Results of using pheromone-baited traps for investigations of *Osmoderma barnabita* Motschulsky, 1845 (Coleoptera: Scarabaeidae: Cetoniinae) in Latvia

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Valainis U., Nitcis M., Aksjuta K., Barševskis A., Cibuļskis R, Balalaikins M., Avgin S.S. 2015. Results of using pheromone-baited traps for investigations of *Osmoderma barnabita* Motschulsky, 1845 (Coleoptera: Scarabaeidae: Cetoniinae) in Latvia. *Baltic J. Coleopterol., 15(1): 37 – 45.*

Osmoderma barnabita Motschulsky, 1845 is a threatened scarab beetle living in the hollows of old deciduous trees. Beetles of the genus *Osmoderma* are known for their fruity odour, which is released by males. Pheromone-baited traps were used for the first time for the study of distribution of *O. barnabita* in Latvia and new data about the species distribution were obtained. The capture-mark-recapture method was used to estimate dispersal ability of *O. barnabita*. Our results suggest that maximum dispersal distance (2090 m) observed in this study is the farthermost record from wild *Osmoderma* populations till now.

Key words: *Osmoderma barnabita,* pheromone-baited traps, dispersal distance, Latvia

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INTRODUCTION

Osmoderma barnabita (Motschulsky, 1845) is one of the four European varieties of the *eremita* species-group (Fig. 1). It was described more than 160 years ago, but often was ignored or considered as synonym of *O. eremita* (Scopoli, 1763). Recently it was rediscovered due to its morphological traits (Sparacio 2001) and genome (Audisio et al. 2007). Numerous specimens from different geographical parts of Latvia have been used for DNA analysis. Due to the geographical location of Latvia, molecular analysis confirmed that Latvian population belongs to *O. barnabita* (Audisio et al. 2007; Telnov & Matrozis 2012).

Fig. 1. Adult female of *Osmoderma barnabita* on the oak stem (Photo: R. Cibuļskis)

This species is included in the category „Near Threatened" in the IUCN European Red List of Saproxylic Beetles (Alexander et al. 2010). This species is restricted to decaying heartwood. It is found only in large, old veteran trees of a variety of broad-leaved species in both relatively open old-growth woodland and traditional cultural landscapes.

In the last 20 years, the number of known localities of *O. barnabita* highly increased due to many studies done in Latvia (Telnov 2005; Telnov & Matrozis 2012). In Latvia, the main host tree species of *O. barnabita* are *Quercus robur*, *Tilia cordata* and *Acer platanoides*, but sometimes also *Fraxinus excelsior, Ulmus glabra, U. laevis, Populus tremula* etc. The

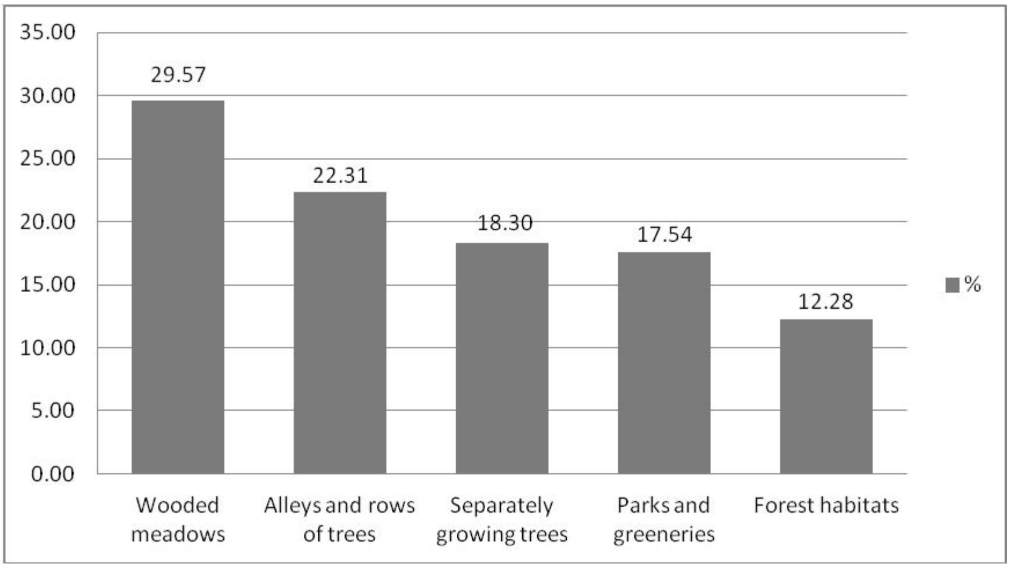

Fig. 2. The distribution of *Osmoderma barnabita* in different biotopes in Latvia

species is distributed both in natural biotopes and dendrological plantations where hollow deciduous trees are available. Currently known localities depending on the type of biotope are illustrated in Fig. 2. Nearly 61 % of all known locations are situated in specially protected areas in Latvia (Telnov 2005; LIFE+ project EREMITA MEADOWS unpublished data).

Most of the former localities in Latvia were identified by the presence of larval excrements in the different biotopes. Several individuals were collected using pitfall traps, window traps or they were observed in their natural habitats (Telnov 2005). The pheromone-baited traps in the study of *O. barnabita* were used for the first time in Latvia.

MATERIAL AND METHODS

According to the previous results (Svensson et al. 2009), the male-produced sex pheromone of *O. barnabita* is identical to that of its European congener *O. eremita*. Therefore, homemade pheromone traps with *O. eremita* pheromone (R)-(+)-gamma-decalactone were used in this field study. The trap consists of a plastic funnel and a container attached to its bottom by black waterproof tape (Fig. 3). A cotton-wool tampon moistened with pheromone was attached to the inside surface of the funnel. Traps were placed on hollow deciduous trees in certain or potential species locations (Fig. 4). The bottom of the trap was covered with moist humus and holes were made to exclude accumulation of rain-water in the traps and to prevent individuals from destruction.

The permit issued by the Latvian Nature Protection Board was obtained. It allows the

Fig. 3. The pheromone trap used in the study (Photo: R. Cibuļskis)

Fig. 4. The pheromone trap on the hollow oak in the nature reserve „Lubāna mitrājs” (Photo: R. Cibuļskis)

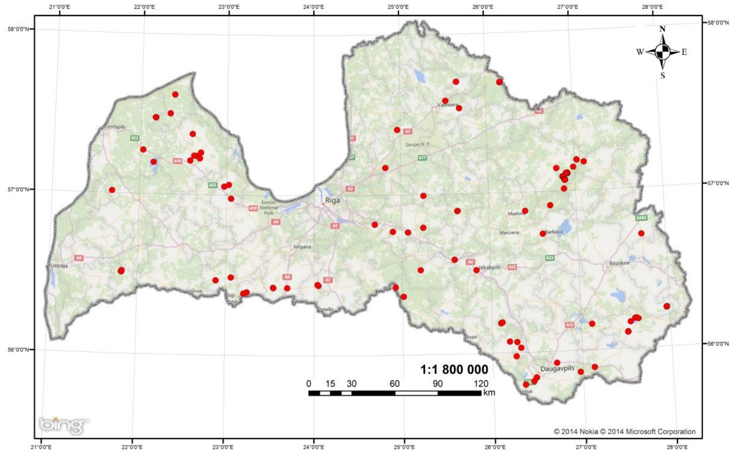

Fig. 5. The location of the pheromone traps in Latvia

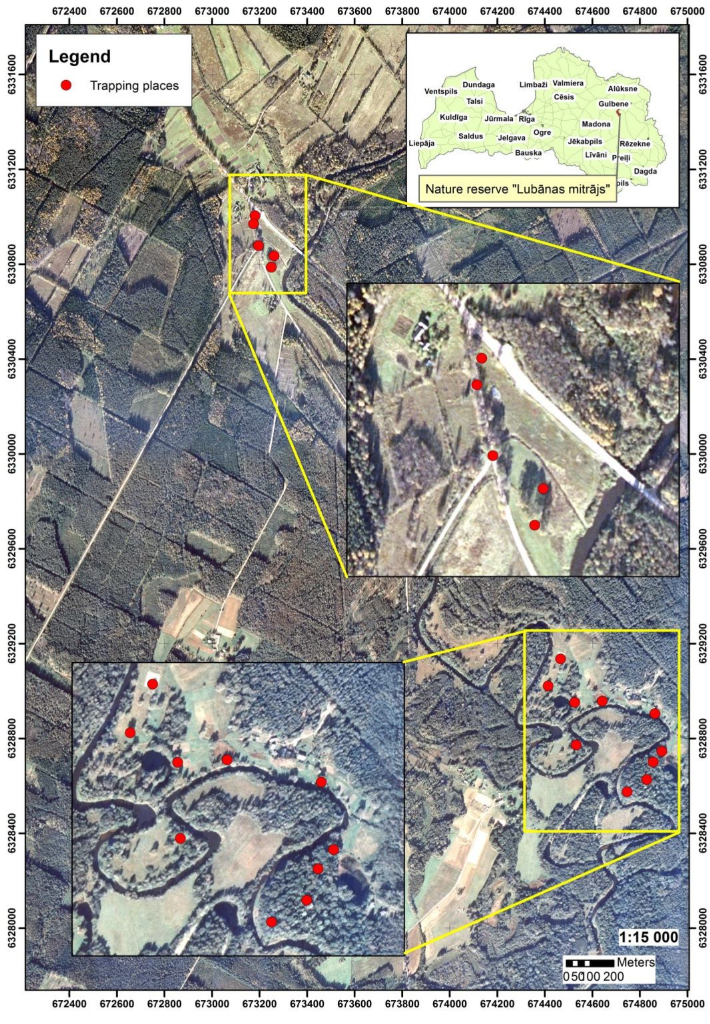

Fig. 6. The location of the pheromone traps in the nature reserve „Lubāna mitrājs"

collection of invertebrates during field research. The study was performed in 2011-2014. Traps were placed on 127 hollow deciduous trees in various regions of Latvia (Fig. 5). To clarify the time when the beetles' flight season starts, we placed several control traps in well-known localities in the nature park „Daugavas loki" on the 10th June each year. When first individuals emerged in the control traps, we placed pheromone traps also in other localities. Each year the traps were placed in different localities. All collected individuals were released after removal from traps.

In 2013, the field research about dispersal ability of *O. barnabita* was performed. The capture-mark-recapture method was used. This study was done in the nature reserve „Lubāna mitrājs", in one of the largest Latvian metapopulations. In total, 15 pheromone-baited traps were placed in hollow deciduous trees during this study (Fig. 6). 26 individuals were marked and released (10 males and 16 females).

RESULTS

In total, 257 specimens of *O. barnabita* were collected from pheromone traps during four years. The earliest date when the activity period of the imago started was June 14, but the latest date when the activity period ended was August 7 (see Table 1).

During the dispersal ability experiment in 2013, 3 (2 females and 1 male) from 26 marked specimens were recaptured in the second sampling. One of the marked-recaptured specimens flew a distance of 2090 m (see Fig. 7) that is the farthermost record from wild *Osmoderma* populations till now. Two other specimens were caught accordingly 131 m and 227 m from the place where they were released.

DISCUSSION

The comparison of studies on the dispersal of species of the genus *Osmoderma* is shown in Table 2. The maximum movement distance observed previously in nature with radio-tracking method was 1504 m (Chiari et al. 2013) and 780 m using mark-recapture method (Oleksa et. al. 2013). For *O. eremita*, such comparative studies have been carried out using tethered flight experiments with ''flight mill'' devices (Dubois et al. 2009, Dubois et al. 2010).

Despite the fact that the male of *O. eremita* produces the pheromone (R)-(+)-gamma-decalactone to attract conspecific females (Larsson et al. 2003, Svensson et al. 2009, Dubois et al. 2010), there is some evidence that this pheromone is also attractive to other males of the same species. Usually the number of males that fall into the traps is insignificant, but in our study males represented 40% of the total collected specimens. It means that males at the beginning of the imago activity period more actively flew to the traps than females. Most of the pheromone traps were placed at the beginning of the flight season and removed from

Table 1. Capture data for *O. barnabita* per year (starting date – the date when the first adult was captured in the field, ending date – the date when the last specimen was captured, captured specimens – the number of specimens captured on the trees)

Year	Starting date	Ending date	Captured specimens	Males	Females
2011	July 5	August 2	106	43	63
2012	July 11	August 7	61	27	34
2013	June 14	July 24	79	28	51
2014	July 4	July 28	11	5	6
Total			257	103	154

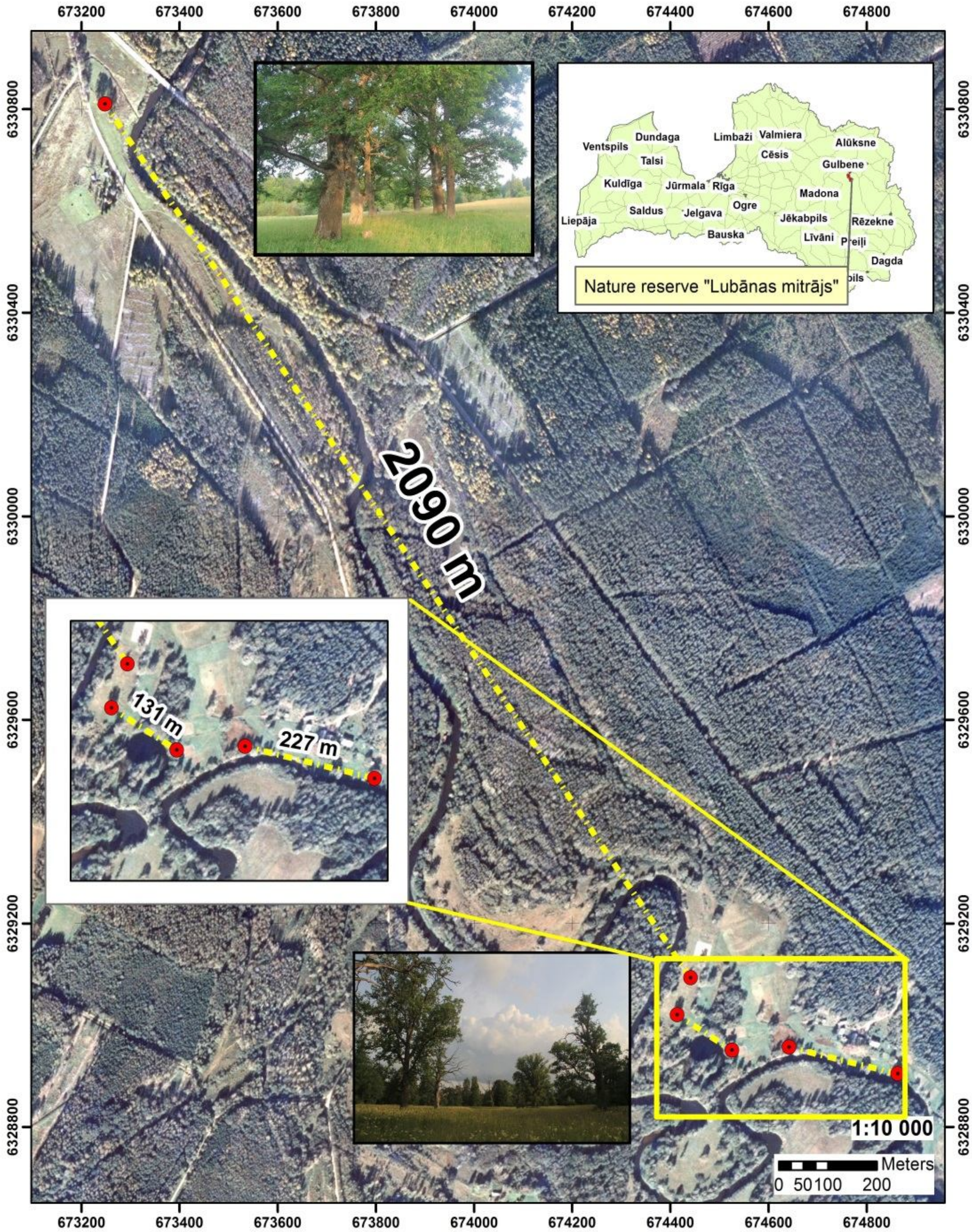

Fig. 7. Dispersal distances of recaptured specimens

the field when the first specimens were collected.

The maximum cumulative flight distance measured in the laboratory experiments was 2361 m, that is similar to the distance observed

Table 2. Comparison of studies on the dispersal of *Osmoderma* genus species (Used abbreviations: CMR = capture-mark-recapture method; RAD = radiotelemetry method; TET = tethered flight method; F – female, M – male; "-" = no data) (Table structure according Chiari et al. 2013 (modified))

	Northern Europe			**Central Europe**		**Southern Europe**	**Eastern Europe**	
	Ranius & Hedin, 2001	Hedin et al., 2008	Svenson et al., 2011	Dubois & Vignon, 2008	Dubois et al., 2010	Chiari et al. 2013.	Oleksa et. al., 2013	Present research
Country	Sweden	Sweden	Sweden	France	France	Italy	Poland	Latvia
Species	*Osmoderma eremita*	*Osmoderma eremita*	*Osmoderma eremita*	*Osmoderma eremita*	*Osmoderm a eremita*	*Osmoderma eremita*	*Osmoderma barnabita*	*Osmoderma barnabita*
Method	CMR	RAD	CMR+RAD	RAD	TET	RAD	CMR	CMR
No. of beetles								
Total	839	65	>1000	17	30	39	34	26
M	-	39	-	10	-	16	0	10
F	-	26	-	7	-	23	34	16
No of dispersing beetles								
Total	8	8	122	1	14	18	8	3
M	7	5	24	0	8	9	0	1
F	1	3	97	1	6	9	8	2
Maximum dispersal distance (m)								
Total	190	180	>500	680	2361	1504	780	2090
M	190	-	-	-	-	299	-	2090
F	70	180	-	680	-	1504	780	227

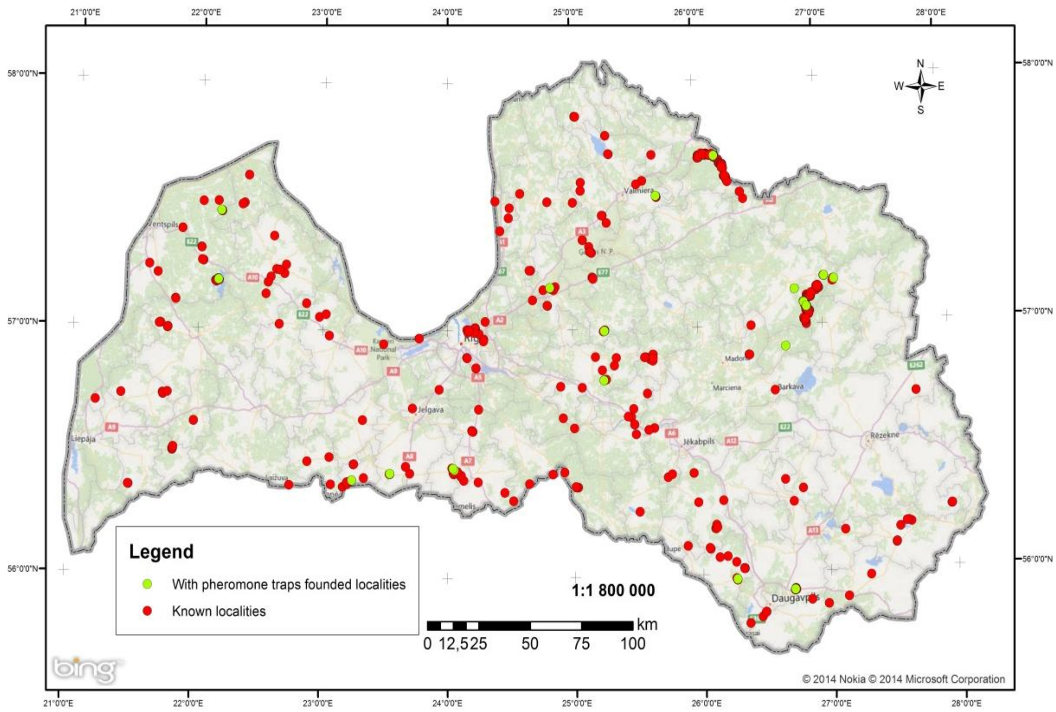

Fig. 8. Localities of *O. barnabita* in Latvia (data from previous studies and our research)

in our study. However, laboratory results are not directly comparable to results obtained in nature because the laboratory experiments tend to measure the physiological capacity for dispersal and do not measure the same dispersal parameters as measured in the field. Our results suggest that several individuals of *O. barnabita* can fly longer distances than previously considered. However, similar studies (Chiari et. al. 2013; Hedin et al. 2008; Ranius & Hedin 2001) show that most of the dispersing individuals do not perform distances more than 250 m long. In case when the habitat become unsuitable for species and mismatch its ecological demands, the imago of this species may disperse widely to find more suitable habitats. However, a metapopulation needs a sufficient amount of interacting populations for its sustainable viability. *O. barnabita* metapopulations in Latvia are irregularly distributed and they are situated many kilometres from each other (see Fig. 8). This effects the exchange of genetic material between metapopulations.

ACKNOWLEDGEMENTS

Thanks to Matti Landvik (Turku University, Finland) for introduction of pheromone traps which were used in this study. We are also very grateful to Dr. Inese Kivleniece for improving the English and Dr. Alexey Shavrin for helpful comments. The research was supported by European Union LIFE+ programme project “Management of Fennoscandian wooded meadows (6530*) and two priority beetle species: planning, public participation, innovation” (No. LIFE09/NAT/LV/000240).

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Received: 21.12.2014
Accepted: 31.03.2015

8th International Conference
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