

# Distribution of tribes of cockchafers of the genus *Melolontha* in forests of the Czech Republic and the dependence of their swarming on temperature

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**ABSTRACT:** The abundance and species spectrum of cockchafers of the genus *Melolontha* and characteristics of the tribes in four forest regions of the Czech Republic was explored. We used light traps, automatic meteorological stations and field investigations to study the course of swarming, species composition, abundance of the respective tribes, sex ratio during swarming and the dependence of swarming on the average daily temperature. Studies will continue in the next years and the objective is to use the results for prognosis of the occurrence of cockchafers and the damages subsequently caused by grubs in forest cultures.

**Keywords:** forest protection; *Melolontha hippocastani*; *Melolontha melolontha*; cockchafer tribe; light trap

Cockchafers of the genus *Melolontha* rank among the potential pests in agriculture and forestry. White grubs usually cause greater damage than adult beetles. Until the 1960's, the white grubs of cockchafers were the most serious pests of orchards, field crops and forest nurseries and cultures. In later years, and particularly after 1980, their abundance and the extent of damage they caused considerably decreased.

Three species of the genus *Melolontha* are found in the Czech Republic. In the past the species *Melolontha melolontha* (Linnaeus, 1758) was spread all over the country up to an altitude of 800 m, especially in agricultural crops. In the second half of the 20<sup>th</sup> century the population density decreased in the major part of the country and the pest was on the verge of extinction as a result of changed technologies in agriculture. In the past ten years we have seen a gradual comeback, particularly to vineyards and orchards. The species *Melolontha hippocastani* (Fabricius, 1801) is spread in some isolated forests in warm locations with sandy soil. They damage the forest stands as well as the neighbourhood of these

forests, e.g. new vineyards and other cultures. In the past the abundance of this species in forest biotopes did not fluctuate as dramatically as *M. melolontha*. However, in recent years the population density of *M. hippocastani* has increased and in some regions the white grub has become a serious drawback to forestation (ŠVESTKA, BALEK 2003; PROKOP 2004). The incidence of the third species, *Melolontha pectoralis* (Megerle von Mühlfeld, 1812), is very sparse and is not economically important.

In the past the incidence of cockchafers or the damages they caused were not distinguished according to the individual species, also because it is difficult to tell the differences between white grubs of the two most common species on the basis of their morphological characters. More important for forest management in the Czech Republic at the present time is *M. hippocastani*, which makes up ca 95% of the area of its incidence in forest stands. It has gradated in south-east Moravia and central Bohemia (ŠVESTKA, KAPITOLA 2004). In both of these relatively distant regions the pest produces numerous four-year tribes. White grubs inflict se-

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vere losses by feeding on roots of seedlings of woody species, namely pine, oak, linden etc., in places even to an extent of 100%. In these two regions only there are more than 25,000 hectares of localities suitable for mass outbreak of this species. At the present time *M. melolontha* has gradated only to a limited extent on forest soil in South Moravia.

## LITERARY REVIEW

KRATOCHVÍL et al. (1953) and MUŠKA (1975) elaborated the periodicity of the incidence of *M. melolontha* and distribution of the tribes in the Czech Republic. Four four-year and three three-year tribes are found in the Czech Republic. The dividing line between the four-year and three-year tribes is the 50-year average air temperature of 14°C during the vegetation period (April–September). Regions where the temperatures are higher are populated with three-year tribes and the colder regions with four-year tribes. In the past the white grub of *M. melolontha* most frequently attacked seedlings and transplants in nurseries in many places in Bohemia and Moravia. ZÁRUBA (1956) discovered that it was the loose, light, slightly sunny soil, which attracted the females to the nurseries, and not the soil completely overgrown with vegetation. Forest cultures were not attacked so frequently, usually only the clearings and margins of open stands. The same author also discovered that forest cultures were affected most of all in the Strážnice area in Moravia and in Bohemia in some parts of the Labe Basin. These localities are typical for the incidence of *M. hippocastani*; it is therefore obvious that *M. hippocastani* was an important forest pest in the Czech Republic also in the past.

The term “cockchafer tribe” includes a set of individuals on a certain territory, whose length of development has been the same for a longer period of time and swarming of the beetles is thus repeated on a regular basis. So far nobody in the Czech Republic has systematically tried to differentiate the individual *M. hippocastani* tribes. We can get an incomplete idea about the occurrence of this species in the past only according to the forest localities. For instance, the flight of cockchafer in 1983 (MUŠKA 2001) in the surroundings of Ratiškovice, Vacenovice and Vracov agrees with the periodicity of incidence of the four-year tribe *M. hippocastani* in this part of South Moravia.

KRATOCHVÍL et al. (1953) summarised data and information about the bionomics of cockchafer from various authors, including the differences between the two most important species. Beetles

emerge from pupae after about 3 to 4 weeks during August to September. They winter in the place of their emergence and in early spring they move to the soil surface where they wait for conditions favourable for flight. According to a number of authors mass swarming takes place when the temperature reaches 20°C, the average daily temperature reaches 15°C and the sum of average temperatures from 1 March to the beginning of swarming is 355°C. In our country swarming usually begins in the period from mid-April to early May. Swarming culminates 8 to 14 days after the flight of the first beetles. In our conditions *M. hippocastani* swarms 1 to 2 weeks earlier and swarming ends as early as late May, while *M. melolontha* sometimes in late June. According to data from Austria (KRATOCHVÍL et al. 1953) both species begin to swarm together, but swarming of *M. hippocastani* culminates and ends earlier. Males prevail at the beginning of swarming and only at the time of culmination the male/female ratio is balanced. Both species are considerably polyphagous and feed on leaves of many forest and fruit trees. Their favourites are oak, hornbeam, beech, birch, walnut, mountain ash, the genus *Prunus*; but the choice of woody species is also influenced by the stage of leaf unfolding. At the beginning of swarming they look for birch, as the leaves are already unfolding. It was also confirmed that cockchafer seek male flowers of spruce and pine. FLEROV et al. (1954) discovered that *M. hippocastani* preferred pine. The period of the first maturation feeding lasts 8 to 14 days and then the females fly off to lay eggs. Some females then continue in second maturation feeding, which lasts 5 to 10 days and after laying eggs the third maturation feeding follows, which lasts ca 8 days. One female lays, on average, 50 to 55 eggs. We have seen regular mass flights of *M. melolontha* from the hatching place to the place of maturation feeding on forest edges, or migration flights to new feeding places. No mass flights of *M. hippocastani* in the same direction were monitored. Evening swarming begins shortly after sunset and ends before nightfall. The beetles increase their activity also during the warmest parts of the day, i.e. from 11 to 15 h. *M. melolontha* females fly from the forest to the fields to lay eggs, while *M. hippocastani* females lay eggs not far from the place of maturation feeding, usually in the forest. That is why *M. hippocastani* causes more damage in forest management and that is also the reason why the population densities of this species in the past decades had not been reduced so much by the changed technologies in agriculture. Under conditions of Central Europe the females of both species prefer localities with looser

soil and sunny exposures; the degree of vegetation cover is not decisive. In 1951 to 1954 HŮRKA (1955) studied the bionomics and behaviour of *M. hippocastani* white grubs in the surroundings of Stará Boleslav. The mass flight of cockchafer in this locality in 1951 agrees with the periodicity of incidence of the four-year tribe *M. hippocastani* in this central Bohemian region.

By cumulative action of natural enemies and unfavourable effects the population density of the new generation is declining; in the first two years by 90 to 93% and in the last year of development by a further 4 to 7%, so that of the original number only about 2 to 3% of the population reach the stage of swarming (KRATOCHVÍL et al. 1953). In this way balanced numbers of swarming cockchafer are maintained from generation to generation. The cockchafer population includes all individuals (white grubs as well as imago) living in a certain locality.

#### Objective of the study and the studied region

Research activities begun in 2004 have been focused on more precise specification of the methods of prognostication of the incidence of white grubs of cockchafer and the damage they cause in forest cultures and on checking the process of effective and environmentally friendly regulation of the abundance of white grubs and adults of the genus *Melolontha*. Research was concentrated to four localities with a denser population of cockchafer of the genus *Melolontha* where forest cultures were damaged by white grub and where maturation feeding of the adults caused defoliation of the trees. In the first stage our attention was focused on studies of the species spectrum of cockchafer and characteristics of the tribe in the individual regions of outbreaks and on monitoring meteorological conditions with a view to the bionomics of species of the genus *Melolontha*.

#### Survey of the studied localities

The Vracov and Bulhary localities lie in South-East Moravia where the long-term average air temperature is 9.3°C. The Kluk and Lipník localities lie in Central Bohemia where the long-term average air temperature is 8.9°C. They are the warmest regions in the Czech Republic where annual precipitation is in the region of 450 mm.

#### MATERIAL AND METHODS

Meteorological conditions have been monitored continuously in South-East Moravia, in the Vracov locality, since April 2003 using automatic meteorological stations 431 B. In addition, the minimal and maximal temperatures and precipitation were measured on a daily basis. The resulting data have been elaborated as monthly surveys with daily data, and annual surveys giving decade data. Subsequently the connection between the course of swarming of the cockchafer and average and maximal daily temperatures is interpreted in graphs.

Monitoring the swarming, ratio of sex and species spectrum of the cockchafer is based on trapping in the light traps equipped with a HQL 125W discharge lamp. Swarming in the light traps has been controlled since 2003 in the Vracov and Lipník localities and since 2004 in the Bulhary and Kluk localities. At the time of swarming the trapped beetles are collected from the vessels of the traps every day and their numbers and sex ratio are recorded. The prerequisite for the running and use of the light traps is their connection to a source of energy. Comparison controls of the sex ratio were conducted by random collection of 100 to 200 cockchafer in the stands at the time when swarming culminated and determination of the sex ratio.

In all the four localities the available data on the intensity of swarming and data on the extent of damage in forest cultures were evaluated as well as the distribution of the individual white grub

Locality	Property of	Dominant cockchafer species	Coordinates	Altitude (m)	Light trap	Meteorological station
Vracov	Forest district Strážnice	<i>M. hippocastani</i>	54°29' 36°62'	193	×	×
Bulhary	Forest enterprise Židlochovice	<i>M. melolontha</i>	54°12' 36°22'	220	×	
Kluk	Forest district Nymburk	<i>M. melolontha</i>	55°55' 35°03'	191	×	
Lipník	Forest district Mimoň	<i>M. hippocastani</i> , <i>M. melolontha</i>	55°71' 34°94'	250	×	

instars in the soil in recent years. On the basis of these findings the cockchafer tribes spread in the individual studied localities and the entire forest regions where outbreaks occurred were specified and characterised.

## RESULTS AND DISCUSSION

### Vracov locality

The strong *M. hippocastani* tribe with a four-year cycle is localised in the Vracov locality. The last heavy swarming was recorded in 2003 and before that in 1999, 1995, 1991, 1987 etc. From literary data about mass swarming in the past (Muška 1975, 2001) we know that the regular four-year development of this tribe has continued for a number of decades. Tribes with different generation development occur only minimally in this region as can be seen from the fact that in 2004 during the entire swarming only 6 cockchafer were trapped in the light traps and in 2005 no cockchafer were trapped. In comparison, in 2003 in total 19,510 cockchafer were trapped during swarming, of which 12,054 (69%) were males and 7,456 (38%) females. The abundance of the individual tribes was confirmed by the proportional numbers of individual instars of white grub found in the soil samples. In 2005 the proportion of white grub of the second and third instars was 99.4% and only 0.6%, respectively. The last two years before the main swarming the white grub causes serious damage feeding on cultures.

In 2003 swarming was heavy (Fig. 1). The first stray beetles began to appear in forest stands on 16 April when the average daily temperatures reached 13°C and the first arrival was monitored in the light trap

on 20 April. With increasing temperatures in the following days the intensity of swarming increased until it reached its maximum on 6 May when the average daily temperature reached 21°C; then the swarming intensity gradually decreased. The last arrival in the light trap was reported on 2 June. Swarming culminated between 28 April and 12 May when 1,000–3,000 beetles were trapped and the average daily temperatures reached 15 to 23°C (Fig. 10). Although the flight of beetles in forest stands was intensive for about one hour at dusk (around 7 p.m.), most of the beetles were caught in the traps between 10 and 12 p.m. Fluctuations in the intensity of swarming were caused by low temperatures (rainfall) in the evening and at night. During the entire time of swarming the males outnumbered the females (Fig. 6). On 7 May orientation comparisons were made of the sex ratio of beetles collected in the stands (64% males, 36% females), which confirmed the results obtained from the light trap (63% males, 37% females). The incidence of *M. melolontha* in the locality in 2003 was only sporadic towards the end of swarming. The next heavy swarming of *M. hippocastani* is expected in 2007.

### Bulhary locality

The strong three-year-cycle tribe *M. melolontha* is localised in the Bulhary locality. The tribe breaks into South Moravia from Austria and this also corresponds with the swarming periodicity. The last heavy swarming was monitored in 1999, 2002 and 2005. Data on the incidence and abundance of tribes of different generation development and swarming in the years between the main swarming are only fragmentary but they indicate that in addition to the

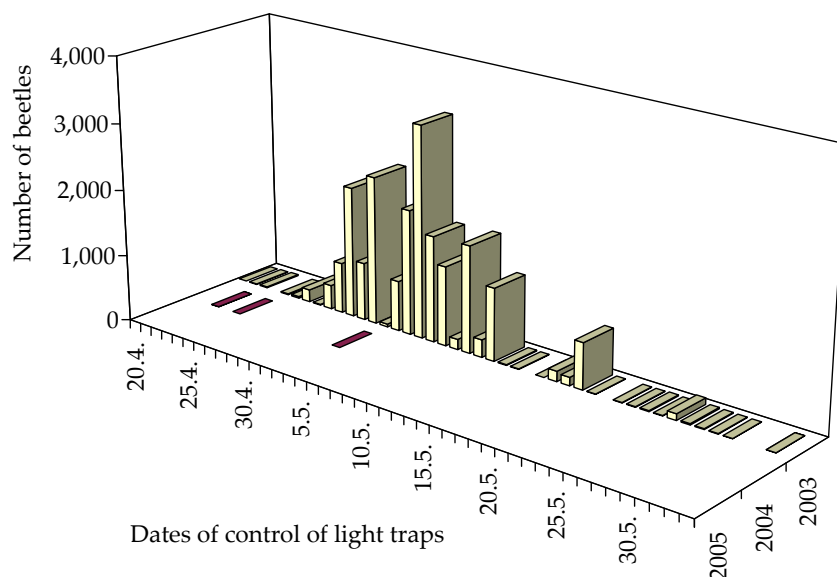


Fig. 1. Course of *Melolontha hippocastani* swarming, Vracov 2003, 2004, 2005

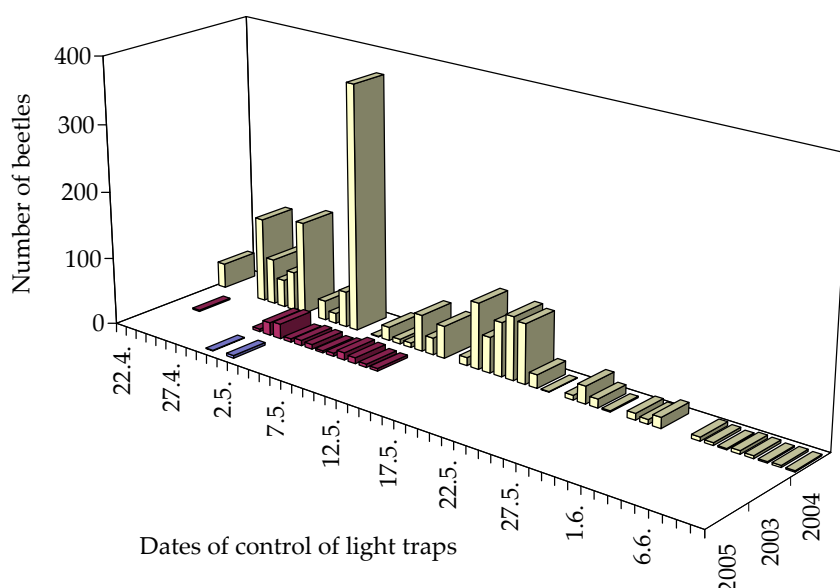


Fig. 2. Course of *Melolontha hippocastani* swarming, Lipník 2003, 2004, 2005

main tribe another weaker tribe with a generation cycle shifted by one year exists in the locality. It was confirmed by results of controls of white grubs in 2003 when the proportion of grubs of the 2<sup>nd</sup> instar was 80% and the proportion of grubs of the 3<sup>rd</sup> instar ca 20%.

In 2004 we saw relatively weak swarming from 20 April to 25 May with no visible maturation feeding, culminating on 24 April (Fig. 5). In the entire swarming period 50 cockchafer were trapped, of which 53 (91%) were males and 5 (9%) were females. Due to the connection to the power network the light trap was not situated in the centre of the pest incidence.

In 2005 swarming in the area was heavy from 18 April to 5 June (Fig. 5) and was accompanied by intensive maturation feeding in forest stands where

severe feeding to clear eating was monitored. The first beetles emerged after 18 April when the average daily temperatures began to rise above 10°C. Swarming culminated between 28 April and 3 May 2005 when the average daily temperature gradually increased from 12 to 20°C. During the swarming period 331 cockchafer were trapped in the light traps, of which 229 (69%) were males and 102 (31%) were females (Fig. 9). According to present findings it was confirmed that two *M. melolontha* tribes appear in the area. The next weak swarming is expected in 2007 and mass swarming in 2008.

#### Lipník locality

Mass swarming of cockchafer in the area was monitored in 1996 and 2000. In the Lipník local-

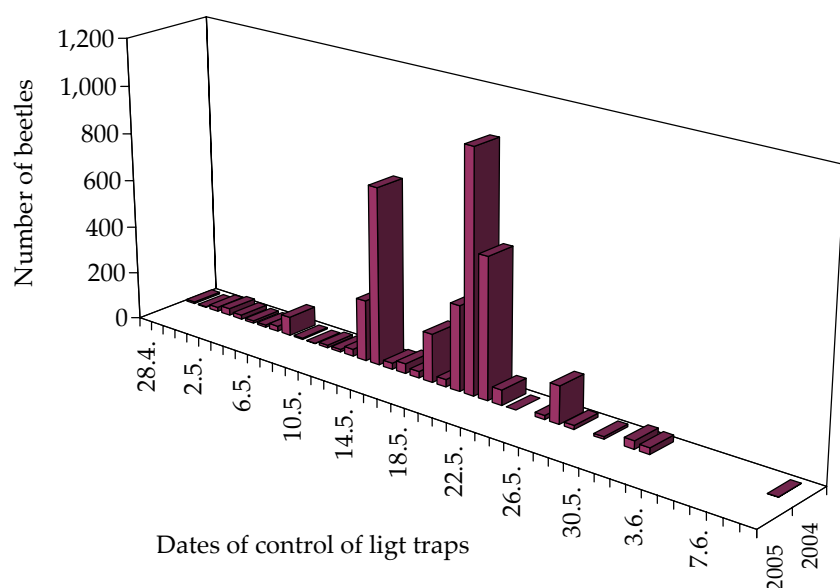


Fig. 3. Course of *Melolontha hippocastani* swarming, Kluk 2004, 2005

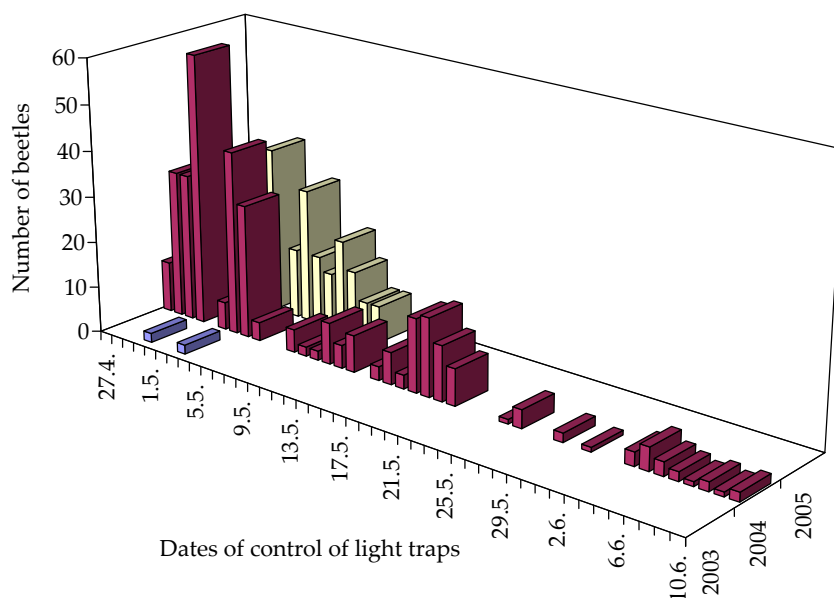


Fig. 4. Course of *Melolontha melolontha* swarming, Lipník 2003, 2004, 2005

ity two four-year tribes of *M. hippocastani* and two four-year tribes of *M. melolontha* have been localised. In the early spring of 2003 white grubs of the 3<sup>rd</sup> instar (98%), grubs of the 1<sup>st</sup> instar (1%) and beetles (1%) appeared.

The weak *M. hippocastani* tribe swarmed in 2003 (Fig. 2); from 30 April to 11 May we trapped 102 cockchafers in the light trap, of which 78 (76%) were males and 24 (24%) were females. Main swarming was seen between 1 to 10 May. Between 6 and 11 May the males outnumbered the females. The very strong tribe *M. hippocastani* swarmed in 2004 (Fig. 2), when 1,651 cockchafers were trapped in the light trap between 22 April and 10 June, of which 1,423 (86%) were males and 228 (14%) were females (Fig. 7).

The weak tribe *M. melolontha* swarmed in 2003 (Fig. 4) trapping 197 cockchafers in the light traps; 108 (55%) were males and 89 (45%) were females. The strong tribe *M. melolontha* swarmed in 2004 (Fig. 4) trapping 1,969 cockchafers; 214 (67%) were males and 104 (33%) were females.

Defoliation was not evident in 2003, while in 2004 clear eating in broadleaved stands was very extensive. In 2003, 197 (66%) specimens of *M. melolontha* and 102 (34%) specimens of *M. hippocastani* were trapped in the light trap. In 2004, during mass swarming 1,651 (84%) specimens of *M. hippocastani* and 318 (16%) specimens of *M. melolontha* were trapped. Extremely strong swarming in 2004 occurred between 22 April and 10 June with several culminations, the strongest on 5 May.

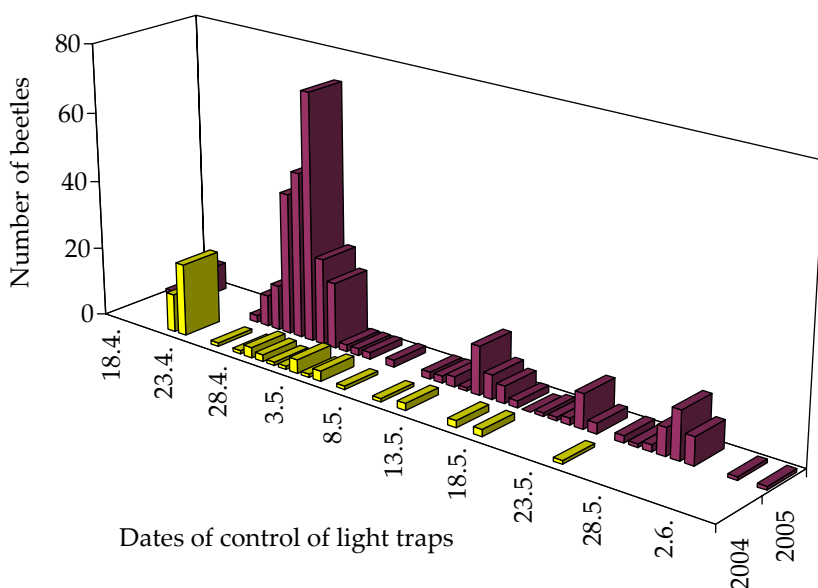


Fig. 5. Course of *Melolontha melolontha* swarming, Bulhary 2004, 2005

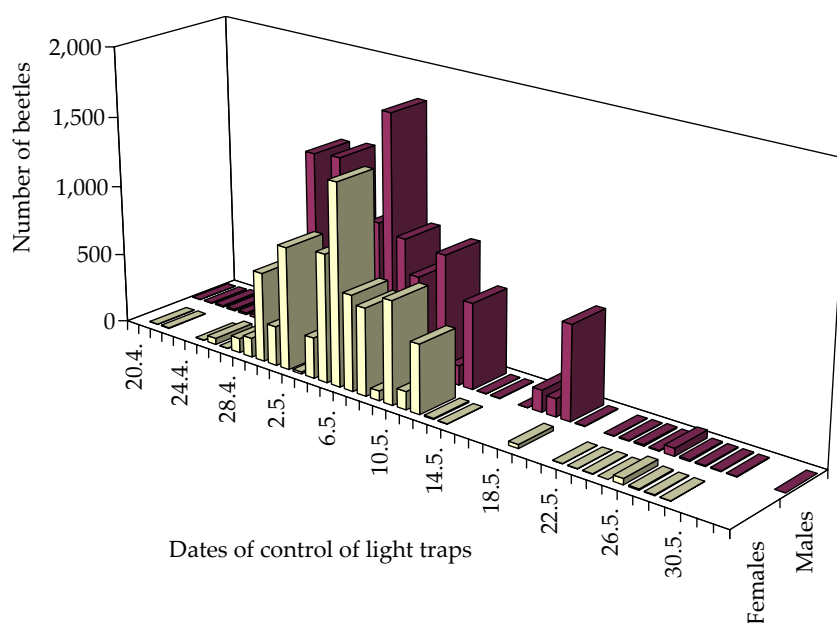


Fig. 6. Swarming of males and females of *Melolontha hippocastani*, Vracov 2003

In 2005 only 5 specimens of *M. hippocastani* and 4 specimens of *M. melolontha* were trapped. The next weak swarming of both species is expected in 2007 and very strong swarming in 2008.

#### Kluk locality

In the Kluk locality the strong four-year cycle tribe *M. hippocastani* is localised. In 2004 the area saw heavy swarming (Fig. 3) accompanied by intensive maturation feeding in forest stands where heavy feeding and clear eating were monitored. During the period of swarming from 28 April to 9 June trapped were 3,862 cockchafer, of which 1,914 (49%) were males and 1,948 (51%) were females. Swarming

culminated between 12 and 21 May. The females markedly outnumbered the males in the period from 13 to 19 May, later there were more males (Fig. 8). According to present findings it was confirmed that one strong tribe of *M. hippocastani* occurs in the area. It is based on the fact that in 2003 only white grubs of the 3<sup>rd</sup> instar were found in the soil and that during swarming in 2005 no cockchafer was trapped in the light trap. The next mass swarming is expected in 2008.

Monitoring the temperature during swarming of *M. hippocastani* and *M. melolontha* confirmed previous findings of authors that we see the first emergence of imagoes when the daily temperatures reach 10–13°C; we see mass swarming on days when

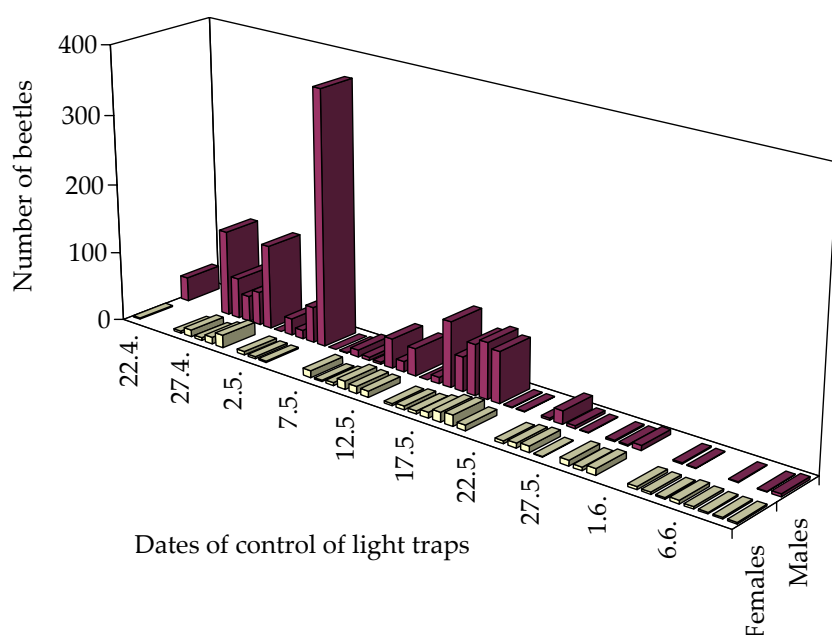


Fig. 7. Swarming of males and females of *Melolontha hippocastani*, Lipník 2004

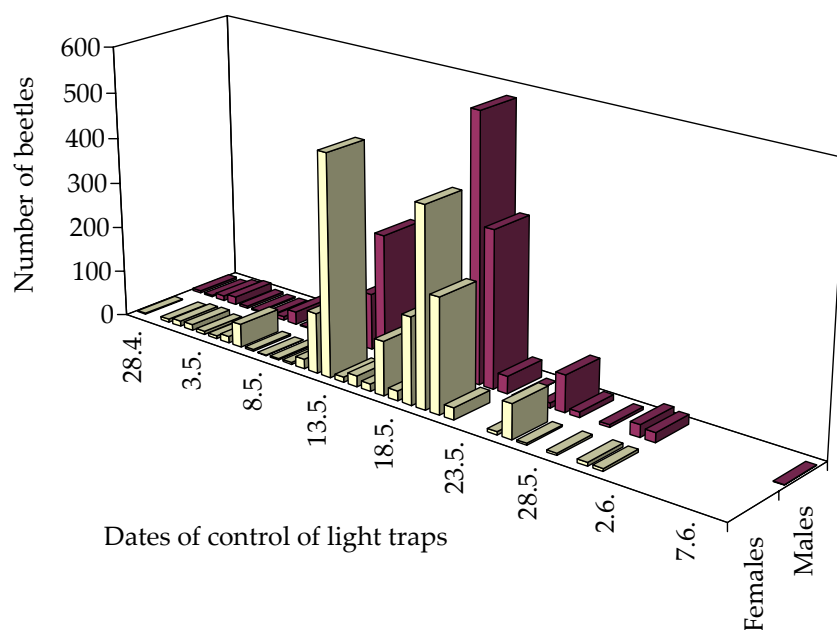


Fig. 8. Swarming of males and females of *Melolontha hippocastani*, Kluk 2004

the average daily temperature is higher than 20°C. Monitoring the swarming in the Vracov locality in 2003 (Fig. 10) and Bulhary locality in 2004 (Fig. 11) proved that swarming was lower on cold days when the average daily temperature dropped below 15°C. Results achieved when monitoring the swarming of *M. hippocastani* and *M. melolontha* in the Lipník locality did not confirm literary data that *M. hippocastani* swarm earlier. Both species began to swarm together and also swarming culminated at the same time. In accordance with literary data inspections of the light traps proved that swarming began in the evening shortly before sunset, but it was not confirmed that swarming ended before complete night-fall. On the contrary, the most numerous arrivals to the light trap in the Vracov locality in 2003 were

seen between 22.00 and 24.00 h. For signalisation of a possible defence intervention against the imagoes it was very important to know that at the beginning of swarming usually males prevail, but either the sex ratio does not become balanced at the time of the culmination of swarming (Figs. 6, 7, 9), or only within a short period of a few days (Fig. 8).

Mass outbreak of *M. hippocastani* and to a lesser extent also of *M. melolontha* endangers some forest sites in south-east Moravia and central Bohemia. They are the following localities:

#### South-East Moravia

Forest district Strážnice – affected area ca 5,000 ha, *M. hippocastani* – four-year tribe, losses in 2001 to

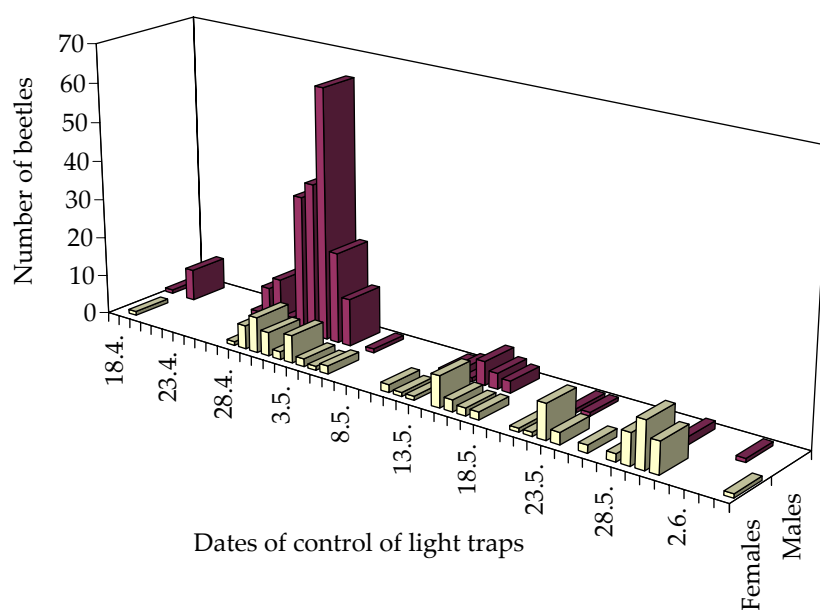


Fig. 9. Swarming of males and females of *Melolontha melolontha*, Bulhary 2005

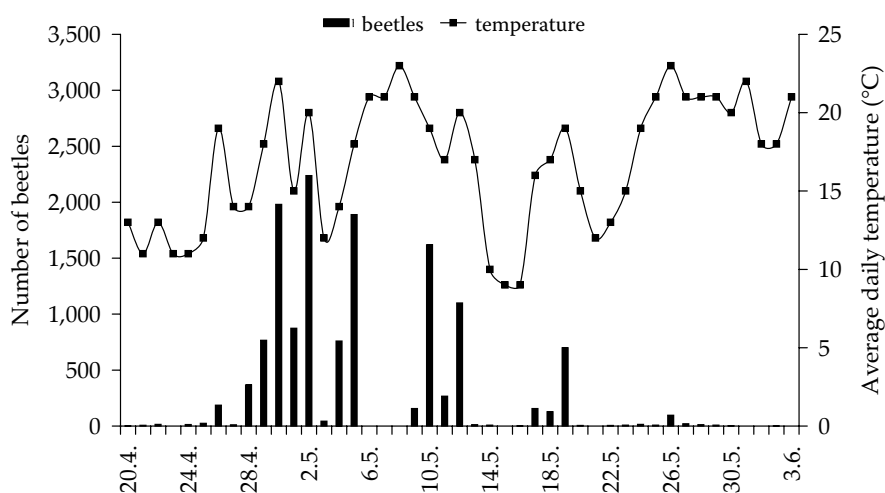


Fig. 10. Correlation between average daily temperature and *Melolontha hippocastani* swarming, Vracov 2003

2002 ca 100 ha, the last heavy swarming in 2003, the next heavy swarming in 2007.

Forest district Valtice – affected area ca 1,500 ha, *M. hippocastani* – four-year tribe, the last heavy swarming in 2003, the next heavy swarming in 2007.

Forest district Mikulov – affected area ca 500 ha, *M. melolontha* – three-year tribe, the last heavy swarming in 2005, the next heavy swarming in 2008.

### Central Bohemia

Forest district Lipník, forest sections Trnávka, Všejan, Vlkava (between Mladá Boleslav and Nymburk) – affected area ca 2,000 ha, *M. hippocastani* – four-year tribe, *M. melolontha* – four-year tribe, in 2002–2003 it damaged 80 ha, the last heavy swarming in 2004, the next heavy swarming in 2008.

Forest district Lipník, forest section Lipka (Stará Boleslav) – affected area ca 1,000 ha, *M. hippocastani* – four-year tribe, the last heavy swarming in 2003, the next heavy swarming in 2007.

Forest district Mělník, shooting grounds Zelená Bouda and Pojizeří (Stará Boleslav) – affected area ca 1,500–2,000 ha, *M. hippocastani* – four-year tribe, the last heavy swarming in 2003, the next heavy swarming in 2007.

Forest district Nymburk (Poděbrady) – affected area ca 400 ha, *M. hippocastani* – four-year tribe, losses in 2002–2003 ca 8 ha, the last heavy swarming in 2004, the next heavy swarming in 2008.

Forest district Nymburk (Kolín) – affected area ca 100 ha, *M. hippocastani* – four-year tribe, losses in 2002–2003 1 ha, the last heavy swarming in 2004, the next heavy swarming in 2008.

### CONCLUSION

In the Czech Republic at the present time cockchafer of the genus *Melolontha*, namely *M. hippocastani*, cause serious damage in forest stands of south-east Moravia and central Bohemia. We see increased incidence and mass outbreaks on an area of

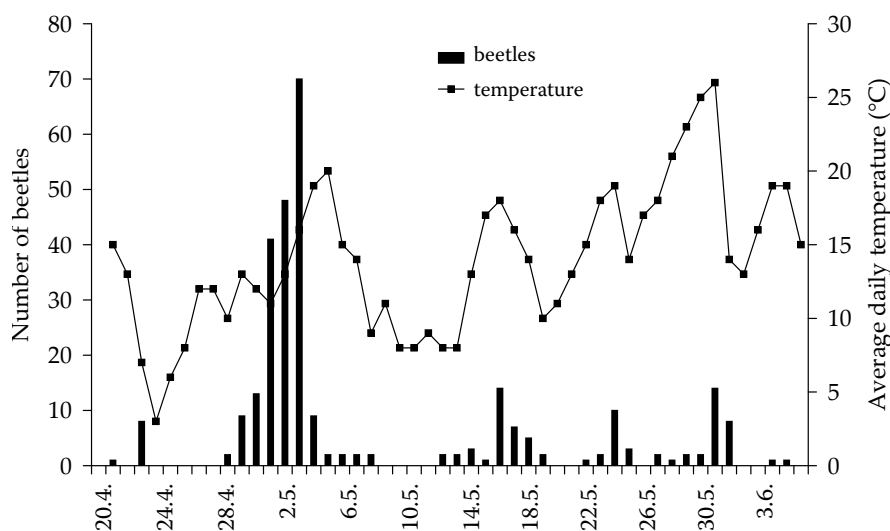


Fig. 11. Correlation between average daily temperature and *Melolontha melolontha* swarming, Bulhary 2005

ca 10,000 ha of forest stands. In south-east Moravia one numerous four-year tribe, *M. hippocastani*, and two three-year tribes of *M. melolontha*, its development delayed by one year, occur. In central Bohemia we see two numerous tribes of *M. hippocastani*, its developmental cycle delayed one year, and two *M. melolontha* tribes, the developmental cycle delayed one year.

Evaluations of the numbers and sex ratio of beetles of both species captured in the light traps showed that in the individual localities in the respective years of swarming the males prevailed over the females and only sporadically in individual days the females prevailed over the males. The present results did not confirm that males swarm earlier than the females. The emergence of beetles began at the time when average daily temperatures reached more than 10–12°C and the maximal swarming took place in the days when the average daily temperature reached 20°C and more.

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## Rozšíření kmenů chroustů rodu *Melolontha* v lesích ČR a závislost průběhu jejich rojení na teplotě

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**ABSTRAKT:** Byla studována početnost a druhové spektrum chroustů rodu *Melolontha* a dále charakteristiky kmenů ve čtyřech lesních oblastech České republiky. S využitím světelného lapače, automatické meteorologické stanice a terénních šetření byl sledován a hodnocen průběh rojení, zastoupení druhů, početnost jednotlivých kmenů, poměr pohlaví v průběhu rojení a závislost průběhu rojení na průměrné denní teplotě. Hodnocení bude pokračovat i v dalších letech s cílem využít výsledky při prognózování výskytu chroustů a škod následně působených ponravami v lesních kulturách.

**Klíčová slova:** ochrana lesa; *Melolontha hippocastani*; *Melolontha melolontha*; chroustí kmen; světelný lapač

Chrousti rodu *Melolontha* náležejí mezi potenciální škůdce v zemědělství i lesnictví. Ponravy obvykle působí větší škody než imaga. Až do šedesátých let minulého století náležely ponravy chroustů k nejvážnějším škůdcům v sadech, polních kulturách i v lesních školkách a kulturách. V pozdějších letech a zejména po roce 1980 došlo k výraznému poklesu intenzity výskytu i rozsahu škod.

V České republice se vyskytují tři druhy rodu *Melolontha*. Druh *Melolontha melolontha* (L.) byl v minulosti rozšířen po celém území do nadmořské výšky 800 m

především v zemědělských kulturách. Jeho populační hustota ve druhé polovině minulého století poklesla na většině území až k práhu vyhubení v důsledku změn technologií v zemědělství. V posledních deseti letech byl zaznamenán jeho pozvolný návrat zejména do vinic a ovocných sadů. Druh *Melolontha hippocastani* (F.) je rozšířen v několika izolovaných lesních komplexech v teplých polohách s písčitou půdou. Škody vznikají v lesních porostech i v sousedství těchto lesních komplexů – např. v nově vysazovaných vinicích i v jiných kulturách. V početnosti tohoto druhu v les-

ních biotopech se v minulosti neprojevovaly tak dramatické výkyvy jako u *M. melolontha*. V posledních deseti letech se však populační hustoty *M. hippocastani* zvyšují a v některých oblastech se jeho ponravy staly vážnou překážkou při zalesňování. Třetí druh *Melolontha pectoralis* (MvM.) se vyskytuje zřídka a nemá hospodářský význam.

V minulosti nebyl často rozlišován výskyt ani způsobené škody podle jednotlivých druhů chroustů. Přispívala k tomu i skutečnost, že na základě morfologických znaků není možné dobře rozeznat ponravy dvou nejběžnějších druhů. Pro lesní hospodářství v České republice má v současnosti podstatně větší význam *M. hippocastani*, který zaujímá asi 95 % plošného podílu škodlivého výskytu v lesních porostech. Je přemnožen na jihovýchodní Moravě a ve středních Čechách. V obou těchto relativně vzdálených oblastech vytváří početné čtyřleté kmeny. Ponravy působí citelné ztráty žírem na kořenech sazenic lesních dřevin, zejména borovice, dubu, lípy aj., lokálně až do rozsahu 100 %. Jen v těchto dvou oblastech je celkem přes 25 000 hektarů vhodných lokalit pro přemnožení tohoto druhu. Druh *M. melolontha* je v současnosti přemnožen na lesní půdě pouze v omezeném rozsahu na jižní Moravě.

Výzkumná práce, zahájená v roce 2004, je zaměřena na zpřesnění metod prognózování výskytu a škod působených v lesních kulturách ponravami chroustů a dále na ověření postupů účinného a ekologicky šetrného regulování početnosti ponrav i dospělců druhů rodu *Melolontha*. Studium bylo zaměřeno na čtyři lokality, kde jsou v současné době zvýšené denzity chroustů rodu *Melolontha* a dochází k poškozování lesních kultur ponravami i k defoliaci stromů úživným žírem dospělců. V první fázi byla pozornost věnována studiu druhového spektra chroustů a charakteristiky kmene v jednotlivých oblastech přemnožení a zaznamenávání meteorologických podmínek se zřetelem na bionomii druhů rodu *Melolontha*.

Kalamitní přemnožení *M. hippocastani* a v menší míře i *M. melolontha* ohrožuje některé lesní oblasti jihovýchodní Moravy a středních Čech. Jedná se o následující lokality:

#### **Střední Čechy**

Lesní správa Lipník, lesní úseky Trnávka, Všejaň, Vlkava (mezi Mladou Boleslaví a Nymburkem) – zasažená plocha 2 000 ha, *M. hippocastani* – čtyřletý kmen, *M. melolontha* – čtyřletý kmen, v letech 2002 až 2003 ztráty v kulturách 80 ha, poslední silné rojení v roce 2004, příští silné rojení v roce 2008.

Lesní správa Lipník, lesní úsek Lipka (Stará Boleslav) – zasažená plocha 1 000 ha, *M. hippocastani* – čtyřletý kmen, poslední silné rojení v roce 2003, příští silné rojení v roce 2007.

Lesní správa Mělník, revíry Zelená Bouda a Pojizeří (Stará Boleslav) – zasažená plocha 1 500–2 000 ha, *M. hippocastani* – čtyřletý kmen, poslední silné rojení v roce 2003, příští silné rojení v roce 2007.

Lesní správa Nymburk (Poděbrady) – zasažená plocha 400 ha, *M. hippocastani* – čtyřletý kmen, v letech 2002–2003 ztráty v kulturách 8 ha, poslední silné rojení v roce 2004, příští silné rojení v roce 2008.

Lesní správa Nymburk (Kolín) – zasažená plocha 100 ha, *M. hippocastani* – čtyřletý kmen, v letech 2002 až 2003 ztráty v kulturách 1 ha, poslední silné rojení v roce 2004, příští silné rojení v roce 2008.

#### **Jihovýchodní Morava**

Lesní správa Strážnice – zasažená plocha 5 000 ha, *M. hippocastani* – čtyřletý kmen, v letech 2001–2002 ztráty v kulturách 100 ha a v roce 2005 40 ha, poslední silné rojení v roce 2003, příští silné rojení v roce 2007.

Polesí Valtice – zasažená plocha 1 500 ha, *M. hippocastani* – čtyřletý kmen, poslední silné rojení v roce 2003, příští silné rojení v roce 2007.

Polesí Mikulov – zasažená plocha 500 ha, *M. melolontha* – tříletý kmen, poslední silné rojení v roce 2005, příští silné rojení v roce 2008.

V České republice v současnosti působí chrousti rodu *Melolontha*, zejména *M. hippocastani*, významné škody v lesních porostech na jihovýchodní Moravě a ve středních Čechách. Celkově je zvýšený a kalamitní stav na ploše 10 000 ha lesních porostů. Na jihovýchodní Moravě je zastoupen jeden početný čtyřletý kmen *M. hippocastani* a dva tříleté kmeny *M. melolontha* s vývojem posunutým o jeden rok. Ve středních Čechách se vyskytují dva početné kmeny *M. hippocastani* s vývojovým cyklem posunutým o jeden rok a dva kmeny *M. melolontha* s vývojovým cyklem posunutým o jeden rok.

Z hodnocení počtu a poměru pohlaví brouků obou sledovaných druhů zachycených ve světelných lapačích vyplynulo, že na sledovaných lokalitách v jednotlivých letech rojení celkově převažovali samci nad samicemi a jen ojediněle v jednotlivých dnech převažovaly samice nad samci. Dosavadní výsledky nepotvrdily okolnost, že samci se rojí dříve než samice. Výlet brouků začínal v době, kdy průměrné denní teploty vystoupily nad 10–13 °C a maximální rojení brouků probíhalo ve dnech, kdy průměrná denní teplota dosáhla 20 °C a více.

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