

New data on the occurrence of *Osmoderma barnabita* (Motschulsky, 1845) in Lithuania with an overview of the species research history

Aleksei Semeniak, Maksims Balalaikins, Adelė Banelienė, Alvydas Gintaras, Mikalai Kazulka, Kristīna Aksjuta, Māris Nitcis, Uldis Valainis

Semeniak A., Balalaikins M., Banelienė A., Gintaras A., Kazulka M., Aksjuta K., Nitcis M., Valainis U. 2021. New data on the occurrence of *Osmoderma barnabita* (Motschulsky, 1845) in Lithuania with an overview of the species research history. *Baltic J. Coleopterol.*, 21(2): 117 - 130.

The hermit beetle *Osmoderma barnabita* have a high conservation value, but the information about the species' occurrence, its ecology and the viability of the population in Lithuania is still insufficient. To create an understanding of *O. barnabita* information in Lithuania a brief history of the species research is recounted. Historical data have been summarized starting from the first possible mention of the species in the territory of Lithuania, which dates back to the 19th century, to studies published until the end of 2021. In the period from 2018 to 2020, a survey of potentially suitable species microhabitats and a collection of samples with pheromone traps were carried out throughout Lithuania. As a result of the study, 179 individuals of this species were captured using pheromone traps, and traces of its vital activity were found on 21 trees. A total of 126 localities of *O. barnabita* have been registered.

Key words: *Osmoderma barnabita*, research history, Coleoptera, fauna, new records, nature conservation.

Aleksei Semeniak, Maksims Balalaikins, Kristīna Aksjuta, Māris Nitcis, Uldis Valainis, Daugavpils University, Institute of Life Sciences and Technology, Coleopterological Research Center, Parades Str. 1a, Daugavpils, LV- 5401, Latvia, e-mail: uldis.valainis@biology.lv

Adelė Banelienė, Alvydas Gintaras, Lithuanian Fund for Nature, Algirdo str. 22-3, 03218 Vilnius, Lithuania, e-mail: adele.b@glis.lt

Mikalai Kazulka, SSPA Scientific Research Center of the National Academy of Sciences of Belarus for Bioresources, Belarus, e-mail: kazulka_n@tut.by

INTRODUCTION

Great attention has long been drawn to the biocenotic role of old-growth trees (Piotrowski & Wolk 1975; Samuelson et al. 1994), emphasizing the need to protect them as a habitat and food source for numerous specialized plant, fungi

and animal species. The ongoing environmental changes that have resulted in the introduction of new forest management models led to the awareness of the need to leave old trees in the forests. Old living trees with hollows, dry slopes, dying parts, as well as dead standing and fallen trees are the habitat for many saproxylobiont

species (Grove 2002). Many of them are among the most threatened organisms in European temperate forest ecosystems and open non-forest ecosystems (Nieto & Alexander 2010; Sverdrup-Thygeson et al. 2010; Stokland et al. 2012; Bütler et al. 2013).

According to a number of studies carried out in Europe, the number of saproxylic beetle species has greatly declined mostly due to the excessive anthropogenic pressure on forest biotopes resulted in decreasing of tree species composition in forests (Speight 1989; Nieto & Alexander 2010; Stokland et al. 2012). Removing fallen and decaying trees are among the most serious factors that negatively affect the abundance and species richness of insects. These measures cause a decrease in the number of ecological niches and fragmentation of habitats, as a result of which isolated populations of beetles are formed (Humphrey et al. 2004; Bergman et al. 2011; Stokland et al. 2012; Müller et al. 2014). Hermit beetles are one of the most important species groups of saproxylic Coleoptera. Among insects living on old trees, the genus *Osmoderma* forms an umbrella taxon for the conservation of other invertebrates (Audisio et al. 2007; Nieto & Alexander 2010; Landvik et al. 2016a). The creation of migration corridors in the patched habitat is a promising approach in maintaining stable populations of this species, therefore intensive faunistic investigations of new localities, especially in highly urbanized countries, are urgently needed.

In Europe, the genus *Osmoderma* is represented by the *O. eremita* complex, in which up to five species have been identified based on morphological, geographic, and molecular data. For a long time, it was considered that *O. eremita* occurs in Lithuania (Ranius et al. 2005; Audisio et al. 2008), but many studies have shown that *Osmoderma barnabita* (Motschulsky, 1845) occurs in the study area (Audisio et al. 2007).

The hermit beetle is quite widespread in the territory of Lithuania, but the localities are scattered and rather small, furthermore are practically un-

connected (Ivinskis et al. 2007b). In Europe, many of its habitats are located outside of large old-growth broad-leaved forests especially in old parks and in private backyards as suitable old trees with hollows are often found in the human environment (Ranius et al. 1997; Oleksa 2003). Such fragmented isolated populations are incapable of dispersal, which negatively affects their stability, genetic heterogeneity and the existence of the population as a whole (Frankham 1996, 2005; Ortego et al. 2015). Therefore, research on the distribution of the hermit beetles, identification of new habitats and development of measures to create continuous interconnected populations are currently relevant.

In the present article, new data on *O. barnabita* in Lithuania are presented. Also, information on the research history of this species for the entire period of research is summarized, based on the Informational system for protected species (Lithuania).

MATERIAL AND METHODS

Summarizing literature data

To get an overview of the state of knowledge of this species in Lithuania and to obtain information about the intensity of research in a particular interval of time, an analysis of all available published sources in which there is a mention of the hermit beetles in the study area was carried out. In addition, all records of *O. barnabita* were summarized for the entire period of the research.

Survey of potentially suitable habitats

This study was carried out to obtain new data on the distribution of the species. For this, according to the necessary criteria, the most suitable habitats located throughout the territory of Lithuania were selected. Forests, parks, oak forest edges, open woodlands, single trees, trees on the roadside, and other large old deciduous trees growing on the territory of Lithuania were selected as sites for the survey. Only hardwood

trees were surveyed. The selected trees were checked for the presence of hollows and cavities. Search by traces of vital activity and pheromone traps were used as methods for collecting field material.

Search traces of vital activity and living individuals

The presence of colonized and potentially suitable for colonization trees was determined in the surveyed area, then a search for hermit beetles (larvae, adults, remains of the hermit beetles and larval faecal pellets more than 7 mm in length) was carried out. Inhabited trees found on the site were registered and their coordinates were noted. Completely hollow and felled trees, as well as cavities covered with soil at the butt part of the tree were not counted as microhabitats of the hermit beetle. Cavities and hollows in the upper part of the trunk were counted with binoculars or, if possible, cavities in the upper part of the tree were examined using a ladder. All hollow trees and trees with signs of beetles confirming the presence of a hermit beetle were examined within a radius of 100 m from the first found tree inhabited by a hermit beetle. The examination was carried out on an area of 1 hectare.

Pheromone trap

The traps were a funnel and a container. Synthetic (R)-(+)-gamma decalactone was used as a pheromone. The traps were used on warm days (the daytime temperature should not be lower than +20°C, the optimal daytime temperature is +24-26°C) from the beginning of July to the end of August. Traps were installed on tree trunks in places where direct sunlight does not reach. Depending on the number of suitable trees, 3 to 10 traps were set up. If there was only one tree with hollows in the park, one trap was used. When examining trees on the roadsides, a particular number of set traps depended on the number of suitable trees, but not more than 10 traps were used within one site. The traps were examined after 2-3 days. Traps were used at each location until the target species was recorded or until the

end of its activity season. All viable individuals captured with pheromone traps were released into the natural environment after the identification of species and sex.

RESULTS

Research history

The division *Osmoderma eremita*, well known from the territory of Europe, into several new taxa (Sparacio 1994, 2000; Tauzin 1994a, b, 1996, 2000, 2002; Krell 1997; Gusakov 2002; Audisio et al. 2003; Dutto 2003; Ranius et al. 2004, 2005) caused a lot of confusion in taxonomy and general knowledge about the distribution of beetles of this genus. Therefore, most of the records of the hermit beetle from the territory of Lithuania dating back to 2007 (Audisio et al. 2007) are cited in the literature as *Osmoderma eremita* Scop., 1763.

The first data from the territory of Lithuania about the hermit beetle appeared in the first half of the 19th century. E. Eichwald (1830) provided information on the species diversity of beetles and mentioned *P. eremita* F., which he considered as the genus *Trichius*. Analyzing this note, it is impossible to unambiguously say that the author cited *Osmoderma eremita*, although the description is quite similar. Eichwald mentioned the beetles' appearance as "pitch black, grooved thorax with two raised ribs", which fits the description of the hermit beetle, as well as the species name "eremita" which means "hermit".

Since the middle of the 20th century, data about the hermit beetle from the territory of Lithuania can be found in the works of S. Pileckis, who together with S. Mastauskis carried out a purposeful study of the beetle fauna. At that time, the list of Lithuanian beetles was expanded considerably due to a detailed study of the collection of Alfonsas Palionis (Pileckis S. 1960).

S. Pileckis (1960) presented a critical review of previous publications on Lithuanian beetles, summarized the results of inspections of beetle

collections stored in Lithuanian natural history museums and private collections, and gave a complete list of beetle species for that time. In the checklist of S. Pileckis (1960), the species *Osmoderma eremita* is indicated under number 880, but no detailed faunistic data for this species are mentioned. After 1960, numerous entomological works were published, but there was very little information about the hermit beetle. S. Pileckis mentioned the hermit beetle in the thesis of 6th Scientific Conference of Plant Protection in the Baltic States (Pileckis (1968)). The author stated that “For the Central Lithuanian lowland and the Žmudzka Upland, the leaf-horned beetles *Gnorimus octopunctatus* F., *Osmoderma eremita* Scop., *Valgus hemipterus* L. which larvae develop in rotten wood are the most characteristic”.

In his monograph (Pileckis 1976), which summarizes previous work, S. Pileckis indicated *O. eremita* as a representative species of the Lithuanian fauna but does not give any additional faunistic notes. He pointed (Pileckis 1979) that *O. eremita* is a characteristic species for the Central Lithuanian region along with mesophilic Central European species ecologically associated with deciduous forests – *Lucanus cervus* L., *Dorcus parallelipedus* L., *Gnorimus octopunctatus* F., *Valgus hemipterus* L.

Since the 90s of the twentieth century, studies of rare and protected species of Coleoptera have been conducted regularly. The hermit beetle was included in the Red Book of the Republic of Lithuania (1992) with the EN category. A distribution map is presented, which shows that almost all records were confined to the central part of the country (Balevičius 1992). In the work of E. Gaidienė (1993), devoted to the accounting of insects stored in the entomological collection of the Kaunas Tadas Ivanauskas Zoological Museum, a list of insects is given, where is noted the presence of three specimens of *O. eremita* collected in Lithuania. Auglys J. (1994, 1996) reported a hermit beetle in Gringalių forest, Panevėžys district, Krekenava forestry, dated August 1, 1987.

Osmoderma eremita was attributed to the category of rare species and noted of its distribution in entire territory excluding the Baltic sea coast region by S. Pileckis and V. Monsevičius (1995) in their brief review of Lithuanian beetle's fauna. On the map of the distribution of the species on the territory of Lithuania, which is given in the monograph, there are points from the northern, southern, central and western parts of the country, but their relevance is not confirmed either by references to literary sources or personal communications of collectors.

The catalogue of entomological collections of the Kaunas Tadas Ivanauskas Zoological Museum was published in 1993, where three hermit beetle specimens were mentioned (Gaidienė 1993). Ivinskis et al. (1996) provide information about the hermit beetle in the collections of the Kaunas Tadas Ivanauskas Zoological Museum and the Institute of Ecology. The authors indicate the following label data - Kaunas d., Gervėnupis, 1 ex, 18.07.1974, leg. E. Gaidienė; Lazdijai d., Meteliai, 1 ex. 09.10.1980, observer unknown. It is also worth noting a note by V. Strazdienė (1998), who reports on a specimen of *O. eremita* from the collection of the Institute of Ecology, collected in the city of Vilnius, in the Verkiai park on July 25, 1977.

Since 2000, several works have appeared on the study of rare and protected insects in various natural areas, among which new finds of *O. eremita* are increasingly mentioned. Obelevičius (2000) found a hermit beetle larva in an old hollow oak in Pakruojis district on May 30, 1998. *O. eremita* is also reported from the Kurtuvėnai regional park (Šiauliai and Kelmė districts); however, no collection material is available (Gliaudys 2001).

Data on the morphology, biology, distribution and conservation status of *O. eremita* in Lithuania is available in the faunistic and ecological survey of insects in forest habitats carried out by Ehnström et al. (2003).

Ivinskis et al. (2004) provide information on the distribution of the hermit beetle in the Neris re-

gional park. The species was recorded on the slopes of the Dūkšta river, Dūkštai forest, environs of Karmazinai. Information about single finds of *O. eremita* can be found in the articles by A. Meržijevskis (2004), V. Inokaitis (2004), R. Ferenc (2004), where the authors provide new data on rare insects in Lithuania in environs of Kruonis, Kaunas, Kazimieravas and Dūkštai forest.

V. Tamutis (2005) in a publication dedicated to beetles from the Red Book of Lithuania considers information on the biology and ecology of the hermit beetle. Ferenc R. (2006) provides data on *O. eremita* from the manual list (cards) of A. Palionis caught in 1925 in Kaunas.

Report about the hermit beetle specimens or signs of their presence in Punios forest (Alytus district), Vidzgiris forest, Vaiguva forest (Kaišiadorys district), Varnikų forest (Trakai district), Dūkštos (Vilnius district) and Dubingiai (Molėtai district) can be found in Ivinskis et al. (2007a). Ivinskis P., Ferenc R., Rimšaitė J. (2007b) summarize the distribution and conservation status of *Osmoderma* in Lithuania and indicate 25 known habitats of the species. Žitkevičius N. (2007) noted *O. eremita* in the Biržai regional park (environs of Karajimiškis) and vicinity of Saločiai, Pasvalys district (flying beetle was attacked by *Passer domesticus*).

Butvila R., Dūda J., Ramonas V. (2007) provided the summary of rare insects with a recorded dated June 2001 from Žagarė environs, Joniškis district. In 2007, the *O. eremita* was included in the new edition of the Red Book of Lithuania (V. Rašomavičius, 2007).

Findings of *O. eremita* can be found in the faunistic summaries edited by G. Vaivilavičius (2008) dedicated to insects and molluscs of the protected areas of Kaunas and Kaišiadorys districts - the hermit beetle in the Lapainia botanical reserve, Strėvivinkų forest, Vaiguvos forest and Kauno Ažuolynas park was recorded. Ivinskis P., Meržijevskis A., Rimšaitė J. (2009) reported on the finding of beetles in *Populus deltoides* (Rodai, Panevėžys district). N. Noreika (2009)

found 1 individual on August, 2005 near Vaitkuškis (Ukmergė district). Šablevičius B. (2011) indicated the hermit beetle for the Lithuanian fauna. A huge amount of data is summarized in the catalogue of Lithuanian beetles, including information on hermit beetle (Tamutis et al. 2011). After a short break in publication activity, Davenis et al. (2018) provided data on the distribution of the hermit beetle and some other rare species of beetles associated with old-growth trees in Lithuania. Actual information about the species (in this case it is recognized as *Osmoderma barnabita*) made it possible to mark many new localities for it. In total, 162 specimens of *O. barnabita* were collected using pheromone traps during two years of the study: 47 specimens in 2017 and 115 – in 2018. During the research time, the hermit beetles were found on *Quercus robur*, *Populus nigra*, *Tilia cordata*, *Acer platanoides*, *Fraxinus excelsior* and *Fagus sylvatica*. Hermit beetles were found in 15 administrative districts of Lithuania.

The most recent data on the hermit beetle in Lithuania are published in the new edition of the Red Book (Rašomavičius V. ed., 2021). According to the Augutis D. (2021), it was collected from more than 200 known localities across the country, mostly in its middle part.

Field research results

During the study, 126 localities of *O. barnabita* were recorded and known localities of the species summarized (Figure 1). In total, 104 *O. barnabita* localities were discovered using pheromone traps in which 133 specimens were captured. The rest of the localities were recorded by visual inspection of microhabitats. In the hollows of 21 trees, traces of the vital activity of *O. barnabita* were found, and in one of the trees, two living specimens of this species were recorded.

The list of records of *O. barnabita*

Aleksandravėlės forest, 55.87311, 25.94079, 26. VI. 2020, 1 ind., A. Markevičiūtė; **Anglininkų for-**

est, 54.60992, 24.255225, 26.VI.2020, 1 ind., A. Gintaras, 54.60805, 24.25469, 26.VI.2020, 1 ind., A. Gintaras; **Antanašės manor**, 55.924061, 25.818494, 26.VI.2020, 1 ind., A. Markevičiūtė; **Aukštieji Šančiai**, Aukštųjų Šančių oak stand, 54.8744, 23.95396, 28.VI.2018, 2 ind., T. Bujanauskas, 54.8845, 23.95378, 09.VII.2018, 1 ind., T. Bujanauskas; **Ažuolija**, Ažuolijos forest, 55.464012, 25.580407, 29.VI.2018, 2 ind., R. Karpuška, 07.VII.2018, 3 ind., R. Karpuška, 55.466056, 25.580183, 29.VI.2018, 2 ind., R. Karpuška, 11.VII.2018, 3 ind., R. Karpuška, 55.4694569, 25.5898143, 10.I.2018, pellets, A. Gintaras; **Baranava**, 54.765397, 24.215138, 12.VI.2020, 1 ind., A. Gintaras; **Belvederio Manor park**, 55.081493, 23.2650583, 24.I.2017, pellets, A. Gintaras; **Bingeliai**, 54.146057, 24.234316, 01.VII.2020, 1 ind., D. Bastytė; **Biržai, Pagirių env.**, 56.167893, 24.651654, 29.VI.2018, 4 ind., A. Gintaras, 07.VII.2018, 2 ind., A. Gintaras, 56.168904, 24.652022, 07.VII.2018, 1 ind., A. Gintaras; **Bukonys**, 55.2272, 24.39539, 28.VI.2020, 1 ind., I. Čeidaitė, T. Bujanauskas; **Burčiakių forest**, 54.7691099, 24.2681297, 16.XII.2016, pellets, D. Bastytė, 54.7696849, 24.2708126, 16.XII.2016, pellets, D. Bastytė, 54.769877, 24.278584, 12.VI.2020, 1 ind., A. Gintaras; **Būdos forest**, 54.607115, 24.363188, 26.VI.2020, 1 ind., A. Gintaras; **Būdų forest**, 54.984928, 24.252155, 28.VI.2020, 1 ind., I. Čeidaitė, T. Bujanauskas; **Dauciuliškės**, Elektrėnų distr., 54.79704269, 24.79821861, VII.-VII.2019, 1 ind., Lithuanian fund of nature team (henceforth LFN team); **Dubingiai**, Dubingių mound, 55.057322, 25.446378, 07.VII.2018, 2 ind., R. Karpuška, 29.VI.2018, 1 ind., R. Karpuška, 55.058108, 25.444575, 11.VII.2017, 1 ind., R. Karpuška, 29.VI.2018, 6 ind., R. Karpuška, 55.06153503, 25.44329107, 22.XII.2016, pellets, D. Augutis; **Dubravai**, Kauno distr., 54.83741531, 24.14601549, VII.-VII.2019, 1 ind., LFN team; **Dubravos forest**, 54.816101, 24.121653, 12.VI.2020, 1 ind., A. Gintaras; **Duburio island**, Zarasų distr., 55.79230876, 25.96279151, VII.-VII.2019, 1 ind., LFN team; **Dusetų forest**, Rokiškio distr., 55.77815280, 25.79652353, VII.-VII.2019, 1 ind., LFN team; **Dušionių forest**, Alytaus dist., 54.29296584, 24.13425203, VII.-VII.2019, 1 ind., LFN team; **Dūkštų oak**, 54.821726, 24.939939, 12.VI.2020, 1 ind., A. Gintaras, 54.817275, 24.927513, 12.VI.2020, 1 ind., A. Gintaras; **Gailiakiemio env.**, 54.5905507, 24.3215498, 20.IV.2018, pellets, D. Bastytė; **Geručių (Glebaus) manor**, 56.3245545, 23.9897732, 29.XI.2017, pellets, A. Gintaras; **Gožiai**, 55.261442, 23.574969, 20.VII.2018, 1 ind., I. Čeidaitė, 55.263953, 23.584955, 20.VII.2018, 1 ind., I. Čeidaitė; **Gudelių plytinė**, Vilniaus distr., 54.82035122, 25.17785067, VII.-VII.2019, 1 ind., LFN team; **Ilzenberga**, Ilzenberg Manor park, 56.161594, 25.525731, 05.VII.2018, 2 ind., A. Markevičiūtė, 56.160976, 25.523695, 05.VII.2018, 1 ind., A. Markevičiūtė, 56.160435, 25.521971, 13.VII.2018., 2 ind., A. Markevičiūtė; 56.1529153, 25.5323191, 09.I.2018, pellets, A. Gintaras; **Jakštonys**, 54.90015, 24.12314, 30.VI.2018, 2 ind., T. Bujanauskas, 54.90464, 24.13568, 07.VII.2018, 1 ind., T. Bujanauskas, 54.90278, 24.13321, 18.VII.2018, 2 ind., T. Bujanauskas; **Joniškėlio Manor park**, Joniškėliomanor, 56.032021, 24.169598, 29.VI.2018, 4 ind., A. Gintaras, 07.VII.2018, 1 ind., A. Gintaras, 56.034239, 24.169045, 07.VII.2018, 1 ind., A. Gintaras, 12.VII.2018, 1 ind., A. Gintaras, 56.035598, 24.169924, 12.VII.2018, 1 ind., A. Gintaras; **Karmėlavos forest**, Jonavos distr., 54.99546581, 24.16951968, VII.-VII.2019, 1 ind., LFN team; **Karvelninkai**, Alytaus distr., 54.49588559, 24.13172810, VII.-VII.2019, 1 ind., LFN team; **Kaunas oak valley**, 54.89951, 23.935787, 20.VII.2018, 2 ind., Ž. Skevičius, 54.90154, 23.94933, 20.VI.2018, 1 ind., 27.VII.2018, 1 ind., 11.VII.2018, 1 ind. K. Guzaitienė, 54.90108, 23.94677, 11.VII.2018, 1 ind., K. Guzaitienė, 29.VI.2018, 1 ind., K. Guzaitienė; **Kaunas Prancūzų g.**, 54.894802, 23.961527, 25.VI.2020, 1 ind., A. Gintaras; **Kazimieravo Manor**, Kazimieravo park, 54.926464, 25.175747, 29.VI.2018, 1 ind., R. Karpuška; **Kėdainiai city park**, 55.30436, 23.97628, 22.VI.2018, 1 ind., I. Čeidaitė; **Kėdainiai dist., Stašaičiai**, 55.265697, 24.138337, 13.VII.2018, 1 ind., I. Čeidaitė, 55.26575, 24.138228, 13.VII.2018, 1 ind., I. Čeidaitė; **Kiemeliai**, Vilniaus distr., 54.85315773, 25.00808757, VII.-VII.2019, 1 ind., LFN team; **Klykūnai**, 54.81378, 24.846328, 25.VI.2020, 1 ind., A. Gintaras; **Krakės**, Krakų forest, 55.430792,

- 23.769908, 20.VII.2018, 1 ind., I. Čeidaitė; **Krekenava, Rodai**, 55.556888, 24.122206, 08.VII.2018, 1 ind., I. Čeidaitė, 20.VII.2018, 1 ind., I. Čeidaitė, 55.557154, 24.121404, 08.VII.2018, 1 ind., I. Čeidaitė; 55.5568251, 24.122435, 04.IV.2018, pellets, A. Gintaras; **Kruonis, Burčiakų forest**, 54.76855, 24.26936, 07.VII.2018, 1 ind., T. Bujanauskas, 54.76905, 24.27138, 28.VII.2018, 1 ind., T. Bujanauskas; **Kuodžių forest**, 53.945346, 23.5374, 01.VII.2020, 1 ind., D. Bastytė, **Lapainios valley**, 54.733009, 24.187196, 24.VII.2017, 2 ind., I. Čeidaitė; **Likiškėliai**, 54.374354, 23.981897, 30.VI.2020, 1 ind., D. Bastytė; **Link Kuodžių**, 53.955882, 23.604631, 01.VII.2020, 1 ind., D. Bastytė; **Lipnikų forest**, Zarasų distr., 55.92332272, 026.04107822, VII.-VII.2019, 1 ind., LFN team; **Malgužių manor**, 56.3242983, 23.9188919, 29.XI.2017, pellets, A. Gintaras; **Onušio manor**, Rokiškio distr., 56.13979900, 25.53186200, VII.-VII.2019, 1 ind., LFN team; **Paaliosė**, 54.801067, 24.875318, 12.VI.2020, 1 ind., A. Gintaras; **Paberžė**, 55.0580466, 25.2389317, 13.XII.2016, pellets, A. Gintaras; **Padūmys**, Kaišiadorių distr., 54.76836117, 24.38878474, VII.-VII.2019, 1 ind., LFN team; **Palimšio forest**, 54.791508, 24.362138, 12.VI.2020, 1 ind., A. Gintaras; **Pagirių manor (Biržų r.)**, 56.1698471, 24.6523486, 20.IV.2018, 2 ind., D. Augutis; **Panemunė**, Kauno distr., 54.87168083, 23.98786328, VII.-VII.2019, 1 ind., LFN team; **Paneriai**, Elektrėnų distr. 54.78536431, 24.91019314, VII.-VII.2019, 1 ind, LFN team; **Pasoda**, 55.198524, 24.362113, 28.VI.2020, 1 ind., I. Čeidaitė, T. Bujanauskas; **Pašetė**, 55.300022, 24.294797, 29.VI.2020, 1 ind., I. Čeidaitė, T. Bujanauskas; **Pietušiai**, 54.838204, 25.011622, 25.VI.2020, 1 ind., A. Gintaras; **Piliakalnis**, 54.255785, 24.00939, 06.VII.2018, 1 ind., D. Bastytė, 54.254262, 24.102113, 30.VI.2018, 4 ind., D. Bastytė, 54.252395, 24.102819, 06.VII.2018, 3 ind., D. Bastytė, 54.25488023, 24.1021671, 08.I.2017, pellets, R. Karpuška; **Plinkšiuo dvaro park**, 56.1388736, 22.1726257, 07.XII.2016, pellets, A. Gintaras; **Pravieniškės, Litvinai**, 54.931025, 24.378737, 11.VII.2018., 1 ind., A. Markevičiūtė; 18.VII.2018., 3 ind., A. Markevičiūtė; 54.923345, 24.348221, 18.VII.2018, 1 ind., A. Markevičiūtė; 54.930827, 24.38468, 23.VII.2018, 1 ind., A. Markevičiūtė; **Raudondvaris**, Raudondvario Manor park, 54.944116, 23.78239, 15.VII.2018, 1 ind., V. Augutė, 54.944278, 23.782019, 21.VII.2018, 1 ind., V. Augutė, 29.VI.2018, 1 ind., V. Augutė, 10.VII.2018, 1 ind., V. Augutė, 54.945779, 23.786125, 29.VI.2018, 1 ind., V. Augutė; **Rytinė Asvejos coast** 54.979828, 25.643193, 29.VI.2018, 1 ind., R. Karpuška, 07.VII.2018, 1 ind., R. Karpuška, 54.98100314, 25.64512527, 12.XII.2017, pellets, R. Karpuška, 54.9783375, 25.6480714, 12.XII.2017, pellets, R. Karpuška; **Rumšiškės**, Rumšiškių forest, 54.8784, 24.18748, 27.VI.2018, 1 ind. T. Bujanauskas; **Salocių park**, 56.23109, 24.418282, 09.VII.2018, 1 ind., A. Gintaras, 12.VII.2018, 3 ind., A. Gintaras, 56.229618, 24.415414, 12.VII.2018, 1 ind., A. Gintaras, 56.231706, 24.416003, 19.VII.2017, 1 ind., A. Gintaras; **Samylai**, 54.85293, 24.104679, 25.VI.2020, 1 ind., A. Gintaras; **Semeliškės env.**, Semeliškių env., 54.644872, 24.647611, 27.VI.2018, 1 ind., D. Bastytė, 30.VI.2018, 6 ind., D. Bastytė; **Skirsnemunė/Šilinė**, Šilinė, 55.090979, 22.957345, 29.VI.2018, 1 ind., V. Augutė, 55.072312, 22.566287, 29.VI.2018, 1 ind., V. Augutė; **Stebeikiai**, Kaišiadorių distr., 54.75026713, 24.27279495, VII.-VII.2019, 1 ind., LFN team; **Strėvininkai**, Kaišiadorių distr., 54.80855914, 24.33485011, VII.-VII.2019, 1 ind., LFN team; **Strošiūnai**, Kaišiadorių distr., 54.79466275, 24.55656182, VII.-VII.2019, 1 ind., LFN team; **Subartonys**, 54.190664, 24.187409, VII.-VII.2020, 1 ind., D. Bastytė, A. Gintaras; **Šienlaukio forest (Lyduvėnai)**, 55.488919, 23.02284, 17.VII.2017, 2 ind., A. Gintaras, 28.VI.2018, 1 ind., A. Gintaras, 21.VII.2018, 1 ind., A. Gintaras; **Tilvikų forest**, 55.97963, 25.92517, 26.VI.2020, 1 ind., A. Markevičiūtė; **Tulpiakėmis (Tulpiakiečio manor)**, 55.337547, 24.419141, 29.VI.2020, 1 ind., I. Čeidaitė; **Verkšionys**, Vilniaus distr., 54.80966242, 24.91591963, VII.-VII.2019, 1 ind., LFN team; **Vikėnų and Švėkšnos park**, 55.498854, 21.635772, 24.VI.2018, 1 ind., V. Augutė, 29.VI.2018, 3 ind., V. Augutė, 55.500152, 21.632301, 29.VI.2018, 1 ind., V. Augutė, 55.497089, 21.633316, 17.VII.2018, 1 ind., V. Augutė, 55.5202357, 21.6132438, 08.XII.2016, pellets, A. Gintaras; **Venta coast**, 56.2349168, 22.5751744, 27.XI.2017, pellets, A. Gintaras; **Vidzgiris**, Vidzgirio forest, 54.385957, 24.006169, 23.VII.2018, 3 ind., Ž. Sinkevičius, 54.379015, 24.011788, 11.VII.2018, 1 ind., Ž. Sinkevičius; **Zarasų distr.** (Klepočių for-

est), 55.757932, 25.979865, 29.VI.2018, 1 ind., R.Karpuška; **Zarasų distr.**, 55.76196197, 25.9787391, 03.I.2017, pellets, D. Augutis, 55.75785558, 25.98001075, 03.I.2017, pellets, D. Augutis; **Žagarės Manor park**, 56.3606333, 23.2591403, 07.XII.2016, pellets, D. Augutis, 56.361171, 23.261124, 29.VI.2018, 4 ind., A. Gintaras, 22.VII.2017, 2 ind., A. Gintaras, 56.362709, 23.262486, 29.VI.2018, 1 ind., A. Gintaras, 56.362729, 23.264731, 29.VI.2018, 4 ind., A. Gintaras; **Žaliakalnis**, Kauno distr., 54.89191822, 23.93972241, VII.-VII.2019, 1 ind., LFN team; **Žalpės river valley**, 55.5262752, 22.856988, 15.XII.2017, pellets, A. Gintaras.

DISCUSSION

Representatives of genus *Osmoderma*, as well as other species that depend on rare and endangered microhabitats, such as old, hollow trees, have a high conservation value (Audisio et al. 2007; Nieto & Alexander 2010; Maurizi et al. 2017). Five species were distinguished in *Osmoderma eremita* s.l. complex in Europe and *O.barnabita* is one of the species which forms this complex (Ranius et al. 2005; Audisio et al. 2007, 2008; Svensson et al. 2009; Carpaneto et al. 2015; Zauli et al. 2016; Landvik et al. 2017; Maurizi et al. 2017).

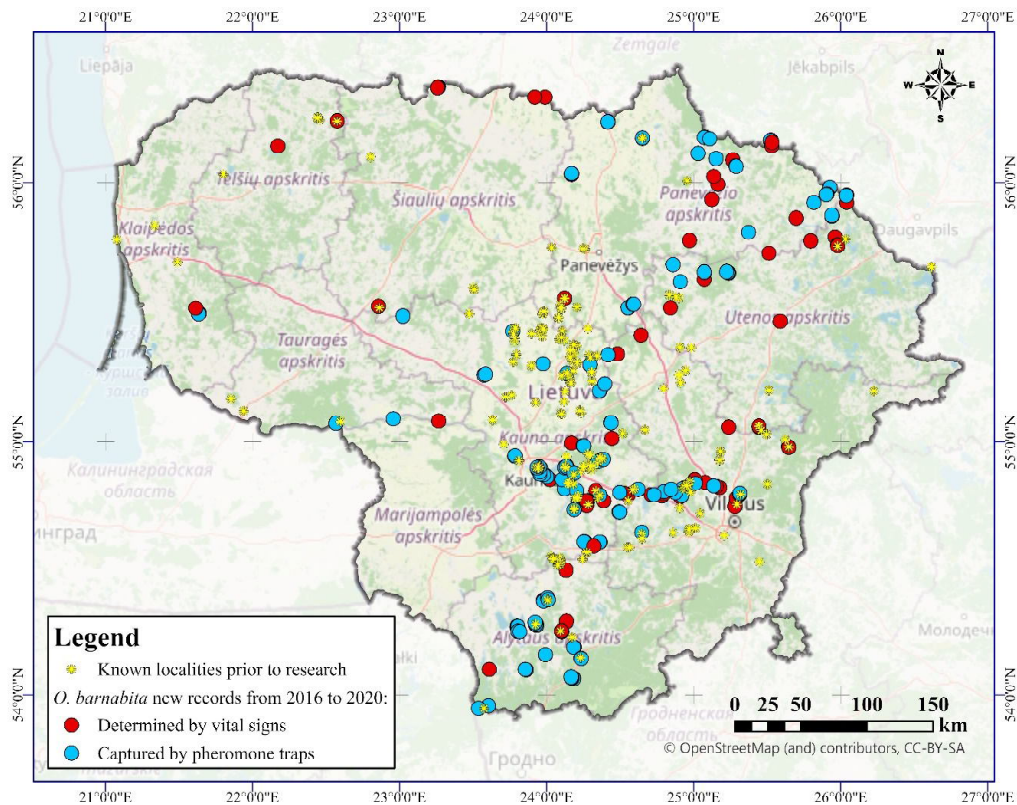


Figure 1. *O.barnabita* localities in Lithuania.

Since 1992 *O. eremita* was listed as priority species in Annexes II and IV of the EU's Habitat Directive (Luce 1996, Ranius et al., 2005); at the same time, *O. barnabita*, as part of the *O. eremita* complex, is subject to all the environmental requirements of the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Audisio et al. 2008, 2009, 2014; Carpaneto et al. 2015; Maurizi et al. 2017) and the Bern Convention (Annex II). This species also is included in the category „Near Threatened” in the IUCN European Red List of Saproxyllic Beetles (Alexander et al. 2010). At the local level, the hermit beetle is listed in the Red Data Book of Lithuania (Rašomavičius, 2007, 2021; Ivinskis, 2006, 2015), and is also an indicator species of key forest habitats (Ivinskis et al. 2018).

Despite the various measures to protect the species, the current population trend of this species in Europe is decreasing (Audisio et al. 2007, Alexander et al. 2010).

The territory of Lithuania plays an important role in the occurrence of *O. barnabita* in the Boreal region. According to Species assessments at EU biogeographical level, the estimated size of *O. eremita* complex inhabited area in Lithuania is 285 km², which is 24.74 % of the total population in the Boreal region.

This article compiles all the historical information, including mentions of the occurrence of *O. barnabita* in Lithuania, and presents the most recent data on the occurrence of *O. barnabita*, based on field studies of habitats suitable for this species. Despite the significant nature conservation value of the territory of Lithuania, there is much less data on protected species, including the occurrence of *O. barnabita*, then in Latvia, and the investigation of hermit beetle in Lithuania was insufficient for a long time (Davenis et al. 2018; Valainis et al. 2021). Purposeful study of the beetle fauna, as well as actual information about hermit beetles, appears in the scientific literature only in the middle of the twentieth century. Further research was limited to the indica-

tion of new localities, and data on the occurrence, biology and ecology of this species in Lithuania were not summarized up to the early 21st century when Ehnström (2003) and Tamutis (2005) were published reviews on rare and protected beetles in Lithuania. In total, only one study of hermit beetles has been conducted in Lithuania, and extensive data have been published as a result (Davenis et al. 2018). In recent years, scientific interest in the occurrence of hermit beetle and problems of species conservation has increased and many new localities were discovered. The ecological network for species dependent on ancient broadleaf trees using *O. barnabita* as a model species was published recently (Valainis et al. 2021). In this article, the area suitable for the occurrence of hermit beetles were identified not only in Lithuania but also in Latvia. In our publication, we provide new data on the prevalence of *O. barnabita*, as well as provide the most recent and complete map of the occurrence of this species in Lithuania, based on all the information available to date (Figure 1). These data will significantly complement the knowledge about the population of *O. barnabita* in Lithuania and will facilitate further research in the country.

ACKNOWLEDGEMENTS

This study was supported by the European Union's environmental funding mechanism LIFE (LIFE16 NAT/LT/000701) under the project LIFE OSMODERMA (Ecological network for *Osmoderma eremita* and other species dependent on veteran trees).

We wish to thank Danas Augutis, Dalia Bastytė-Cseh, Tadas Bujanauskas, Remigijus Karpuška, Kristina Guzaitienė, Vita Augutė, Žydrūnas Sinkevičius, Indrė Čeidaitė for their assistance during the sampling, which enhanced this contribution. The authors are grateful to Vytautas Tamutis for his valuable remarks and advice.

REFERENCES

- Audisio P., Ballerio A., Carpaneto G.C., Antonini G., Mancini E., Coletti G., Piattella E., & De Biase A. 2003. *Osmoderma eremita* s.l. in Europa meridionale: stato delle conoscenze e problemi di conservazione (Coleoptera, Cetoniidae). Proceedings of the International Symposium "Dead wood: a key to biodiversity", Mantova, May 29-31, 2003, Sherwood, 95, suppl. 2. (ed. by F. Mason, G. Nardi & M. Tisato), pp. 57-60.
- Audisio P., Brustel H., Carpaneto G. M., Coletti G., Mancini E., Piattella E., Trizzino M., Dutto M., Antonini G. & De Biase A. 2007: Updating the taxonomy and distribution of the European *Osmoderma*, and strategies for their conservation. — *Fragmenta entomologica*, Roma 39: 73–290.
- Audisio P., Brustel H., Carpaneto G. M., Coletti G., Mancini E., Trizzino M., Antonini G., De Biase A. 2008. Data on molecular taxonomy and genetic diversification of the European Hermit beetles, a species-complex of endangered insects (Coleoptera: Scarabaeidae, Cetoniinae, *Osmoderma*). *Journal of Zoological Systematics and Evolutionary Research* 47 : 88-95.
- Auglys J. 1994. Retosios vabzdžių rūšys Aukštaitijoje 1987–1993 m. [Rare species of insects in Aukštaitija, in 1987–1993]. *Raudoni lapai* 2: 20.
- Auglys J. 1996. Retos gyvūnų rūšys Krekenavos regioniniame parke [Rare species of animals in Krekenava Regional Park]. *Raudoni lapai* 4: 10–12.
- Augutis D. 2021. Niūriaspalvis auksavabalis *Osmoderma barnabita* (Motschulsky, 1845).- In: Rašomavičius, V., (ed.). *Red Data Book of Lithuania. Animals, plants, fungi.* - Vilnius, p. 122.
- Balevičius K. (Ed) 1992. Lietuvos Raudonoji knyga. Retosios ir nykstančios gyvūnų augalų bei grybų rūšys [Red Data book of Lithuania. Rare and Endangered Species of Animals, Plants and Fungi]. Environmental Protection Department of the Republic of Lithuania, Vilnius, Lithuania, 364 pp.
- Bergman K.-O., Jansson N., Claesson K., Palmer M.W. & Milberg P. 2011. How much and at what scale? Multiscale analyses as decision support for conservation of saproxylic oak beetles. *Forest Ecology and Management*, 265, 133–141.
- Bütler, R., Lachat, T., Larrieu, L. & Paillet, Y. (2013) Habitat trees: Key elements for forest biodiversity. *In Integrative Approaches as an Opportunity for the Conservation of Forest Biodiversity* (ed. by Kraus, D. & Krumm, F.), pp. 84-91. Joensuu, Finland.
- Butvila R., Dūda J., Ramonas V. 2007. Duomenys apie retas vabzdžių rūšis [Data about rare insect species]. *Raudoni lapai* 9: 37–40.
- Carpaneto, G. M., Baviera, C., Biscaccianti, A.B., Brandmayr, P., Mazzei, A., Mason, F., Battistoni, A., Teofili, C., Rondinini, C., Fattorini, S. & Audisio, P. (2015) A Red List of Italian saproxylic beetles: Taxonomic overview, ecological features and conservation issues (Coleoptera). *Fragmenta Entomologica*, 47, 53-126.
- Davenis S.A., Rimšaitė J., Ivinskis P., Ferenc R. 2018. Data on distribution of hermit beetle (*Osmoderma barnabita*, Motschulsky, 1845) (Coleoptera: Cetoniidae) and some other rare beetle (Coleoptera) species related to veteran trees in Lithuania. *Bulletin of the Lithuanian Entomological Society. Volume 2* (30) 8–15
- Dutto, M. 2003. Sulla presenza di *Osmoderma eremita* (Scopoli, 1763) in Slovenia e nell'estremo nord-est dell'Italia e designazione del neotipo (Coleoptera, Scarabaeoidea, Cetoniidae). *Naturalista siciliano*, IV series, 27 (3-4), 233-236.
- Ehnström B., Ivinskis P., Ferenc R. 2003. Kertinių miško buveinių vabzdžiai [The insects of forest key habitats]. Vilnius, Lithuania, 80 pp.

- Ferenca R. 2004. New and rare for Lithuania beetles (Coleoptera) species registered in 1978–2004. *New and Rare for Lithuania Insect Species. Records and Description* 16: 11–22.
- Ferenca R. 2006. A. Palionio vabalų rinkiniai [The collection of beetles of A. Palionis]. In: Ivinskis P, Rimšaitė J (Eds) *Entomologas Alfonsas Palionis (1905 - 957)*. Vilnius, Lithuania, 162-216.
- Frankham, R. 1996. Relationship of genetic variation to population size in wildlife. *Conservation Biology*, 10, 1500-1508.
- Gaidienė E. 1993. Catalogue of entomological collections of Tadas Ivanauskas zoological museum. Kaunas, Lithuania, 244 pp (In Lithuanian).
- Gliaudys S. 2001. Kurtuvėnų regioninio parko rytinės ir pietrytinės dalies vabalai (Coleoptera) [The beetles (Coleoptera) of eastern and south-eastern parts of Kurtuvėnai regional park]. *Kurtuvėnų regioninio parko metraštis* 6 (7): 17-29.
- Grove S.J. 2002 – Saprophytic insect ecology and the sustainable management of forests – *Ann. Rev. Ecol. and Syst.* 33: 1–23.
- Gusakov, A.A. 2002. Scarabaeid beetles of the subfamily Trichiinae (Coleoptera, Scarabaeidae) in the Fauna of Russia. Species of the genus *Gymnodus* Kirby, 1827. 55 pp. Eidos, Kaluga. [In Russian].
- Humphrey J.W., Sippola A.-L., Lemperiere G., Dodelin B., Alexander K.N.A. & Butler J.E. 2004. Deadwood as an indicator of biodiversity in European forests: from theory to operational guidance. *Monitoring and Indicators of Forest Biodiversity in Europe - From Ideas to Operationality* (ed. by M. Marchetti), pp. 192–206. European Forest Institute, Joensuu, Finland. *EFI Proceedings* No. 51.
- Inokaitis V. 2004. Naujos ir retos Lietuvos entomofaunos vabalų (Coleoptera) rūšys, aptiktos 2000-2003 metais [New and rare for the Lithuanian fauna Coleoptera species found in 2000–2003]. *New and Rare for Lithuania Insect Species. Records and Description* 16: 7–10.
- Ivinskis P., Ferenc R., Pacevičius V. 1996. Kai kurie duomenys apie retus vabzdžius saugomos ekologijos instituto, T. Ivanausko zoologijos muziejaus ir privačiose kolekcijose [Some data about rare insect species stored in the collections of Institute of Ecology, T. Ivanauskas zoological museum and private collections]. *Raudoni lapai* 4:21-25.
- Ivinskis P., Jonaitis V., Rimšaitė J., Ferenc R. (2004b) Neris regioninio parko vabzdžių įvairovė ir apsauga [Species diversity and protection of insects in Neris regional park] [abstract]. 10-oji mokslinė konferencija “Žmogaus ir gamtos sauga,” 20-22 May, 2004, Kaunas, Lithuania, 163-166.
- Ivinskis P., Rimšaitė J., Ferenc R. 2007a. Nauji duomenys apie retas gyvūnų rūšis [New data about rare animal species]. *Raudoni lapai* 9: 22-26.
- Ivinskis P., Ferenc R., Rimšaitė J. 2007b. Status and distribution of *Osmoderma eremita* and *Cucujus cinnaberinus* (Coleoptera) in Lithuania. In 4th International conference „Research and conservation of biological diversity in Baltic region”. Book of abstracts. Daugavpils: 45.
- Ivinskis P., Meržijevskis A., Rimšaitė J. 2009. Data on new and rare for the Lithuanian fauna species of Coleoptera. *New and Rare for Lithuania Insect Species. Records and Descriptions* 21: 45-63.
- Ivinskis P., Rimšaitė J., Davenis S.A. 2018. *Medžiai senoliai*. Vilnius.
- Krell, F.-T. 1997. Zur Taxonomie, Chorologie und Eidonomie einiger westpaläarktischer Lamellicornia (Coleoptera). *Entomologische Nachrichten und Berichte*, 40 (4), 217-229.
- Landvik M., Niemelä P., Roslin T. 2016a. Opportunistic habitat use by *Osmoderma barnabita* (Coleoptera: Scarabaeidae), a saprophytic beetle

- dependent on tree cavities. *Insect Conservation and Diversity* 9: 38–48.
- Landvik, M., Firmino Miraldo, A.A., Niemelä, P., Valainis, U., Cibulskis, R. & Roslin, T.V. (2017) Evidence for geographic substructuring of mtDNA variation in the East European Hermit beetle (*Osmoderma barnabita*). *Nature Conservation*, 19, 171-189
- Luce J.-M. 1996. *Osmoderma eremita*. In: Helsingen, P.J., L. Willemsse & M.C.D. Speight (Eds.), 1996. Background information on invertebrates of the Habitats Directive and the Bern Convention 3: 64-69.
- Maurizi E., Campanaro A., Chiari S., Maura M., Mosconi F., Sabatelli S., Zauli A., Audisio P. & Carpaneto G.M. 2017. Guidelines for the monitoring of *Osmoderma eremita* and closely related species. *Nature Conservation*, 20, 79–128
- Meržijevskis A. 2004. Nauji duomenys apie retas vabzdžių rūšis Lietuvoje [New data about rare insects species in Lithuania]. *Raudoni lapai* 8: 16
- Muller J., Jarzabek-Muller, A., Bussler H. & Gossner M.M. 2014. Hollow beech trees identified as keystone structures for saproxylic beetles by analyses of functional and phylogenetic diversity. *Animal Conservation*, 17, 154–162.
- Nieto A. & Alexander K. N. A. 2010. European red list of saproxylic beetles. European Commission, European Union, IUCN –Species Programme, IUCN –SSC. 44 pp.
- Noreika N. 2009. New records of rare species of Coleoptera found in Ukmergė district in 2004-2005. New and Rare for Lithuania Insect Species. *Records and Descriptions* 21: 68 - 71.
- Obelevičius S. 2000. Į Raudonąją knygą įrašytų gyvūnų stebėjimai Pakruojo rajone [The monitoring of animals included in to Red Data Book in Pakruojis district]. *Raudoni lapai* 7: 25–26.
- Oleksa A., Szwalko P., Gawroński R. 2003. Pachnica *Osmoderma eremita* (Scopoli, 1763) (Coleoptera: Scarabaeoidea) w Polsce - występowanie, zagrożenia i ochrona [The hermit beetle *Osmoderma eremita* (Scopoli, 1763) (Coleoptera: Scarabaeoidea) in Poland – occurrence, threats and protection]. *Rocz. Nauk. Pol. Tow. Ochr. Przyr. "Salamandra"* 7: 101-123. (in Polish, English sum.)
- Ortego J., Bonal R., Muñoz A. & Espelta J.M. 2015. Living on the edge: the role of geography and environment in structuring genetic variation in the southernmost populations of a tropical oak. *Plant. Biol. J.*, 17: 676-683.
- Piotrowski W., Wołk K. 1975. O biocenotycznej roli martwych drzew w ekosystemach leśnych. *Sylwan* 114, 8: 31-35.
- Pileckis S. 1960. Indėlis į Lietuvos vabalų (Coleoptera) faunos pažinimą [Contribution to the knowledge of beetles (Coleoptera) fauna in Lithuania]. *LŽŪA mokslo darbai* 7 (3): 303-336.
- Pileckis S. 1968. On the knowledge of lamellicorn beetles (Coleoptera, Scarabaeidae) of the Lithuanian SSR [abstract]. The thesis of 6th Scientific Conference of Plant Protection in Baltic States. 25–27 March, 1968, Tartu, Estonia, 112–114.
- Pileckis S 1976. Lietuvosvabalai [The beetles of Lithuania]. *Mokslas, Vilnius, Lithuania*, 244 pp.
- Pileckis S. 1979. Relict and little-known species of beetles (Coleoptera) found in the Lithuanian SSR [abstract]. Materials of 7th International Symposium on the Entomofauna of Middle Europ. Leningrad, Lithuania, 188–190 (In Russian).
- Pileckis S., Monsevičius V. 1995. Lietuvos fauna. Vabalai 1 [Lithuanian fauna. The beetles Vol. 1]. *Mokslas, Vilnius, Lithuania*, 304 pp.
- Ranius T., Aguado L.O., Antonsson K., Audisio P., Ballerio A., Carpaneto G.M., Chobot K., Gjurašin B., Hanssen O., Huijbregts H., Lakatos F., Martin O., Neculiseanu Z., Nikitsky N.B., Paill W., Pirnat A., Rizun V., Ruicănescu A., Stegner J., Süda I., Szwalko P., Tamutis V., Telnov D., Tsinkevich V., Versteirt V., Vignon V., Vögeli M.,

- Zach P. 2005. *Osmoderma eremita* (Coleoptera: Scarabaeidae: Cetoniinae) in Europe – Anim. Biodiv. Conserv. 28: 1–44.
- Ranius T., Nilsson S.G. 1997. Habitat of *Osmoderma eremita* Scop. (Coleoptera: Scarabaeidae), a beetle living in hollow trees – J. Insect Conserv. 1: 193–204.
- Ranius T. & Hedin J. 2004. The occupancy pattern of a saproxylic beetle, *Osmoderma eremita*, in a fragmented landscape predicted from a RAMAS metapopulation model. In: Species conservation and management: case studies (ed. by H.R. Akcakaya, M. Burgman, O. Kindvall, C.C. Ward, P. Sjögren-Gulve, J.S. Hatfield & M.A. McCarthy). Oxford University Press, New York.
- Šablevičius B. 2011. Vabalai [The beetles]. Kaunas, Lithuania, 103
- Samuelsson J., Gustafsson L., Ingelög T. 1994. Dying and dead trees, a review of their importance for biodiversity. Swedish Threatened Species Unit, Uppsala
- Sparacio I. 1994. *Osmoderma cristinae* n. sp. di Sicilia (Insecta Coleoptera: Cetoniidae). Naturalista siciliano, IV series, 17 (3-4), 305-310.
- Sparacio I. 2000. Osservazioni sulle *Osmoderma* Le Peletier et Audinet-Serville europee con descrizione di una nuova specie dell'Italia meridionale (Coleoptera Cetoniidae). Naturalista siciliano, IV series, 24 (3-4), 225-239.
- Speight M.C.D. 1989. Saproxylic Invertebrates and their Conservation. Council of Europe, Nature and Environment, Strasbourg 42.
- Stokland J.N., Siitonen J. & Jonsson B.G. 2012. Biodiversity in Dead Wood. Ecology, biodiversity and conservation, Cambridge University Press, Cambridge, UK.
- Strazdienė V. 1998. Niūraspalvis auksavabalis (*Osmoderma eremita*) ekologijos instituto kolekcijose [*Osmoderma eremita* in collections of Institute of Ecology]. Raudoni lapai 6: 13.
- Svensson G.P., Oleksa A., Gawroński R., Lassance J.M. & Larsson M.C. 2009. Enantiomeric conservation of the male-produced sex pheromone facilitates monitoring of threatened European hermit beetles (*Osmoderma* spp.). Entomologia experimentalis et applicate, 133, 276-282.
- Sverdrup-Thygesen A., Hanssen, O. & Ødegaard, F. 2010. Scientific basis for management plan of the hermit beetle *Osmoderma eremita*. — NINA Rapport 631. 44 pp. [In Norwegian.]
- Tamutis V. 2005. Beetles (Insecta, Coleoptera) of the Red Data Book of Lithuania. In: Sklodowski J, Huruk S, Barševskis A, Tarasiuk S (Eds) Protection of Coleoptera in the Baltic Sea Region. Warsaw, Poland, 23–35
- Tauzin P. 1994a. Le genre *Osmoderma* Le Peletier et Audinet-Serville 1828 (Coleopt., Cetoniidae, Trichiinae, Osmodermatini). Systématique, biologie et distribution (Première partie). L'Entomologiste, 50 (3), 195-214.
- Tauzin P. 1994b. Le genre *Osmoderma* Le Peletier et Audinet-Serville 1828 (Coleopt., Cetoniidae, Trichiinae, Osmodermatini). Systématique, biologie et distribution (Deuxième partie). L'Entomologiste, 50 (4), 217–242.
- Tauzin, P. 1996. Complément à la note sur le genre *Osmoderma* (Coléoptères, Cetoniidae, Trichiinae). L'Entomologiste, 52 (3), 105-106.
- Tauzin P. 2000. Localités connues de *Osmoderma eremitum* Scopoli en France. Le Coléoptériste, 39, 133-136.
- Tauzin P. 2002. *Osmoderma eremitum*: compléments sur sa distribution en France et nouvelle information sur la taxonomie du genre (Coleoptera, Cetoniidae, Trichiinae, Osmodermatini). L'Entomologiste, 58 (3-4), 145-151.
- Tamutis V., Tamutė B. & Ferenc R. 2011. A catalogue of Lithuanian beetles (Insecta, Coleoptera). ZooKeys 121: 1-494.

Vaivilavičius G. (Ed) 2008. Vabzdžiai ir moliuskai Kauno ir Kaišiadorių rajonų saugomose teritorijose [The insects and molluscs in protected territories of Kaunas and Kaišiadorys districts]. Kaunas, Lithuania, 96 pp.

Valainis U., Balalaikins M., Soms J., Bastytė-Cseh D., Gintaras A., Banelienė A., Augutis D., Žukovskienė M., Nitcis M., Zolovs M. 2021. Ecological network for species dependent on ancient broadleaf trees using *Osmoderma barnabita* as a model species - a new approach. *Insect Conservation and Diversity*, 1-15.

Zauli A., Carpaneto G.M., Chiari S., Mancini E., Nyabuga F.N., Redolfi De Zan L., Romiti F., Sabbani S., Audisio P.A., Hedenström E., Bologna M.A. & Svensson G.P. 2016. Assessing the taxonomic status of *Osmoderma cristinae* (Coleoptera: Scarabaeidae), endemic to Sicily, by genetic, morphological and pheromonal analyses. *Journal of Zoological Systematics and Evolutionary Research*, 54, 206-214.

Žitkevičius N. 2007. Niūraspalvio auksavabalio (*Osmoderma eremita* Scop.) radvietės Biržų regioniniame parke ir Pasvalio rajone [The find-

ings of *Osmoderma eremita* Scop. in Biržai regional park and Pasvalys district]. *Raudoni lapai* 9: 56–57.

Received: 30.11.2021

Accepted: 21.12.2021

Published: 30.12.2021