area was hit by swarming accompanied by intensive maturation feeding in the forest stands. During the entire period of swarming, from 28 April to 9 June, 3862 cockchafers were caught in the light trap, of which 1,914 were males (49%) and 1,948 were females (51%). Swarming culminated between 12 and 21 May. In the period between 13 and 19 May the females outnumbered the males; in general, the sex ratio was almost balanced.

On 11 and 12 May 2004 the biological product Boverol against swarming female cockchafers containing spores of the fungus *Beauveria bassiana* (Balsamo) Vuillemin in an inert filling mass (amorphous silicon dioxide) was experimentally applied aerially by the Robinson R 22 type helicopter over a total area of 108 ha in selected stands of this locality. The dose per 1 ha contained 1×10^{13} spores of

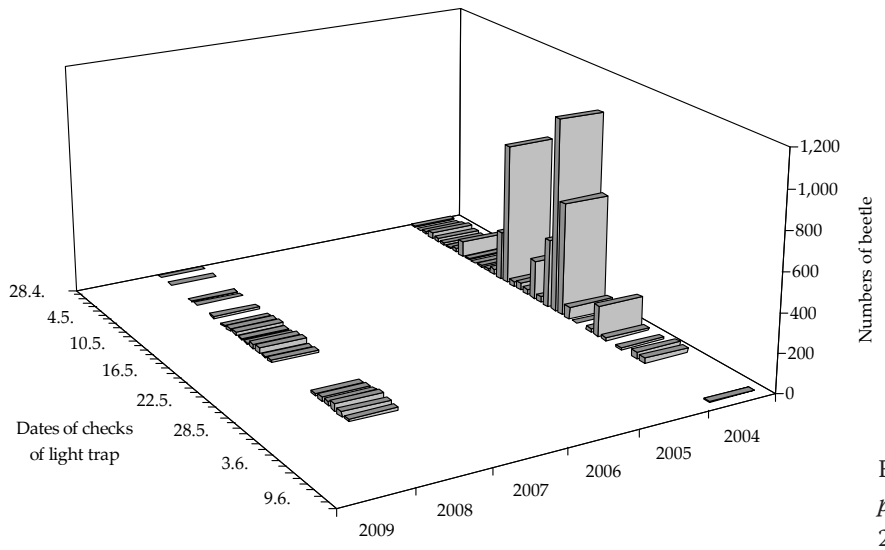

Fig. 11. Course of *Melolontha hippocastani* Fabr. swarming, Kluk 2004–2009

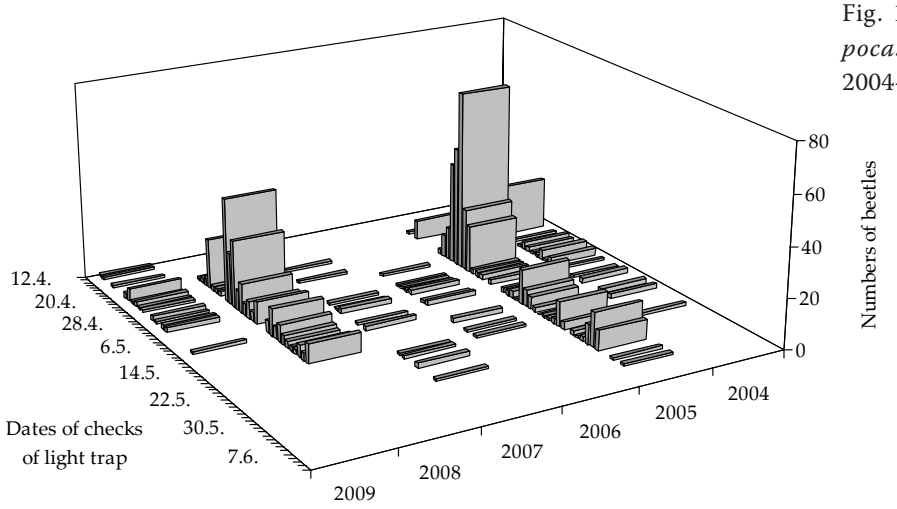

Fig. 12. Course of *Melolontha hippocastani* Fabr. swarming, Bulhary 2004–2009

B. bassiana dispersed in the oil carrier Dedal 90 EC in a dose of 3.3 l·ha^{-1} and water in a dose of 6.55 l·ha^{-1}. The water suspension was dispersed into the stand at the time when the swarming of *M. hippocastani* Fabr. females began to culminate, so that the fungal spores were carried on the bodies of the females into the soil during egg-laying and infected the earliest stage of the grubs.

From 28 April to 30 May 2008, i.e. the entire period of swarming, a total of 289 cockchafers were caught in the light trap (Fig. 11), of which 142 were males (49%) and 147 were females (51%). Swarming culminated from 25 May to 29 May.

We compared the numbers of *M. hippocastani* Fabr. adults caught in the light trap in 2004 (3,862 specimens) and 2008 (289 specimens) and we discovered that the population density of the species in the Kluk locality in 2008 fell to ca 7% against 2004.

The considerable reduction in the numbers of caught *M. hippocastani* Fabr. adults may be correlated with the experimental application of Boverol in 2004. In 2006 we monitored the 2nd instar grubs and discovered 8 to 19 grubs per 1 m^2. The numbers of the 1st instar grubs were monitored in 2009 and 7 to 16 grubs per 1 m^2 were discovered. These data confirmed that the population density of the species dropped to some extent but not to such an extent as resulted from the number of specimens caught in the light trap. Exact comparisons of the abundance of the *M. hippocastani* Fabr. population after swarming in 2004 and 2008 will be clear after we obtain control results of the abundance of the 2nd instar grubs in 2010.

Bulhary locality

Bulhary lies in southern Moravia in one of the warmest areas of the Czech Republic (Tolasz et

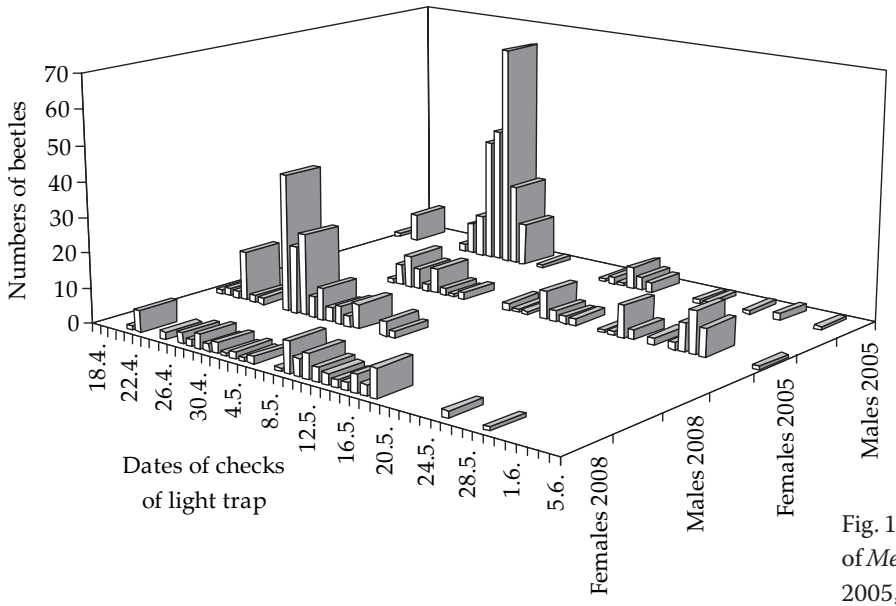

Fig. 13. Swarming of males and females of *Melolontha melolontha* (L.), Bulhary 2005, 2008

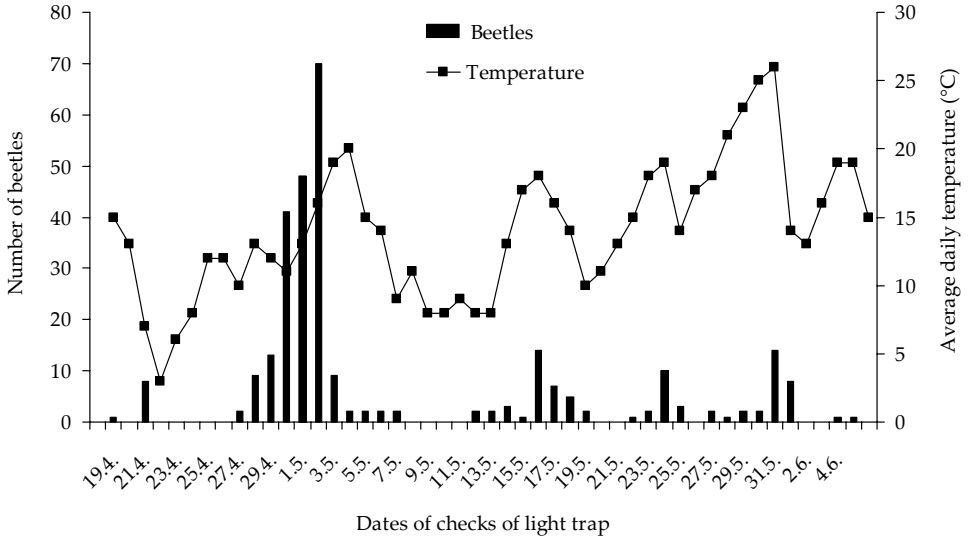

Fig. 14. Course of daily temperature and flight activity of *Melontha melolontha* (L.), Bulhary 2005

al. 2007). In this locality one very abundant tribe of *M. melolontha* (L.) appears in a cycle of every three years (swarming in 2005–2008) – Fig. 12. This tribe spreads into southern Moravia from Austria (Kratochvíl et al. 1953). Apart from the predominant tribe two other less abundant tribes appear whose generation cycle is one year advanced or set back (swarming in 2004–2007 and 2006–2009, respectively). In 2005 and 2008 total defoliation of broad-leaved stands appeared locally when the strong *M. melolontha* (L.) tribe swarmed; defoliation in the other years was negligible.

In 2005, during swarming, a total of 331 cockchafers were caught in the light trap, of which 229 were males (69%) and 102 were females (31%). The flight of beetles was monitored from 18 April to 5 June. The first beetles started to appear when average daily temperatures began to rise above 12°C. Swarming culminated between 28 April and 3 May, when the average daily temperatures ranged between 12 and 20°C (Figs. 13 and 14).

In 2008, during the next swarming, 225 cockchafers were caught in the light trap, of which 144 were males (64%) and 81 were females (36%). The flight of cockchafers was monitored from 19 April to 29 May. The first beetles started to appear at the time when average daily temperatures began to rise above 12°C. Swarming culminated between 27 April and 5 May 2008, when the average daily temperatures ranged between 12 and 15°C (Figs. 13 and 15).

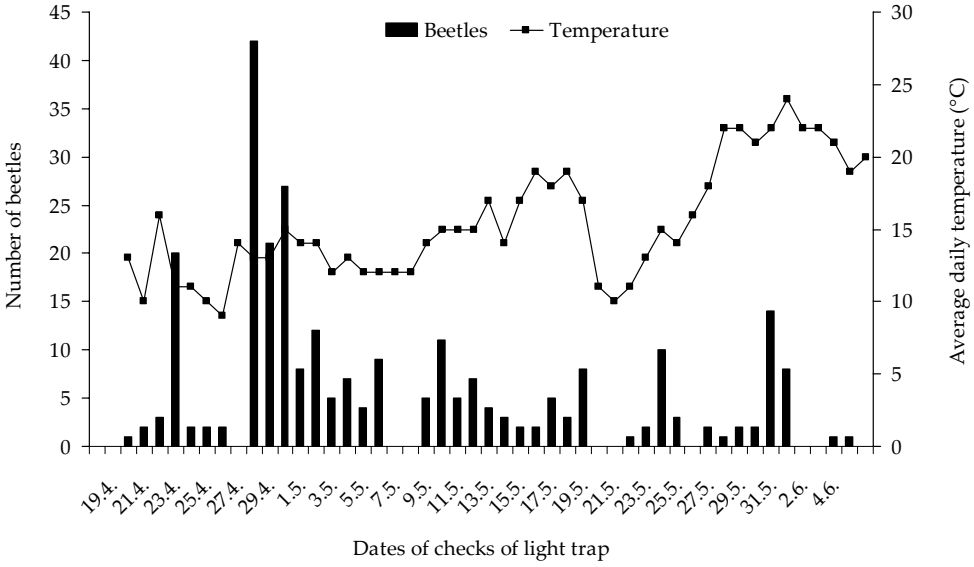

Fig. 15. Course of daily temperatures and flight activity of *Melolontha melolontha* (L.), Bulhary 2008

In 2004, 2006, 2007 and 2009 the less numerous tribes of *M. melolontha* (L.) swarmed. In 2004, 58 cockchafers were caught in the light trap, of which 86% were males; in 2006 13 cockchafers, of which 100% were males; in 2007 12 cockchafers, of which 100% were males and in 2009 23 cockchafers and 100% of them were males.

In the years of heavy swarming (2005 and 2008) we saw a difference between males and females in the time of swarming; the swarming of females culminated at the time when the swarming of males was on the wane (Fig. 13).

In both cases, males significantly prevailed in samplings (2005: $\chi^2 = 48.7$; $P < 0.00001$; 2008: $\chi^2 = 17.6$; $P < 0.0001$). Significant linear correlations were found between the numbers of caught males and females (2005: $r = 0.79$; $P < 0.0001$; 2008: $r = 0.91$; $P < 0.0001$).

CONCLUSION

In forest regions of the Czech Republic at present we discovered three tribes of *Melolontha hippocastani* Fabr. appearing in a four-year cycle and one tribe of *Melolontha melolontha* (*L.)* appearing in a three-year cycle.

From 2003 to 2009 we monitored the abundance of populations of cockchafers of the genus *Melolontha* caught in light traps and we discovered that in general the population densities of the strong *M. hippocastani* Fabr. and *M. melolontha* (L.) tribes were decreasing in all the four localities which we monitored; in Vracov between 2003 and 2007 the numbers of *M. hippocastani* Fabr. decreased by 52%; in Lipník between 2004 and 2008 the numbers of *M. hippocastani* Fabr. decreased by 32%; in Kluk between 2004 and 2008 the numbers of *M. hippocastani* F. decreased by 93% (this datum will be specified after we record the numbers of grubs in 2010); and in Bulhary between 2005 and 2008 the numbers of *M. melolontha* (L.) decreased by 22%. Even though the abundance of the beetles has declined, they may still damage the forest plantations heavily; the losses could be very extensive in Vracov, Lipník and Kluk and locally in Bulhary. The development in the abundance of cockchafer populations in the studied localities will be specified in greater detail in the following years during swarming (2011–2012).

We evaluated the correlation between the course of temperatures and the beginning and intensity of swarming of adults and discovered that adults of both species began to swarm when the average daily temperatures reached ca 12–13°C, usually in the third decade of April (rarely in the second April decade) and that mass swarming occurred when the average daily temperatures reached ca 15°C and more, i.e. ca from late April to the third decade of May.

In the case of *M. hippocastani* Fabr. no significant differences were discovered between the males and females in the time of swarming. On the contrary, the females of *M. melolontha* (L.) swarmed later than the males.

We evaluated the sex ratio during swarming and discovered that during the entire period of swarming more males than females of *M. hippocastani* Fabr. were caught in the light traps in the locality Vracov (in 2003 62%:38% and in 2007 61%:39%) and Lipník (in 2004 84%:16% and in 2008 82%:18%), while this ratio was almost balanced in the Kluk locality (in 2004 49%:51% and in 2008 49%:51%). In the Bulhary locality more *M. melolontha* (L.) males were caught in the light trap during the entire period of swarming (in 2005 69%:31% and in 2008 64%:36%).

In 2007 we compared the sex ratio of *M. hippocastani* Fabr. cockchafers caught at a certain date in the light traps and in the open space in the locality Vracov; we discovered that in both cases the males outnumbered the females (64%:36%, and 63%:37%, respectively). On the contrary, in 2004 comparisons of the sex ratio of *M. hippocastani* Fabr. caught in the locality Lipník showed that females caught in the open space outnumbered the males (46%:54%) and in the light traps the males outnumbered the females (80%:20%). Therefore we cannot positively derive from these results whether the sex ratio based on the numbers of cockchafers caught in the light traps gives us a realistic picture of the actual sex ratio of cockchafers in forest stands.

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Corresponding author:

Ing. Milan Švestka, DrSc., Výzkumný ústav lesního hospodářství a myslivosti, v.i.i., Strnady 136, 252 02 Jíloviště, Česká republika
tel.: + 420 602 298 803, e-mail: vulhm@mboxzn.cz