

Data on the distribution of *Osmoderma barnabita* Motschulsky, 1845 (Coleoptera: Cetoniidae) in Bulgaria from 1904 to 2022

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Abstract: The hermit beetle, *Osmoderma eremita* s.l. (Scopoli 1763), is a species complex of scarab saproxylic beetles listed in the IUCN Red List of Threatened Species and protected in Bulgaria by Bern Convention, the Habitats Directive, and the Bulgarian Biodiversity Act. The taxonomic status of the species complex in Bulgaria is not fully known. It is believed that *Osmoderma barnabita* Motschulsky, 1845 is the main species present in the country, but it is also possible that *Osmoderma lassalei* Baraud and Tausin, 1991 exists in the southernmost parts, where is the northern limit of its distribution. Data collected over the years on the presence of *O. barnabita* are very scarce due to its hidden lifestyle and lack of interest from the scientists. The present study aims to summarise all available data on *O. barnabita* in Bulgaria (literature, National Natural History Museum – Bulgarian Academy of Sciences collection, field work, and citizen science) for the period from 1904 to 2022. A map of the current species distribution was generated. The altitudinal distribution ranged from 0 to 1700 m, mainly in mountainous areas with well-preserved forests. Eighty-three percent of the records with exact coordinates were from forests aged above 50 years, and 35% were from forests aged above 100 years. There were also individual records from cities, showing the need to protect urban green spaces and the old trees within them. Based on the results obtained, *O. barnabita* is newly registered for six Natura 2000 sites, confirmed in 18 sites; and for the remaining 18, where it is included in the standard data forms based on modelling its habitat, additional studies are needed to confirm or exclude it.

Keywords: conservation, distribution, Natura 2000, *Osmoderma eremita*

Introduction

The hermit beetle, *Osmoderma eremita* s.l. (Scopoli, 1763), is a species complex of scarab saproxylic beetles associated with hollow veteran trees in the broadleaf forests of Europe (Maurizi et al., 2017). The complex consists of *Osmoderma eremita* s.str. in western Europe; Italian endemics *Osmoderma italicum* Sparacio, 2000 and *Osmoderma cristinae* Sparacio, 1994; *Osmoderma barnabita* Motschulsky, 1845 in eastern Europe; and *Osmoderma lassallei* Baraud and Tausin, 1991 from Greece and European Turkey (Audisio et al., 2009). They are listed in the IUCN Red List of Threatened Species (Cálix et al., 2018) as priority species of community interest: *O. eremita* and *O. barnabita* have a Near Threatened


status and decreasing population trend; *O. lassallei* has an Endangered status and decreasing population trend; *O. italicum* has an Endangered status and unknown population trend; and *O. cristinae* has an Endangered status and stable population trend (Nieto et al., 2010). The species complex is protected by the Bern Convention and the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) under Annexes II and IV as a high-priority species. It is also a protected species under the Bulgarian Biodiversity Act (09.08.2002, latest amendment, State Gazette No. 102/23.12.2022), and it is included in the Red Book of Bulgaria (Guéorguiev, 2015). The main limiting factor for *O. eremita* s.l. populations is the disappearance of old


hollow trees due to anthropogenic activities. As stated by Ranius et al. (2005), the conservation of *O. eremita* relates to three areas that are challenging for nature conservation in Europe: preserving natural woodlands, habitats associated with old agricultural landscapes and small pockets of nature in urban areas.

According to Jurc et al. (2008), *O. eremita* s.l. is a stenotopic, foliophilic, sylvicolous, xylo-detriticolous, phytophagous and saproxylic species. It is a dendrobiont, that inhabits the hollows of old, still-living trees. It occurs in old deciduous forests, with preferred habitats being forest edges and riverbanks; it prefers oak (*Quercus* sp.), then linden (*Tilia* sp.), willow (*Salix* sp.), beech (*Fagus sylvatica* L.), cherry (*Prunus* sp.), pear (*Pyrus* sp.), apple (*Malus domestica* Borkh.) and other old fruit trees in orchards. The microhabitat of *O. eremita* s.l. is exclusively decaying and rotting old trees. Females lay their eggs in decaying wood in tree hollows, where the larvae develop. Larval development lasts 2–3 years. Adult insects occur from May to early September, but they are most commonly seen in June and July. In the autumn, the adults die (Tauzin, 1994a; 1994b; Oleksa et al., 2007; Dubois, 2009; Chiari, 2011; Chiari et al., 2015; Maurizi et al., 2017).

In the Balkan Peninsula as a whole, the species of the *Osmoderma* complex are not well studied, either taxonomically or ecologically. According to genetics studies, there are two well-defined clusters, each consisted by two species: the first cluster is restricted to western Europe (*O. eremita* and *O. cristinae*) and the second one to eastern Europe (*O. barnabita* and *O. lassallei*). The morphological characteristics used to distinguish *Osmoderma* species are not always clear, and they vary considerably. The lack of well-defined boundaries can lead to a high degree of uncertainty when studying populations living in areas of contact between the ranges of different taxa because of the presence of mixed morphological traits that make it difficult to assign individuals to one of the two neighbouring taxa. Furthermore, apart from *O. lassallei* and *O. barnabita*, a few poorly investigated taxa exist in the area between the Balkan Peninsula and the Caucasus Mountains. Although the nominative species *O. eremita* is relatively well studied, there is little information on *O. barnabita*; moreover, the ecology and distribution of *O. lassallei* are completely unknown (Audisio et al., 2007; Audisio et al., 2009; Landvik et al., 2017). The first records of *O. eremita* s.l. in Bulgaria were made by

three authors between 1904 and 1909 (Markovich, 1904; 1909; Nedelkov, 1906, 1909; Yoakimov, 1904). Since then, data on *O. eremita/barnabita* from Bulgaria have been mentioned only in a few papers published in the period 1960–2005 (Anguélov, 1960; Nüssler, 1986; Palm, 1966; Ranius et al., 2005). In total, there are about 13 known findings, mainly from the south-western and south-eastern parts of Bulgaria. Reasons why so few data have been collected over the years have to do with the hidden lifestyle of this species and the lack of interest from scientists.

It should be noted that for practical conservation reasons, the species from the complex in Bulgaria is kept as *O. eremita*; this determination was made in line with EC recommendations (Council Directive 92/43/EEC). The species is included in 30 protected Natura 2000 sites in Bulgaria, based on published records and the availability of its potential habitat, assessed by modelling ([Supplementary material 01 \[*\].xlsx](#) ).

According to the Habitats Directive country reports under Article 17 in 2013 (for the period 2007–2012), the species has Favourable (FV) status in all parameters for Alpine, Continental and Black Sea biogeographical regions; in 2019 (for the period 2013–2018), the assessment of all status parameters was ‘Unknown - XX’ (<https://eunis.eea.europa.eu/index.jsp> ). The present study aims to summarise all available data on *Osmoderma barnabita* in Bulgaria to date, in order to facilitate environmental conservation efforts to protect the species.

Material and methods

To generate a map of the known distribution of *O. barnabita* in Bulgaria, we compiled presence records from the following sources: published scientific literature and country reports; the collection of the National Museum of Natural History – Bulgarian Academy of Sciences (NMNHS – BAS); field data collected by the authors and other professional entomologists in 2012–2021 and by citizen science (voluntary provided data from amateurs, members of the Bulgarian Facebook group ‘The Insects and the Entomologists’) incorporated in the SmartBirds.org database (Popgeorgiev et al., 2015). For the forest age and Natura 2000 sites analyses, only records with exact coordinates (accuracy up to 20 m) were used; this resulted in 47 records.



Fig. 1. *Osmoderma barnabita* (male) – Sredna Gora Mts.

Results and discussion

We reported the distribution of *Osmoderma barnabita* in Bulgaria (Fig. 1), and 66 out of 79 records were new and unpublished (Fig. 2, [Supplementary material 02 \[* .xlsx\]](#)). Their altitude ranged from 0 to 1700 m, mainly in mountainous areas with well-preserved forests. The findings in the plains and in some towns (Smolyan, Sliven) were interesting as they showed a wider distribution than those only in the mountain forests. Eighty-three percent of the records with exact coordinates were from forests aged above 50 years, and 35% were from forests aged above 100 years.

Most likely, the hermit beetle was a more frequent species in Bulgaria in the past. In the early 20th century, Markovich (1909) mentioned that it was a common species in Razgrad Town. However, only single findings are evident nowadays, despite the efforts made and the use of more sophisticated methods for collection, such as pheromone traps. The difficulty in finding the species was also reflected in the preparation of the standard forms for the Natura 2000 sites in Bulgaria, where data were deficient

(DD) in 19 cases and of medium quality (M) in the rest ([Supplementary material 01 \[* .xlsx\]](#)).

Based on the results obtained, the species is newly registered for the following six sites: BG0000134, ‘Choklyovo blato’; BG0000366, ‘Kresna–Ilindentsi’; BG0000382, ‘Shumensko plato’; BG0000608, ‘Lomovete’; BG0001023, ‘Rupite–Strumeshnitsa’; and BG0001043, ‘Etropole–Baylovo’. Moreover, for the first time, exact and up-to-date data are reported for the following sites: BG0000164, ‘Sinite kamani’; BG0000167, ‘Belasitsa’; BG0000301, ‘Cherni rid’; BG0000314, ‘Rebro’; BG0000494, ‘Tsentralen Balkan’; BG0000496, ‘Rilski manastir’; BG0001007, ‘Strandzha’; BG0001012, ‘Zemen’; BG0001013, ‘Skrino’; BG0001021, ‘Reka Mesta’; BG0001028, ‘Sreden Pirin–Alibotush’; BG0001030, ‘Rodopi Zapadni’; BG0001032, ‘Rodopi Iztochni’; and BG0001493, ‘Tsentralen Balkan–buffer’. In this way, the presence of *O. barnabita* has been confirmed in 18 protected areas; for the remaining 18, additional studies are needed to confirm or exclude it.

Although, not exactly validated within the boundaries, for such sites as BG0001011, ‘Osogovska

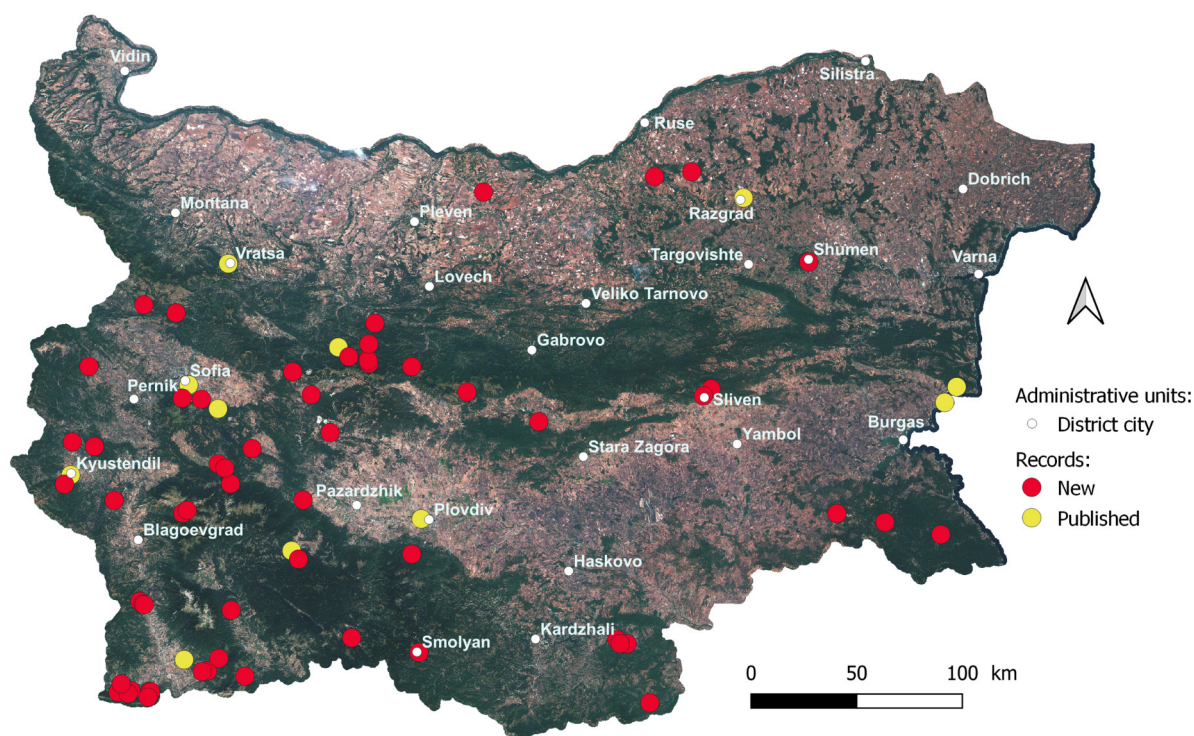


Fig. 2. Map of the current *Osmoderma barnabita* distribution in Bulgaria, based on a satellite map of Bulgaria from Sentinel 2 (Geopolymorphic Cloud, 2017).

planina’, it can be argued that the species is certainly present there. We show recent findings that are quite close to the administrative boundary of the area, which is enough to credibly claim that it is also present in other places in the zone where potential habitats exist. Unfortunately, there are also sites where the species has not only never been established but where almost complete degradation of the existing forests and a lack of old trees were also observed, making the existence of *O. barnabita* impossible (e.g. BG0000271, ‘Mandra–Poda’ and BG0000198, ‘Sredetska reka’).

Two main priority directions for species conservation in Bulgaria could be identified: the preservation of old-growth forests and the strengthening of systematic surveys on them. Considerable efforts are being made to identify and preserve old-growth forests and forest islands and to protect them and exclude them from forestry activities, both at the state level and by non-governmental organisations (NGOs) and the scientific community. There have been some successes, such as the declaration of areas with old-growth forests to be inaccessible for economic activi-

ties (Order RD-49-421/02.11.2016 of the Ministry of Agriculture and Food; <http://www.iag.bg/docs/lang/1/cat/14/index>), as well as the Forest Stewardship Council (FSC) certification of all state forest enterprises, resulting in at least 10% of the natural forest area in Natura 2000 sites being designated as old-growth forest protection areas. These areas with old-growth forests were considered in the forest management plans and in the orders for the designation of the Natura 2000 protected sites, thus ensuring their persistence. Attention also needs to be paid to the protection of old urban trees (Carpaneto et al., 2010; Kadej et al., 2016) in parks, gardens and other green areas, as it is obvious that vital populations of the species could also exist there (the records from Sliven, Smolyan, etc.).

Although there has been some increase in the amount of presence data in recent years, including from citizen science, there is still an urgent need for further research using a variety of methods (Chiari et al., 2012; Maurizi et al., 2017). Especially, such research can help to establish the distribution and population characteristics and status of the species.

Large-scale awareness-raising campaigns and data collection by volunteers (tourists, forest workers, schoolchildren, and students) can also help improve species presence data. At the same time, it is important that specific scientific studies, such as taxonomic composition, population dynamics and dispersal, be sufficiently funded by various projects (government, conservation, etc.) to ensure long-term and sustainable data collection and expert analysis. The combination of both approaches, citizen science and expert research, would greatly support the future preparation of management plans for this species and the areas it inhabits.

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References

- Anguélov P. 1960 Etudes sur l'entomofaune du parc Delassement et culture Ostrova (l'île au milieu de Maritza) près de Plovdiv, avec quelques notes faunologiques. *Annuaire des Musées de Plovdiv* 3: 7–40. (In Bulgarian)
- 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 (Coleoptera, Scarabaeidae, Cetoniinae). *Fragmenta Entomologica* 39: 273. <https://doi.org/10.4081/fe.2007.124>
- Audisio P., Brustel H., Carpaneto G.M., Coletti G., Mancini E., Trizzino M., Antonini G., De Biase A. 2009 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. <https://doi.org/10.1111/j.1439-0469.2008.00475.x>
- Cálix M., Alexander K.N.A., Nieto A., Dodelin B., Soldati F., Telnov D., Vazquez-Albalade X., Aleksandrowicz O., Audisio P., Istrate P., Jansson N., Legakis A., Liberto A., Makris C., Merkl O., Mugerwa Pettersson R., Schlaghamersky J., Bologna M.A., Brustel H., Buse J., Novák V., Purchart L. 2018 European Red List of Saproxyllic Beetles. IUCN, Brussels, 12 pp.
- Carpaneto G.M., Mazziotta A., Coletti G., Luiselli L., Audisio P. 2010 Conflict between insect conservation and public safety: the case study of a saproxyllic beetle (*Osmoderma eremita*) in urban parks. *Journal of Insect Conservation* 14: 555–565. <https://doi.org/10.1007/s10841-010-9283-5>
- Chiari S. 2011 Ecology of the hermit beetle (*Osmoderma eremita*) in Mediterranean woodlands. Roma: Tre University, Rome, 115 pp.
- Chiari S., Carpaneto G.M., Zauli A., Marini L., Audisio P., Ranius T. 2015 Habitat of an endangered saproxyllic beetle, *Osmoderma eremita*, in Mediterranean woodlands. *Écoscience* 19: 299–307. <https://doi.org/10.2980/19-4-3505>
- Chiari S., Zauli A., Mazziotta A., Luiselli L., Audisio P., Carpaneto G.M. 2012 Surveying an endangered saproxyllic beetle, *Osmoderma eremita*, in Mediterranean woodlands: a comparison between different capture methods. *Journal of Insect Conservation* 17: 171–181. <https://doi.org/10.1007/s10841-012-9495-y>
- Guéorguiev B. 2015 Coleoptera. In: Golemansky V. et al. (eds) Red Data Book of the Republic of Bulgaria. Volume 2. Animals. BAS and MoEW, Sofia. <http://e-ecodb.bas.bg/rdb/en/vol2/>
- Dubois G.F. 2009 Ecologie des coléoptères saproxyllyques : Biologie des populations et conservation d'*Osmoderma eremita* (Coleoptera : Cetoniidae). Université Rennes 1, 239 pp.
- Jurc M., Ogris N., Pavlin R., Borkovic D. 2008 Forest as a habitat of saproxyllic beetles on Natura 2000 sites in Slovenia. *Revue d'Écologie* 63: 53–66.
- Kadej M., Zając K., Smolis A., Tarnawski D., Malkiewicz A. 2016 Isolation from forest habitats

- reduces chances of the presence of *Osmoderma eremita* sensu lato (Coleoptera, Scarabaeidae) in rural avenues. *Journal of Insect Conservation* 20: 395–406.
<https://doi.org/10.1007/s10841-016-9873-y>
- Landvik M., Miraldo A., Niemelä P., Valainis U., Cibulskis R., Roslin T. 2017 Evidence for geographic substructuring of mtDNA variation in the East European Hermit beetle (*Osmoderma barnabita*). *Nature Conservation* 19: 171–189.
<https://doi.org/10.3897/natureconservation.19.12877>
- Markovich A. 1904 Materiali po nasekomnata fauna na razgradska okolnost. *Travaux de la société bulgare des sciences naturelles* 2: 221–252. (In Bulgarian)
- Markovich A. 1909 Prinosa za nasekomnata fauna na Razgradska okolnost. *Sbornik za umotvorenia, nauka i knizhnina*, Sofia 25: 3–20. (In Bulgarian)
- 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.
<https://doi.org/10.3897/natureconservation.20.12658>
- Nedelkov N. 1906 Contribution to the entomological fauna of Bulgaria. *Periodichno spisanie na balgarskoto knizhovno druzhestvo* 66: 404–439. (In Bulgarian)
- Nedelkov N. 1909 Fifth contribution to the entomological fauna of Bulgaria. *Sbornik za umotvorenia, nauka i knizhnina*, Sofia 25: 3–37. (In Bulgarian)
- Nieto A., Mannerkoski I., Putschkov A., Tykarski P., Mason F., Dodeli B., Tezca S. 2010 *Osmoderma eremita* (errata version published in 2017). The IUCN Red List of Threatened Species 2010: e.T15632A105873655.
<https://doi.org/10.2305/iucn.uk.2010-1.rlts.t15632a105873655.en>
(accessed 7 Apr 2023)
- Nüssler H. 1986 Eine von *Osmoderma eremita* Scop. abweichende Weibchen-Form aus Südwestbulgarien. *Faunistische Abhandlungen Staatliches Museum für Tierkunde Dresden* 13: 113–117.
- Oleksa A., Ulrich W., Gawroński R. 2007 Host tree preferences of hermit beetles (*Osmoderma eremita* Scop., Coleoptera: Scarabaeidae) in a network of rural avenues in Poland. *Polish Journal of Ecology* 55: 315–323.
- Palm T. 1966 På koleopterologiska excursioner vid Bulgariens Svarta havskust. *Entomologisk Tidskrift* 87: 5–22.
- Popgeorgiev G., Spasov S., Kornilev Y. 2015 SmartBirds – Information system with biological information.
<http://www.smartbirds.org>
(accessed 1 Apr 2023)
- Ranius T., Aguado L.O., Antonsson K., Audisio P., Ballerio A., Carpaneto G.M., Chobot K., Gjurasin B., Hanssen O., Huijbregts H., Lakatos F., Martin O., Neculiseanu Z., Nikitsky N.B., Paill W., Pirnat A., Rizun V., Ruicanescu A., Stegner J., Sda 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. *Animal Biodiversity and Conservation* 28 (1): 1–44.
- 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.
- Yoakimov D. 1904 Prinosa kam balgarskata fauna na nasekomite. *Coleoptera. Sbornik za umotvorenia, nauka i knizhnina*, Sofia 20: 1–43. (In Bulgarian)

Supplementary materials

01

Document title: Information from the Standard Data Form (SDF) for *Osmoderma eremita* s.l. in the national report under Article 17 of the Habitats Directive (2019) and validity of the information

Kind of document: Microsoft Excel (OpenXML)

MIME type: application/vnd.openxmlformats-officedocument.spreadsheetml.sheet

Document name: [000516000452023-01.xlsx](#) 

<https://doi.org/10.48027/hnb.45.061/01> 

02

Document title: Records of the presence of *Osmoderma barnabita* in Bulgaria in the period 1904–2022

Kind of document: Microsoft Excel (OpenXML)

MIME type: application/vnd.openxmlformats-officedocument.spreadsheetml.sheet

Document name: [000516000452023-02.xlsx](#) 

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