

Osmoderma eremita (Coleoptera, Scarabaeidae, Cetoniinae) in Europe

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Abstract

Osmoderma eremita (Coleoptera, Scarabaeidae, Cetoniinae) in Europe.— Research, monitoring and development of preservation strategies for threatened species are often limited by national borders even though a global perspective would be more appropriate. In this study, we collected data on the occurrence of a threatened beetle, *Osmoderma eremita*, associated with tree hollows in 2,142 localities from 33 countries in Europe where it is or has been present. The larvae develop in tree hollows and very few observations of larvae have been observed in dead logs on the ground. As long as there is a suitable tree hollow, it appears that *O. eremita* may use any tree species. Oaks (*Quercus* spp.) are the trees mainly used by *O. eremita*, followed by lime (*Tilia* spp.), willow (*Salix* spp.), beech (*Fagus sylvatica*) and fruit trees (*Prunus* spp., *Pyrus* spp., *Malus domestica*). *O. eremita* is still found in some remnants of natural forest, but is mainly observed on land that has long been used by man, such as pasture woodlands, hunting parks, avenues, city parks and trees around agricultural fields and along streams. The occurrence of *O. eremita* seems to have decreased in all European countries. Relatively high densities of *O. eremita* localities occur in Central Europe (northern Italy, Austria, Czechia, southern Poland and eastern Germany), some parts of Northern Europe (south-eastern Sweden, Latvia) and France. In some regions in north-western Europe, the species is extinct or may occur at some single sites (Norway, Danish mainland, The Netherlands, Belgium, north-eastern France). There are few data from south-eastern Europe. Many local extinctions of *O. eremita* are to be expected in the near future, especially in regions with recent habitat loss and fragmentation. *O. eremita* is useful as an indicator and umbrella species for the preservation of the entire invertebrate community associated with hollow trees in Europe. A preservation plan for *O. eremita* should include three aspects that are of general importance in nature conservation in Europe today: (1) preservation of remnants of natural forests with old, broad-leaved trees, (2) preservation and restoration of habitats related to traditional agricultural landscapes and (3) preservation of remaining "islands" of nature in urban areas.

Key words: Saproxylic, Cavity, Habitat Directive, Pollarding, Bioindicator, Scarabaeoidea.

Resumen

Osmoderma eremita (Coleoptera, Scarabaeidae, Cetoniinae) en Europa.— La investigación, el control y el desarrollo de estrategias de conservación de especies amenazadas en peligro de extinción están habitualmente confinadas por fronteras nacionales aunque sería más apropiado una perspectiva más global. En este trabajo se recogen datos sobre la presencia de un escarabajo en peligro de extinción, *Osmoderma eremita*, asociado a huecos de árboles en las 2.142 localidades de 33 regiones de Europa donde se ha encontrado. La larva se desarrolla en los huecos de los árboles y se ha observado pocas veces en troncos muertos en el suelo. Parece ser que *O. eremita* es capaz de utilizar cualquier especie de árbol siempre que tenga un hueco disponible. Los árboles más utilizados por *O. eremita* son los robles (*Quercus* spp.), seguidos del tilo (*Tilia* spp.), el sauce (*Salix* spp.), el haya (*Fagus sylvatica*) y los árboles

frutales (*Prunus* spp., *Pyrus* spp., *Malus domestica*). *O. eremita* se encuentra todavía en algún remanente de bosque natural, pero se observa principalmente en tierras que han sido usadas por el hombre como zonas de bosques aclarados, cotos de caza, avenidas, parques urbanos y en árboles alrededor de campos agrícolas y a lo largo del curso de ríos. Parece ser que la presencia de *O. eremita* ha disminuido en todas las regiones europeas. Las mayores concentraciones de localidades con presencia de *O. eremita* aparecen en Europa central (norte de Italia, Austria, República Checa, sur de Polonia y Alemania del este), en algunas partes del norte de Europa (sureste de Suecia, Latvia) y en Francia. En algunas regiones del noroeste de Europa, se ha extinguido o puede encontrarse de forma aislada (Noruega, Dinamarca, Países Bajos, Bélgica, noreste de Francia). Hay pocos datos del sureste europeo. Se prevén algunas extinciones locales de *O. eremita* en un futuro inmediato, especialmente en regiones con una pérdida y fragmentación del hábitat. *O. eremita* es una especie útil como indicador y paraguas para la preservación de toda la comunidad de invertebrados asociados a los agujeros de árboles en Europa. Un plan de preservación de *O. eremita* debería incluir tres aspectos que son de importancia general en la conservación de la naturaleza en Europa hoy en día: (1) preservación de los remanentes de bosques naturales con árboles viejos, (2) preservación y restauración de hábitats relacionados con los paisajes agrícolas tradicionales y (3) preservación de las "islas" de naturaleza que se mantienen en áreas urbanas.

Palabras clave: Saprófita, Cavidad, Directiva de Hábitats, Desmoche, Bioindicadores, Scarabeoidea.

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Introduction

In temperate and Mediterranean regions of Europe, old trees are now scarce and many species dependent on this habitat seem to be confined to small remnants with no possibility for dispersal between the populations (e.g. Harding & Rose, 1986; Speight, 1989). This is because old-growth deciduous forests have declined to a very small proportion of their original extent (Hannah et al., 1995). Up until the nineteenth century, old trees were also widespread in pasture woodlands and wooded meadows, but abandoned management and changes of land use have severely reduced these habitats (e.g. Nilsson, 1997; Kirby & Watkins, 1998).

When trees age, hollows with wood mould often form in the trunks. Wood mould is loose wood colonised by fungi, often with remains from bird nests and insects. Trunk hollows with wood mould harbour a specialised fauna mainly consisting of beetles, flies, mites, pseudoscorpions and ants. Many invertebrate species associated with hollow trees are threatened (e.g. Ehnström & Waldén, 1986; Warren & Key, 1991), and therefore the protection of this fauna should be an important goal for nature conservation in Europe.

A strategy for nature conservation should be based on knowledge about which sites should be given priority. Which habitat types are most valuable for invertebrates living in tree hollows? How are these habitats distributed in Europe? As neither time, economical resources or taxonomic expertise are available to carry out detailed surveys of saproxylic invertebrates throughout Europe, we need to find surrogates that provide clues about the conservation values but are easier to survey. One possibility is to measure the amount of habitat (in this case, large or hollow trees), while another is to survey indicator species. Surveys of old trees have been conducted with different protocols in Britain (e.g. Clifton, 2000) and Sweden (e.g. Hultengren & Nitare, 1999; Ranius et al., 2001). Lists with saproxylic insects that may be used as indicators have been compiled by Speight (1989), Rundlöf & Nilsson (1995) and Nilsson et al. (2001). One weak point with these surrogates is that they have usually been developed based on personal experience from a restricted region; the lists of indicator species and suggested methods to survey old trees are adopted to the researcher's study area, and do not necessarily suit the whole of Europe. Another problem is that to count all hollow and large trees (as in Ranius et al., 2001) or to survey presence or absence of tens of saproxylic insect species (as in Rundlöf & Nilsson, 1995; Nilsson et al., 2001) is expensive and time-consuming. It will therefore take a long time until there are sufficient data of this kind to allow comparisons between different parts of Europe.

A simple measure of conservation values could be achieved by collecting data about the presence of a single species. One beetle species, *Osmoderma eremita* (Scopoli, 1763; Coleoptera: Cetoniidae), has been more studied in ecological research than any

other invertebrate species associated with tree hollows (see Ranius, 2002b, for a review). This species has a high priority according to the European Union's Habitats Directive (Luce, 1996), and has therefore been surveyed in many countries in recent years. It is also listed by the Bern convention. A study in south-eastern Sweden showed that in sites with tree hollows, those with *O. eremita* present have a higher species richness of other threatened beetle species associated with tree hollows (Ranius, 2002a). The fact that this species is easy to survey also improves its suitability as an indicator species (Ranius & Jansson, 2002).

In this paper we compile data on the occurrence of *O. eremita* in Europe. It is written by 28 co-authors each responsible for one or more European countries. Information has been compiled from museums and private collections, literature and field surveys. The paper is based on a private initiative, based on the belief that entomology and nature conservation would do better with stronger co-operation between conservationists from all European countries.

Taxonomy

Osmoderma species occur in northern America, Europe, Turkey, south-eastern Siberia, north-eastern China, Korea and Japan (Shaffrath, 2003a). Taxonomists's opinions differ about the forms of *Osmoderma* in Europe. According to Tauzin (1994a, 1994b, 1996, 2002), there are two *Osmoderma* species in Europe: *O. eremita* (Scopoli) in Western Europe and *O. lassallei* Baraud & Tauzin in Eastern Europe. Sparacio (1994) described a third species, *O. cristinae*, endemic for Sicily. Later, Krell (1996) treated these three European forms of *Osmoderma* as different subspecies of *O. eremita*. However, in a recent review of the European *Osmoderma*, Sparacio (2001) considered again both *O. lassallei* and *O. cristinae* as distinct species, and described a fourth possible separate species of this complex, *O. italica* (recently emended *O. italicum* by Audisio et al., 2003), considered endemic to the southern mainland of Italy. A new, but partly questionable, nomenclatorial and taxonomic scenario of the European *Osmoderma* was finally recently introduced by Gusakov (2002). An ongoing genetic study by P. Audisio and coll., based on comparison of mtDNA genes sequences, will probably provide greater insight in the taxonomy of the species complex. For simplicity, in this paper we do not distinguish between *Osmoderma* forms, but provisionally apply the name *O. eremita* to all *Osmoderma* in Europe.

Life history

Normally, the adults of *O. eremita* are found from July to September, but in some regions (Germany, Slovenia and Italy) there have been several observations in June and even a few in April and May (Stegner, 2002; Schaffrath, 2003a; P. Audisio, pers. obs.; G. Carpaneto, pers. obs.; A. Pirnat, pers. obs.).

The adults normally die in autumn; nevertheless, a hibernating adult female has once been found in January in the forest of Fontainebleau, France (Tauzin, 1994b). When rearing the species in the laboratory, Tauzin (1994b) observed adult males to have a lifetime of 10–20 days, while females lived for more than 90 days. Schaffrath (2003a) fed isolated males which reached lifetimes of 90 days. In a field study in Sweden, males and females seemed to have the same life-time, with a maximum of about one month (Ranius, 2001).

During a research project conducted over several years in Sweden, *O. eremita* was only found active at daytime (T. Ranius, pers. obs.), while in Russia, active adults have also been observed at dusk and night time (N. Nikitsky, pers. obs.) and in Germany and France at dawn (Schaffrath, 2003a; Stegner, 2002). Flying individuals have mainly been seen in the early afternoon on warm, sunny days.

According to Luce (1996), *O. eremita* females lay 20–80 eggs. When Jönsson (2003) reared the beetle in the laboratory, he searched for larvae one–two months after the eggs were laid, and found 12–18 larvae produced by each female. Egg incubation lasts 14–20 days: initially the eggs are dull white, they then become yellowish and redouble their size, up to a diameter of 5 mm. First instar larvae have a length of 6 mm, but at complete development they can reach 60 mm and have a weight of more than 12 g (Schaffrath, 2003a). Before metamorphosis, the larvae construct an oval cocoon made of their excrements and wood mould (Tauzin, 1994b). From laboratory studies, we know that cocoons are made in autumn (September), but metamorphosis takes place in the following spring (May–June) (Tauzin, 1994b). However, in Italy, D. Baratelli (pers. comm.) observed that two larvae found in February developed into adults in April and May of the same year.

In laboratory and field studies in Poland, Pawłowski (1961) found the generation time to be three or four years. The larval feeding period was between 65 and 93 weeks. Feeding activity took place when the average daily temperature exceeded 13°C, which means that in Poland the larvae are active about 30 weeks per year. Developing time and hibernation depend on the temperature of the wood mould, which varies between years and localities. In Germany, Russia and Latvia, the development time in the field is also usually either three or four years (Nikitsky et al., 1996; Schaffrath, 2003a; D. Telnov, pers. obs.).

The population size varies widely between trees (Ranius, 2001). In an area in southeastern Sweden there were, on average, 11 adult beetles per hollow oak and year (Ranius, 2001), and a similar population size per tree has been reported from Hallands Väderö, southwestern Sweden (Jönsson, 2003). At both these sites, there were almost 100 adult beetles per year in some trees. Circumstantial records suggest that the population size per tree is of the same magnitude in other parts of Europe. For instance, in chestnut and willow trees in Lovero Valtellino (Lombardia, Italy) normally 5 to 30, but

sometimes more, individuals per tree were observed (P. Audisio, pers. obs.). Also in Latvia, oaks and lime trees have been found harbouring populations of the same magnitude (D. Telnov & F. Savich, pers. obs.). Schaffrath (2003b) counted the larvae and cocoons in three oaks and one beech in Germany and found 30–120 individuals, which implied that there was about one larva per litre of wood mould. In France, Prunier (1999) counted the larvae in the trunk of an old oak from 1 to 7 m from the ground and found more than 150 larvae.

Males of *O. eremita* emit a characteristic odour that French entomologists have called "odeur de prune" (= odour of plums) or "odeur de cuir de Russie" (= odour of Russian hide) (Tauzin, 1994b). German entomologists have called the beetle "Aprikosenkäfer" because it smells like apricots (Eisenach, 1883), even though "Eremit" and "Juchtenkäfer" (from Juchtenleder = Russian hide) are more commonly used names. The odour can be perceived by humans several metres from the beetle. Chemical analyses have revealed that the males emit the same compound (a decalactone) that is emitted by apricots and plums, and that the compound works as a pheromone that attracts female *O. eremita* (Larsson et al., 2003).

Only on a few occasions have *O. eremita* adults been seen feeding. In Croatia, B. Gjurašin has collected *O. eremita* adults on flowers (*Leucanthemum* sp. and *Viburnum* sp.) on two occasions, and in Spain, there has been a sighting on flowers of *Sambucus nigra* (L. O. Aguado, pers. obs.). From Germany, M. Bahn (Schnitter in litt.) has reported two specimens from umbelliferous plants. Schaffrath (2003a) has collected a few reports of observations from flowers and sap flows. In Poland, Russia and Estonia, the beetle has been observed feeding on sap flows (Tenenbaum, 1913; Pawłowski, 1961; N. Nikitsky, pers. comm.; I. Süda, pers. obs.). Entomologists frequently search this source for insects although only a few *O. eremita* individuals have been encountered, suggesting that *O. eremita* visit these habitats only rarely. P. Szwajko (unpublished data) has once observed a female *O. eremita* feeding on a ripe yellow plum (*Prunus* sp.). In the laboratory, Schaffrath (2003b) has found that adult beetles feed on bananas and apples.

Habitat requirements

Most findings of *O. eremita* have been made in hollow but still living, standing trees. The beetle has also been found in dead, standing trees, but probably such trees are often unsuitable because they are too dry. On some occasions (for instance, we know one tree in Sweden, one in Poland, three in Latvia and one in Estonia), living adults or larvae have been found in downed tree trunks. A few times, the species have been found in old stubs (Latvia: D. Telnov, pers. obs.; Russia: N. Nikitsky, pers. obs.; Germany: Stegner, 2002). At many localities, hollows suitable for *O. eremita* occur only in very large trees, but at other sites the species

has also been found at relatively thin, slow-growing trees. For instance, the species has been found in Sweden in a hollow oak (*Q. robur*), growing on a hill, with a diameter of 22 cm (Ranius & Nilsson, 1997), in central Italy in a beech (*Fagus sylvatica*) with a diameter of 25 cm (P. Audisio, pers. obs.), and in Germany in a hornbeam (*Carpinus betulus*) of 25 cm diameter (J. Stegner, pers. obs.). We believe that most oak trees with the beetle present are 150–400 years, while trees of rapid-growing species may often harbour *O. eremita* when they are younger; poplars (*Populus* spp.) and willow trees (*Salix* spp.) may harbour *O. eremita* when they are only a few decades old (Schaffrath, 2003a). The beetle inhabits fruit trees that are 80–100 years old (Stegner, 2002). Pollarded oaks in France harbour *O. eremita* when they are only 70–140 years (V. Vignon, pers. obs.). Also in Latvia, the species has been found in many seemingly younger oaks, especially in urban habitats (D. Telnov, pers. obs.).

The species mainly inhabits trunk hollows containing large amounts of wood mould. This has been shown in studies in pasture oaklands in Sweden (Ranius, 2000; Hedin & Mellbrand, 2003). Observations from chestnuts, willows and oaks in Italy confirm this (P. Audisio, pers. obs.). Also Luce (1995) found that hollows of an intermediate to large size were used by *O. eremita* to a higher extent than smaller hollows. Moreover, the body size of the adult beetles has been found to be larger in trees with more wood mould (Hedin & Smith, 2003). *O. eremita* inhabits trees with entrance holes situated a few (2–5) metres from the ground more frequently than those with holes near the ground (Hedin & Mellbrand, 2003). However, the beetle occurs over a wide range of heights; it has been found in several tree hollows situated 15–25 m from the ground (V. Vignon, P. Orabi & J.-M. Luce, pers. obs.) but on some occasions also at or even below the ground level (Prunier, 1999; V. Vignon, pers. obs.).

The larvae usually dig between the wood mould and the internal wall of the trunk hollow (Palm, 1959; Pawłowski, 1961; D. Baratelli, pers. comm.). There, they eat the wall and increase the tree hollow and the amount of wood mould. Often the frass from *O. eremita* larvae is a dominating part of the tree hollow content. In this way *O. eremita* may improve the habitat for other species living in tree hollows (Ranius, 2002a). *Elater ferrugineus* L. and other click beetles, *Tenebrio* spp. and alleculids such as *Prionychus* spp. are beetle species that often occur together with *O. eremita* [reported from France (Brustel, 2001), Denmark (Martin, 1993), Germany (Schaffrath, 2003b), Poland (Pawłowski, 1961) and Sweden (Ranius, 2002a)]. The most important predator on *O. eremita* larvae is probably the larvae of the click beetle *Elater ferrugineus* (Schaffrath, 2003b). Other enemies are less known. Vertebrates predating on *O. eremita* have only occasionally been reported. However, in Koziencice Forest (central Poland), several adults

of *O. eremita* have been preys of the roller *Coracias garrulus* L. (Ranius, 1998). Mites and nematodes are other possible enemies, which so far have only been described anecdotally. Larvae infested by mites (deutonymphs of *Gamasina*), collected in winter (southern Poland) in a hollow stump of alder, died in the laboratory during the following summer killed by these mites (Szwajko, pers. obs.). There is one record of larvae infested by a nematode (Martin, 1993). *Protaetia lugubris* (Herbst) is a Scarabaeid beetle that seems to have similar habitat requirements as *O. eremita* (Luce, 1995), and therefore it has been suggested that they may be competitors (Ranius, 2002c).

Tree species

Oak (*Quercus* spp.) is the most important tree for *O. eremita*, followed by lime trees (*Tilia* spp.), willows (*Salix* spp.), beech (*Fagus sylvatica*) and fruit trees (*Prunus* spp., *Pyrus* spp., *Malus* spp.) (fig. 1). In many regions, ash (*Fraxinus* spp.), elm (*Ulmus* spp.), chestnut tree (*Castanea sativa*), aspen and poplars (*Populus* spp.), birch (*Betula* spp.) and maple (*Acer platanoides*) are also important host trees. Mulberry trees (*Morus* spp.), common alder (*Alnus glutinosa*), plane trees (*Platanus* spp.) walnut trees (*Juglans regia*) and hornbeam (*Carpinus betulus*) are other tree species which the beetle has been found in. Findings from needle trees are more rare; however, the species has been found in silver fir (*Abies* spp.) in Greece and Denmark, in yew trees (*Taxus baccata*) of France (Caillol, 1913 in Tausin, 1994b), and in Scots pine (*Pinus sylvestris*) in Slovakia and Poland. The species has been found in exotic tree species such as false acacia (*Robinia pseudoacacia*) (for instance, in France, Germany, Italy and Austria), Japanese honeysuckle (*Lonicera nipponica*) (Janssens, 1960), silver maple (*Acer saccharinum*) (in Germany: Stegner, 2002) and horse chestnut (*Aesculus hippocastanum*) (in Denmark, Sweden, Poland and Austria).

Most localities today occur on land that has been used by man for a long time. Only in some regions, such as Spain, southern Italy and the Balkans, more or less natural forests are reported to be the major habitat of *O. eremita*. Perhaps the beetle is to a higher extent associated with man-made, more open habitats in Northern Europe (even though the beetle may occur in shaded situations also in Scandinavia), but occurs in denser forests further south. This could be a compensation for the climate (cf. Thomas, 1993); in regions with colder climate the species tends to avoid the most shaded situations (Ranius & Nilsson, 1997), while in regions with warm and dry climate, free-standing trees perhaps tend to be too dry. However, it is difficult to achieve hard evidence for this hypothesis.

In Scandinavia, pasture woodlands and deer parks with broadleaved trees are the most important habitat. Also in Germany, the largest *O. eremita* localities are on land that has been used for grazing or hunting (Schaffrath, 2003b).

The species inhabits urban habitats such as parks and alleys. For instance in Banská Bystrica (Franc, 1997), Strasbourg, Rome, Florence, Dresden, Leipzig, Salzburg, and Kaunas, *O. eremita* occurs in the city centres. In several regions, such as Hungary, Slovakia, some parts of Russia and south-eastern Germany, the *O. eremita* localities are concentrated to floodplain areas, where the habitat may be forests or smaller woods in agricultural land. Old orchards may be important habitats, especially in central Europe (e.g. Eastern Germany, Austria and Slovenia).

In some regions, the beetle mainly uses pollarded trees. Pollarding implies that tree branches are repeatedly cut in order to increase the productivity of wickers, poles and fuel-wood. In parts of France, there are extensive networks of hedgerows where *O. eremita* inhabits pollarded oaks. In the intensively cultivated Po river basin of northern Italy, pollarded willows along riversides are the most important habitat for *O. eremita*. Abandoned practice of pollarding constitutes a threat to *O. eremita* in these areas.

Metapopulation ecology

In a study in Sweden, the occupancy rate of *O. eremita* per tree was positively correlated with the number of hollow trees per stand (Ranius, 2000; fig. 2). The positive correlation is consistent with what metapopulation ecologists refer to as Levins's rule (Hanski & Gilpin, 1997). Ecological studies of *O. eremita* support the view that each tree possibly sustains a local population and that the populations in stands together form a metapopulation (Ranius, 2002b). For instance, the species has been found to have a restricted dispersal (Ranius & Hedin, 2001; Hedin et al., 2003), and the population fluctuations in individual trees take place asynchronously (Ranius, 2001).

A survey of an area in southeastern Sweden revealed that *O. eremita* still occurs in almost all larger stands, but the occupancy pattern did not indicate any connectivity between stands (Ranius, 2000). This could be because the density of hollow oaks historically has been much higher than today. Over the last two centuries, old oaks have severely declined in Sweden (Eliasson & Nilsson, 2002; Hedin, 2003). Thus, most hollow tree stands were probably colonized by *O. eremita* long ago and, lately, the beetle has been confined to small stands without connectivity.

In the area surveyed in southeastern Sweden, *O. eremita* was systematically absent from single trees and very small stands, probably because of extinctions from these stands (Ranius, 2002c). This is consistent with the underlying reasoning of the minimum viable metapopulation size (MVM) concept (Hanski et al., 1996). MVM is an estimate of the minimum number of interacting local populations (in this case hollow trees inhabited by *O. eremita*) that is necessary for long-term survival of a metapopulation. Computer simulations of *O.*

eremita show that its metapopulation dynamics are slow, in the sense that it may take centuries from the decrease of the number of hollow trees until the small *O. eremita* population finally become extinct (Ranius & Hedin, 2004). Therefore, in many smaller stands which still harbour a population today, we should not expect *O. eremita* to be able to survive in the long run (Ranius & Hedin, 2004).

Survey methods

As *O. eremita* rarely leave the tree hollows, the species must be actively searched for. Where no surveys targeting *O. eremita* have been conducted, we should expect that many localities with *O. eremita* remain unknown.

The most efficient methods to survey *O. eremita* are pitfall trapping (Ranius, 2001; fig. 3) and searching for larvae (Martin, 2002) or remains of adult beetles and excrements in the wood mould (Ranius & Jansson, 2002). Pitfall trapping is carried out during late summer (July–August), when the adults are active. If the traps are emptied at least every second day and the beetles are released, the method is not destructive. By marking, releasing and recapturing the adults, population sizes may be calculated (Ranius, 2001). Martin (2002) has searched for larvae in the wood mould. This is preferably done in late autumn when the larvae occur higher up in the wood mould and are easier to find than at other times of the year.

Ranius & Jansson (2002) have searched for remains (pronotum, elytra and heads) of adult beetles and excrements from larvae in a certain amount of wood mould from each tree. In Eastern Germany, excrements have been searched for at trunk-bases and many new occurrences were found in this way (Stegner, 2002). Several Scarabaeid species have similar excrements, however, the shape and size make it possible to determine *O. eremita* excrements (Stegner, 2002). These methods can be used throughout the year and are appropriate when large areas should be systematically surveyed. As excrements and remains of adults may persist for many years, their presence does not ascertain that there is presently a living population in the tree. For this reason it is useful to combine the methods with pitfall trapping: first excrements and remains of beetles are searched for, and then pitfall traps are set only in those trees where excrements or remains of beetles have been found. This is a much more efficient way to search for localities with living adults in comparison to solely using pitfall traps.

Another method to record the presence of the species is to smell for the unmistakable scent of the species. This should be done in July or August, on warm days or afternoons. It is usually necessary to be very near the entrance hole, but sometimes it is possible to smell the beetles from a distance of up to tens of metres.

Window trapping is not an appropriate method to survey *O. eremita* (Ranius & Jansson, 2002). Hand-collecting of adult beetles is possible, but



Fig. 1. Typical trees harbouring *Osmoderma eremita* for different parts of Europe: A. Pollarded oaks in hedgerows in western France; B. Oaks in a historical pond-region in Eastern Germany; C. Pastured oak-land in southern Sweden; D. Beech forest in Germany, the tree harboured *O. eremita* before it was storm-felled; E. An alley with willow trees in a park in Germany.

Fig. 1. Árboles típicos que cobijan a Osmoderma eremita de distintas partes de Europa: A. Robles desmochados en zonas de setos en el oeste de Francia; B. Robles en una región con charcas de Alemania del Este; C. Tierras de pastoreo con robles en el sur de Suecia; D. Hayedo de Alemania, el árbol cobijaba a O. eremita antes de que fuera cortado por una tormenta; E. Un paseo con sauces en un parque de Alemania.

because the beetles rarely leave the tree hollows, it is not very efficient. *O. eremita* does not seem to be attracted by baits such as red wine and molasses, normally used for cetonid beetles.

Known localities with *O. eremita* may be monitored, either by studying the beetle population

itself or by studying its habitat. The beetle population may be monitored by pitfall trapping. The field work must be done at the correct period (which differs between years), pitfall traps must be set in a sufficiently number of trees, and the data must be statistically analysed (Ranius,

2001). The habitat may be monitored by revisiting the localities, checking that the inhabited trees are alive and not suffering from competition of neighbouring trees or any other threat. This is much cheaper than monitoring the beetle population, and may generate advice about which management measures are needed. The potential to get new hollow trees in the future should also be evaluated and planned for. Both these kinds of monitoring may be conducted, for instance, every five years.

Occurrence in individual countries

The occurrence of *O. eremita* in each country where it occurs (fig. 4) is described below. Lists with localities (those mapped in the figures) are given in the Appendix. Updated information about projects dealing with *O. eremita* are available at the web site www.ereimit.net.

Albania (fig. 5)

Most records are from the northern part of Albania. The only information obtained regarding host tree concerns an adult found in Tamara on a beech (*Fagus sylvatica*) (W. Schwiendbacher, pers. com.). The species has been found both in lowland (Shkodër) and mountain areas (Maja e Ragamit, Maja e Poliçanit).

Austria (fig. 6)

O. eremita is regarded as a highly endangered species (Franz & Zelenka, 1994). However, it has been recorded from more than one hundred localities dispersed over a wide part of Austria. The distribution has its centre on the thermally advantaged Eastern Lowland and extends to the inner–alpine Low Mountain Range, 800–1,000 m a.s.l. Previously, the species was found in wood and parkland landscapes managed with a low intensity, but today the species is restricted to old fruit plantations, trees along paths and streams, and at estates and animal parks with protected woodland. Some of the localities are large and only managed with a low intensity by humans. The inhabiting *O. eremita* populations therefore probably have a low extinction risk here. Such localities are the parks of Laxenburg (B. Dries & J. Roppel, pers. comm.) and Purgstall (F. Ressler, pers. comm.) in Lower Austria, the Lainzer Tiergarten in Vienna (Zabransky, 1998), and the old fruit plantations in the smallholdings in Upper Austria and in the western parts of Styria (Kreissl, 1974; Mitter, 2001).

Oak (*Quercus* spp.), willow (*Salix* spp.) and lime trees (*Tilia* spp.) are the most important tree species, whereas beech (*Fagus sylvatica*), ash (*Fraxinus excelsior*), elm (*Ulmus glabra*) and birch (*Betula* spp.) are more rarely used. Apple (*Malus* spp.) and pear

(*Pyrus* spp.) orchards seem to be important habitats in some areas. Occasionally *O. eremita* has been reported from introduced tree species such as horse chestnut (*Aesculus hippocastanum*), black poplar (*Populus nigra* var. *pyramidalis*) and false acacia (*Robinia pseudoacacia*).

Our present knowledge on the distribution of *O. eremita* is mainly due to coincidental collecting. Reports for many localities are old and the species may have become extinct due to habitat loss.

Belarus (fig. 7)

O. eremita is a rare, local species in Belarus, and is included in the Red Data Book (Lapitsin, 1993). In total, *O. eremita* has been found at 14 localities (Arnol'd, 1902; Alexandrovich & Pisanenko, 1991; Alexandrovich et al., 1996; Rubchenya & Tsinkevich, 1999; Solodovnikov, 1999; Lukashenya et al., 2001). All findings are from old forests or parks, mainly in lime tree (*Tilia* spp.), oak (*Quercus* spp.), elm (*Ulmus glabra*) and ash (*Fraxinus excelsior*), but also aspen (*Populus tremula*) and poplar (*Populus* spp.).

During the last few years, several new localities with *O. eremita* have been discovered. One locality is the park of Priluki in the Minsk district. This is an ancient park with old lime, ash and oak trees. There are many similar parks in Belarus where *O. eremita* would possibly be found if the species was surveyed.

Belgium (fig. 8)

The last confirmed record of *O. eremita* in Belgium dates back to 1944, and the species has therefore been regarded as regionally extinct. However, a recent record has been reported from the valley of "la Berwinne" (near Visé). *O. eremita* has been recorded from 15 localities in three different provinces: Brabant (central Belgium), Limburg (eastern Belgium) and Luik (southeastern Belgium). It has been found in old trees in woodlands (mainly oak (*Quercus robur*)), river–sides, pastures (mainly willows (*Salix* spp.)), and orchards (apple (*Malus domestica*), cherry, prune (*Prunus* spp.) and pear trees (*Pyrus* spp.)) (Janssens, 1960). *O. eremita* in Belgium is classified as endangered and is protected.

Belgium has a long history of forest fragmentation and remaining forests have been intensively managed, with a huge impact on fauna and flora (described by Desender et al., 1999). Especially in the northern part of Belgium (Flanders), forests have totally disappeared (e.g. Tack & Hermy, 1998), while in Wallonia, natural forests have been converted to intensively managed tree plantations. Old trees have been removed, and are still being removed, not only from forests but also from agricultural areas. As a result, the chance for beetles dependent on tree hollows to persist has severely decreased.

No survey specifically targeting *O. eremita* or any other saproxylic insects has been conducted during the last few decades other than two recent surveys

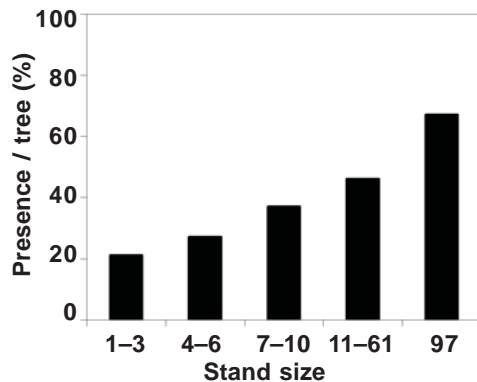


Fig. 2. Frequency of occurrence / tree of the beetle *Osmoderma eremita* in relation to stand size in localities in the province of Östergötland (from Ranius 2002a, $n = 155$), southeastern Sweden. Stand size is defined as the number of hollow oaks within a cluster with a distance of < 250 m from one hollow oak to another.

Fig. 2. Frecuencia de presencia / árbol del escarabajo *Osmoderma eremita* en relación con el tamaño de la parcela en localidades de la provincia de Östergötland (de Ranius 2002a, $n = 155$), sureste de Suecia. El tamaño de la parcela se define como el número de huecos en robles dentro de un grupo con una distancia de < 250 m de un hueco a otro.

of saproxylic beetles in a few forests (Versteirt et al., 2000; Heirbaut et al., 2002). Old localities where the species has been found have not been revisited for the study of *O. eremita*.

Bosnia and Herzegovina (fig. 9)

There are old records of *O. eremita* from a wide range of Bosnia–Herzegovina. The altitudinal range is from 50 (Mostar) to 1,350 m a.s.l. (Igman and Treskavica).

Localities with the species present are almost certainly still widespread throughout the country. However, owing to the civil war, it seems no surveys have been conducted over the last few years.

Bulgaria (fig. 5)

In Bulgaria, *O. eremita* has been recorded from the large mountain area of Stara Planina (which extends in the centre of the country from W to E), from the southwestern mountains (Rila and Pirin Mts.) and from the Black Sea coast. Nüssler (1986) has reported the species from locality 1,400 m a.s.l. We



Fig. 3. *Osmoderma eremita* and a pitfall trap. The trap consists of a jar placed inside a hollow oak with the opening on the level with the wood mould surface.

Fig. 3. *Osmoderma eremita* y una trampa. La trampa consiste en un recipiente situado dentro del hueco del roble con la abertura a nivel de la superficie de la madera desmenuzada.

know the habitat only for two single specimens: one has been flying in an orchard (M. Mazur, pers. comm.) and another collected in "xerothermic scrub" (E. Migliaccio, pers. comm.).

Croatia (fig. 9)

In Croatia, *O. eremita* has a broad range, but is rare. There are records from 31 localities, made between 1892 and 2000. *O. eremita* is not a protected species but some localities with *O. eremita* are protected areas (such as Mt. Velebit, Mt. U.ka, Mt. Papuk, Mt. Medvednica, ōumberak and Plitvice). No surveys focusing on *O. eremita* have ever been conducted in Croatia.

Czechia (fig. 6)

O. eremita is local and rare in the Czech republic; in the Red Data Book of the Czech and Slovak Republics it is regarded as endangered (Škapec, 1992). Most of the *O. eremita* localities are situated in southern and eastern Bohemia and most-southern and north-eastern Moravia, but there are a few localities also in other parts of Czechia.

Numerous suitable habitats have been lost during the last fifty years. Nevertheless, some habitats, for instance, parks near castles and alleys, have been preserved as isolated fragments with local *O. eremita* populations still present. Some *O. eremita* populations inhabit preserved lowland

forests with large broadleaved trees, especially in southern Moravia. Many populations seem to be small and isolated, so the risk of local extinctions in many cases is probably high. Another endangering factor in Czechia is the ongoing removal of "unhealthy" hollow trees, especially in anthropogenic habitats which host the majority of the *O. eremita* populations.

Most findings have been made in oak (*Quercus* spp.), elm (*Ulmus* spp.), lime (*Tilia* spp.), willow (*Salix* spp.) and fruit trees (Balthasar, 1956). According to Kollar (2000), the localities in Czechia are mainly in the lowland (up to 500 m, rarely 600 m a.s.l.).

The distribution of *O. eremita* is relatively well known, with over 500 findings from about 200 localities. This is due to a high number of entomologists in the Czech Republic; the species has never been systematically surveyed.

The first published survey of distribution of *O. eremita* in Czechia was a grid map by Jelínek (1992). More recently, Kollar (2000) summarized *O. eremita* records. During the last two years, mapping has been conducted within the scope of NATURA 2000. A more detailed survey is in preparation by K. Chobot.

Denmark (fig. 10)

O. eremita is rare in Denmark, and has only been found on Eastern Jutland (Jylland) and the islands Zealand (Sjælland), Lolland, and Falster (Martin, 2000). It seems to have become rarer in Zealand over the last 100 years, and has probably disappeared from Jutland, whereas its presence in several localities on Lolland have been discovered during the last few decades. There are records from 28 localities. However, when these were recently revisited, the species were only found in 9 of them, even though hollow trees are still present at all localities. *O. eremita* was searched for in every tree whenever possible. However, some entrance holes were too small or situated too high to reach by ladder. At the largest locality (Bognæs Storskov, Zealand) *O. eremita* was found in 16 trees, while at the other localities the species was found in 2–10 trees. This means that the survival of the *O. eremita* in Denmark is uncertain in the very near future as the populations are small and very isolated.

The species has been found breeding in several different deciduous trees, and once also in a conifer tree: silver fir (*Abies alba*). The most important habitat is privately-owned deer parks or forests situated near old estates and manors. There, the species occurs mainly in oak (*Quercus robur*) beech (*Fagus sylvatica*), and ash (*Fraxinus excelsior*). Outside the forests, it has especially been found in avenue trees: lime (*Tilia cordata*), elm (*Ulmus glabra*) and horse chestnut (*Aesculus hippocastanum*).

Specimens from 28 localities were registered, when museums and private collection were re-

viewed in 1990–1991. These 28 localities were surveyed, and living specimens were found at 10 localities (Martin, 1993). When these ten localities were inventoried in 1999 (Martin, 2002), *O. eremita* was found in 61 hollow trees (46 oaks (*Quercus robur*), 10 beeches (*F. sylvatica*), 3 horse chestnuts (*A. hippocastanum*) and 2 ashes (*F. excelsior*)). Of these trees, 49 were alive, although several later fell during a hurricane in December 1999.

Estonia (fig. 11)

Until recent years, *O. eremita* was known in Estonia only from an undated record from Tartu, probably originating from the 19th century. In 1995, the species was found in an oak in a wooded meadow in Koiva woodland in southern Estonia. The beetles have since been found there repeatedly, once feeding on a flow of oak sap. A cocoon including remains of an adult has also been found in a hollow maple (*Acer platanoides*) stub in an avenue at Koikküla, a village situated nearby (Süda, 1998, 2003).

Starting in 1999, the Estonian Seminatural Community Conservation Association performed so-called bush clearing in the woodland. The aesthetic aspect was over-emphasized in the work and a large amount of dead or broken trees were burnt or removed, including large oak trees (Süda, 2003). Despite this, *O. eremita* is still present at woodlands along the Koiva river, although the number of suitable trees is small.

The existing population and possible new populations were searched for in 2000–2002 within the Estonian NATURA 2000 program. Despite the extensive search, no new records of *O. eremita* were recorded, although suitable habitats can be found at other places in Estonia, e.g. on Saaremaa Island.

Finland (fig. 11)

O. eremita is only known from one locality in Finland: the island of Ruissalo (Runsala) in Turku. This is however a large locality; in an area of about 5 x 2 km, living specimens have been found in 117 trees, remains from adults occurred in 62 trees, and excrements were found in another 155 trees (Landvik, 2000).

France (fig. 8)

In France, more than 300 localities with *O. eremita* are known. Thus, *O. eremita* is widely distributed in France, but most existing sites are relatively remote from each other, leaving wide empty spaces, particularly in forest regions. The species seems to have decreased severely, especially in the northern part of the country. In the southern part of France, there are probably still many localities that have not been discovered (J.–M. Luce, pers. comm.).

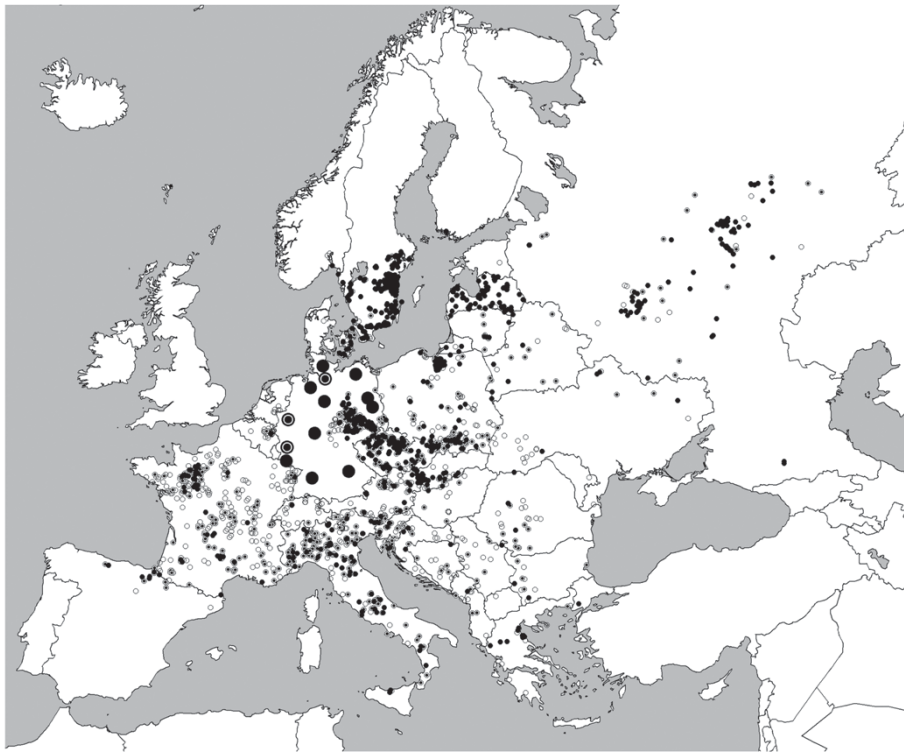


Fig. 4. Distribution of *Osmoderma eremita* in Europe: ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later. Larger circles represent records in German federal states where we do not have data for the individual localities.

Fig. 4. Distribución de *Osmoderma eremita* en Europa: ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro de 1990 o posterior. Los círculos más grandes representan registros en Alemania Federal de donde no disponemos de datos de localidades por separado.

Most of the localities are not in forests but in agricultural landscapes. Forests with *O. eremita* are normally only small localities situated far (often more than 100 km) from each other. These forests have a different history, for instance: (1) old forests planted by Colbert in the 17th century in the Forest of Bercé (Sarthe Department) and in the Forest of Tronçais (Allier Department); (2) forests conserved by the Barbizon School of Painters in the Fontainebleau forest during the 19th century; (3) ancient castle parks (such as Forest of Compiègne in the Oise Department); (4) very old urban parks with old trees (for instance, Strasbourg and Mulhouse); (5) forests that have been grazed by cattle, for instance the Forest of Massane (Pyrénées Orientales) (Garrigue & Magdalou, 2000) and the Forest of Sare (Pyrénées Atlantiques) (Van Meer, 1999); and (6) religious sites, such as the beech grove on the pilgrim site of the Sainte-Baume (Var Department) in the Provence region.

In contrast with these isolated forest habitats, there are often many more hollow trees in hedge-

row networks where *O. eremita* exists. There, the species mainly inhabit old, pollarded oaks. Examples of such networks are, for instance: (1) in the north of the Aveyron Department in an area of more than 500 km²; (2) in Bourbonnais in the Allier and Cher Departments in an area about 2,000 km²; and (3) in the west part of France in an area about 30,000 km², in the Ille-and-Vilaine, Indre-and-Loire, Loire-Atlantique, Maine-and-Loire, Morbihan, Mayenne, Orme and Sarthe Departments (Vignon & Orabi, 2003a, 2003b).

Before land consolidation (in the sixties), *O. eremita* occurred probably continuously in landscapes with hedgerow networks. Today, the hedgerow networks have become more fragmented.

Oak is the most important tree species, followed by chestnut (*Castanea sativa*), ash (*Fraxinus excelsior*) and beech (*Fagus sylvatica*). *O. eremita* has also been found in common alder (*Alnus glutinosa*), birch (*Betula* spp.) (Prunier 1999), wild cherry (*Prunus avium*), poplar (*Populus* spp.), apple (*Malus* spp.) [rather fre-

quently in the Orne Department, (J.–F. Asmodé & V. Vignon, pers. obs.)), willow (*Salix* spp.) and plane tree (*Platanus hybrida*) (especially in towns). In the Mediterranean beech grove of Sainte–Baume, *O. eremita* has also been found in yew trees (*Taxus baccata*).

A pollarded oak grows relatively fast; a tree with a diameter of 50 cm is normally between 70 to 120 years old (Brin, 1999), and such a tree may harbour *O. eremita*. Pollarded trees over 300 years old are very rare, and trees over 140 years seem to die relatively fast. Very old, dying trees are normally cut down to be used as firewood, partly for aesthetic reasons.

Only a few sites have been subject to detailed surveys of hollow trees and *O. eremita*. When trees were mapped in the forest of Massanne, there were on average 60 hollow trees per hectare. The occupancy rate of *O. eremita* was about 6% (Garrigue & Magdalou, 2000). Two hedgerow network regions in the western part of France, that may form the largest locality for *O. eremita* in France, have also been surveyed. In an 8,500 hectares site in the Sarthe Department, one hollow tree per hectare was found. Even in this fragmented site, *O. eremita* was present. In the Orne Department, a hedgerow network was found to have 5 hollow trees per hectare in an area of 5,000 hectares. The highest density observed in hedgerow networks is 10 hollow trees per hectare in 200 hectares which have never been subjected to land consolidation (J.–F. Asmodé & V. Vignon, pers. obs.). *O. eremita* occurs in 2 to 20 % of the hollow trees in different parts of the hedgerow network in the Sarthe and Orne Departments (J.–F. Asmodé & V. Vignon, pers. obs.). A higher occupancy rate, 26%, has been observed in a hedgerow network in the Aveyron Department (Brustel, pers. comm.).

The low occupancy rate in the hedgerow networks implies that there is a long distance between trees harbouring *O. eremita*. Therefore, the habitat fragmentation is at many places probably too high for long–term survival of the species. We assume that in more than 80% of the localities where *O. eremita* is present today, there is a substantial risk of extinction within 50 to 100 years. A study of a Carabid beetle in a hedgerow network indicated that its current distribution was better correlated with characteristics of the landscape 50 years ago than the present situation (Petit & Burel, 1998). Perhaps the situation is similar in *O. eremita*, and in which case we should expect local extinctions in the future due to the habitat destruction over the last few decades.

At many sites, there are no younger trees to take over the role as hollow trees in the future. As it will take a long time before new hollow trees are generated, survival of insects in hollow trees is possible only as long as the present old trees are preserved.

The hedgerow networks, which constitute the most important habitat for *O. eremita*, have been subject to severe fragmentation since the 1960's. The decrease in numbers of hollow trees is not

only due to the reduction of hedgerows, but also to the lower density of trees in the hedgerows. Today, the hollow trees are very old, and renewal of the habitat is difficult. The traditional practice of pollarding trees has been abandoned because it no longer serves any economic function. This development is also a consequence of the agricultural policy favouring intensive farming of cereals, for example, rather than cattle rearing and horse–breeding.

Forests with high densities of hollow trees are small and rare. It takes longer for hollows to form in forest trees than in pollarded trees. Therefore, the renewal of hollow trees in forests is in many cases difficult. Planning for the maintenance and the renewal of hollow trees has to be conducted in cooperation with administrators of the countryside and foresters.

Germany (fig. 6)

More than 1,000 records of *O. eremita* (both recent and historical) are known from Germany. They are mainly from lower regions (less than 400 m a.s.l.) (Schaffrath, 2003b). *O. eremita* occurs in all federal states in Germany. According to Schaffrath (2003b), there are at present 111 localities with *O. eremita*. However, investigations in recent years have resulted in a growing additional number (see Stegner, 2002; Ringel et al., 2003). The highest density of localities are in parts of Baden–Württemberg and Hessen and Niedersachsen and in Eastern Germany (Mecklenburg–Vorpommern, Brandenburg, Sachsen–Anhalt, Sachsen). In Mecklenburg, Brandenburg, Berlin and Baden–Württemberg, the localities are often wide, open forests. In Sachsen and Sachsen–Anhalt, *O. eremita* is widespread, especially in great flood plain areas around Elbe, Mulde and Saale which contain remnants of old forests and pasture lands. *O. eremita* also occurs in landscape parks, orchards (especially known in Sachsen) or historical pond regions, where oaks have been planted around the ponds (Stegner, 2002). On the outskirts of villages there are often pollarded trees, especially willows, that may be used by the beetle. In cities, sometimes even in the city centres, *O. eremita* regularly live in alleys, city parks and cemeteries. The most important trees are oak (*Quercus* spp.) and lime–trees (*Tilia* spp.), followed by willows (*Salix* spp.), beech (*Fagus sylvatica*) fruit trees (*Malus* spp., *Prunus* spp.) and ash (*Fraxinus excelsior*).

Changes in land use, both in agriculture land and in forests which affect *O. eremita*, took place in Western Germany several decades earlier than in the East (Schaffrath, 2003b). Old–growth forests have been cut down, and forests with lime trees, oaks, hornbeams and beeches have been replaced by conifer plantations. Where deciduous forests remain, trees are usually cut down long before tree hollows can be generated. In



Fig. 5. Distribution of *Osmoderma eremita* in Serbia, Montenegro, Macedonia, Albania, Greece, Rumania, Moldova and Bulgaria: ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later.

Fig. 5. Distribución de *Osmoderma eremita* en Serbia, Montenegro, Macedonia, Albania, Grecia, Rumania, Moldavia y Bulgaria: ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro de 1990 o posterior.

pasture landscapes and parks, free-standing trees have become scarcer for several reasons, for instance due to ceased removal of underwood (Vera, 2000). On agricultural fields and in alleys trees have been removed. Besides, a wide relinquishing of old fruit plantations has led to a massive lost of suitable habitats in Western Germany (Stegner, 2002). A problem, which today is mainly "eastern", is the loss of large trees due to the development of housing and trade areas and new highways (Saxony: Lorenz, 2001; Schaffrath, 2003b). For instance, many trees with *O. eremita* were lost due to the building of an automobile factory in Dresden.

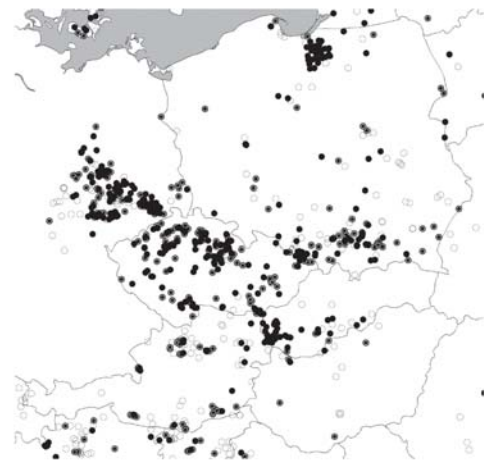


Fig. 6. Distribution of *Osmoderma eremita* in Eastern Germany, Poland, Czechia, Slovakia, Austria and Hungary: ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later.

Fig. 6. Distribución de *Osmoderma eremita* en Alemania del este, Polonia, República Checa, Eslovaquia, Austria y Hungría: ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro de 1990 o posterior.

In Germany, the conservation of *O. eremita* should be ensured by the Federal Nature Protection Act, but due to the safety regulations based on civil law, liability laws and insurance laws, hollow trees in cities and villages are often cut much earlier than necessary. Possible safeguards for trees are rarely considered. Many localities with *O. eremita* are included in NATURA 2000 sites (according to EU's Habitats Directive), but especially trees in towns are usually not included in such sites. This means that some important localities for *O. eremita* in Germany do not have any site protection by NATURA 2000 (Schaffrath, 2003b; Stegner, 2002).

Many findings in Germany occur in isolated trees or very small stands where it is unlikely the species will be able to survive in the long term. In the 19th century, *O. eremita* was probably common all over Germany (Horion, 1958). In the 1950s, Horion (1958) described the beetle as "...only local and not common; in the west and southwest a rarity...". Schaffrath (2003b) published the first grid-based distribution map for Germany, based on historical and recent records available from museums and private collections. A coordinate-based map of Saxony (Saxony) was published by Stegner (2002) and is continued under www.ereimit.net. A grid-based map of Mecklenburg-Vorpommern was published by Ringel et al. (2003).

According to a new focus of nature protection on *O. eremita*, numerous investigations have recently been accomplished, collecting a lot of new data. The preparation of management plans for NATURA 2000 sites in the next few years as well as the demand for monitoring by Habitats Directive will give us even better knowledge about the occurrence of this species.

Great Britain

O. eremita does not occur in Great Britain (Alexander, 2002).

Greece (fig. 5)

O. eremita seems to be widespread in Greece, but not common. It has been found from the low hills of the Peloponnese (Elis) to 1,700 m a.s.l. (Katara Pass). Most findings have been made in mountain forests of beech (*Fagus sylvatica*), chestnut (*Castanea sativa*), and Grecian fir (*Abies cephalonica*) (G. Gobbi, A. Liberto & D. Baiocchi, pers comm.). In Thessaly, the species occurs in beech, oak, and willows in the deciduous forests of Mount Ossa and Mount Olympus, between 100 and 1,200 m a.s.l. (Dutru in Tausin, 1994b).

Hungary (fig. 6)

Endrődi (1956) stated that *O. eremita* was rare in Hungary, but distributed throughout the whole country. This was confirmed when we went through insect collections. Most findings are from floodplain areas, mostly in willow trees (*Salix* spp.). However, the species also occurs at other places, for instance on Kékes, the highest mountain peak in Hungary.

O. eremita is on the National Biodiversity Monitoring Program (Merkl & Kovács, 1997) as a relevant species when monitoring very old trees or forests. However, so far no detailed studies have been conducted on the species in Hungary.

Ireland

O. eremita does not occur in Ireland (Alexander, 2002).

Italy (fig. 9)

O. eremita is distributed throughout most of Italy. Most of the known localities in Northern Italy are in low altitude areas (up to 700 m a.s.l.), while in Southern Italy and Sicily, the species has been found up to 1,500 m a.s.l. The host trees for *O. eremita* are, in decreasing order of importance: deciduous and evergreen oaks (especially *Quercus robur*, *Q. ilex*, *Q. petraea*, *Q. frainetto*), chestnut (*Castanea*

sativa), willows (*Salix* spp.), beech (*Fagus sylvatica*), mulberry (*Morus* spp.), lime (*Tilia cordata*), maple (*Acer* spp.), elm (*Ulmus* spp.), plane-tree (*Platanus orientalis*), aspen (*Populus tremula*) and walnut (*Juglans regia*).

Along the Aterno river valley (Pile and Preturo) and the Peligna river valley (Sulmona), as well as at the springs of Pescara river (Popoli), *O. eremita* occurs mainly in woods of white willow *Salix alba* (Marotta et al., 1997). Also in Pianura Padana (Po Valley), a large and intensively cultivated lowland, *O. eremita* is mainly found in planted willows. Further south, the distribution of *O. eremita* ranges from the remnants of evergreen Mediterranean forests, which stretch along the Tyrrhenian coast up to the belt of montane beech forest. Several *O. eremita* localities are in the submontane and low montane belt of central and southern Apennines, while others are in beech forests of Abruzzo, Basilicata and Calabria. Along the central Tyrrhenian coast, the species has only been found in two adjacent natural reserves: Castelfusano and Castelporziano, both situated 20–30 km from Rome. Despite intensive search, *O. eremita* has never been found in the Circeo National Park, which includes large areas of forests with old trees.

During the last few decades, several records of *O. eremita* have been made in old trees (mainly oaks) situated in parks or avenues in urban areas (e.g. Florence and Rome). An example of such a locality is "Villa Borghese", a historical park situated in the centre of Rome, where the beetles live in old holm oaks (*Quercus ilex*). At such places the old hollow trees are threatened due to conflicts with public safety.

We have more information about the species from northern Italy, due to the large number of entomologists there. Surveys focused on *O. eremita* have been carried out only recently and are still in progress (P. Audisio and G. Carpaneto in Central Italy and A. Ballerio and D. Baratelli in northern Italy).

Latvia (fig. 11)

O. eremita is known throughout Latvia, but most of the populations are small and isolated. Today more than 302 findings are known from 83 localities. 95% of the localities have been discovered during the last four years. This species is protected in Latvia and included in the Red Data Book of Latvia (Spuris, 1998).

The species mainly inhabits old parks, avenues, old broad-leaved forests, and pasture woodlands (Spuris, 1998; Šternbergs, 1988; Telnov, 2001, 2002; Telnov & Kalniņš 2003). Sixty percent of all records are from agricultural and urban areas, mainly city parks and alleys. In forests, the species has only been observed in very old trees, while in agricultural and urban landscapes *O. eremita* often inhabits trees that seem to be comparatively younger. Lime tree (*Tilia cordata*), oak (*Quercus robur*) and maple (*Acer*

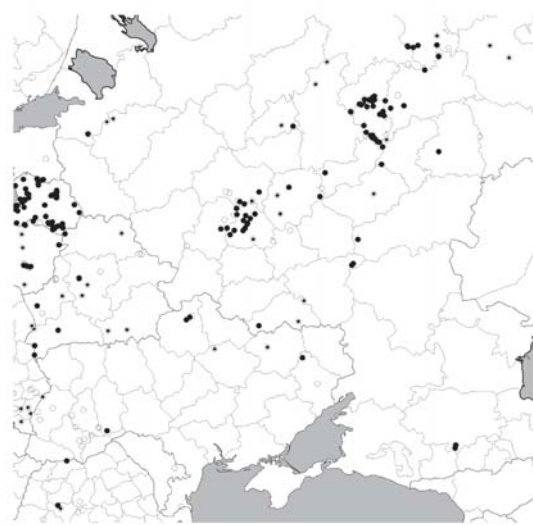


Fig. 7. Distribution of *Osmoderma eremita* in Belarus, Russia and Ukraine: ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later.

Fig. 7. Distribución de *Osmoderma eremita* en Bielorrusia, Rusia y Ucrania: ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro de 1990 o posterior.

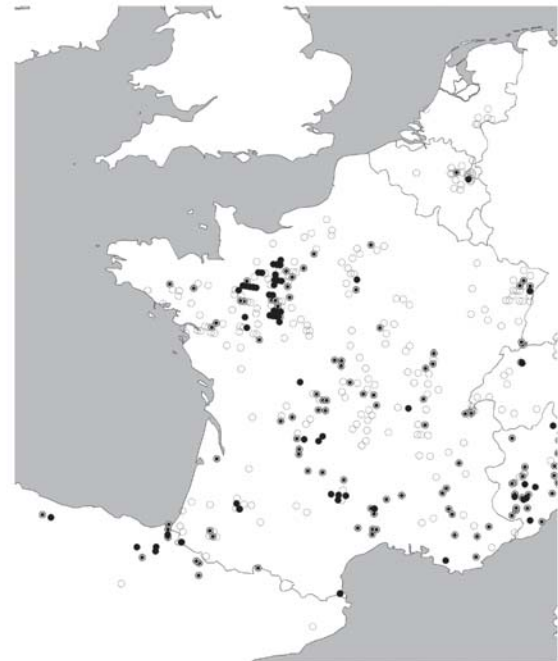


Fig. 8. Distribution of *Osmoderma eremita* in The Netherlands, Belgium, France and Spain: ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later.

Fig. 8. Distribución de *Osmoderma eremita* en Países Bajos, Bélgica, Francia y España: ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro en 1990 o posterior.

platanooides) are the most important tree species (Telnov, 2001, 2002). In forests, the localities are usually small (often 1–3 trees) and situated several kilometres from each other. Some old parks and avenues harbour tens of suitable trees.

The species is monitored since 2000 by revisiting localities and observing species presence/absence. The only extinctions observed so far have been the result of felling old trees regarded as dangerous in the city of Rīga and other places. Because many populations are so small and isolated, the risk for local extinctions is high during the following few decades.

Data from literature and insect collections (museums and private) have been compiled. In the collections there were only about 55 specimens collected during the last 155 years. Field surveys have been conducted mostly during the last four years.

Lithuania (fig. 11)

In Lithuania, *O. eremita* is rare and regarded as vulnerable (Pileckis & Monsevičius, 1992) with most findings being from the central part of the country (Pileckis & Monsevičius, 1995). The species has been found in oak (*Quercus* spp.), maple (*Acer*

platanooides) and ash (*Fraxinus excelsior*), both in parks and forests. There are only two localities, both near Kaunas, where *O. eremita* has been recorded several times: Kaunas Oakery (Azuolynas) Park (in the city center of Kaunas), where there are many oak and lime trees, and a mixed forest near Kaunas. No survey focused on *O. eremita* has ever been conducted in Lithuania.

Macedonia (fig. 5)

In the literature, we found one record of *O. eremita* from in Macedonia (Mikšif, 1955); it was from 1941.

Moldova (fig. 5)

In Moldova, *O. eremita* is regarded as critically endangered (CR) (Neculiseanu & Dînilă, 2000). We know only one specimen from Moldova, collected near Bender, in eastern Moldova, in 1917 (Miller & Zubovski, 1917; Medvedev & Shapiro, 1957).

In 2001, surveys revealed the presence of several saproxylic beetles regarded as indicator by species (Speight, 1989). However, *O. eremita* was not found (Neculiseanu et al., 2001). More surveys are to be conducted and these will hopefully also provide records on *O. eremita*.

The Netherlands (fig. 8)

O. eremita is considered extinct in the Netherlands. The last specimen was collected in 1946 in Wijnandsrade, in the extreme south of the country. The very few specimens in Dutch collections suggest that *O. eremita* has been extremely rare over the last 200 years. Most of the Netherlands has been deforested for centuries and localities with a long-term supply of decaying large trees have been particularly scarce since a long time ago. As a result, many saproxylic insects occurred in isolated populations and eventually became extinct.

No specific surveys focused on *O. eremita* have been conducted. Many skilled amateur coleopterists have been active there during the last century and it seems most unlikely that they have overlooked *O. eremita* during this time.

Norway (fig. 10)

Live specimens of *O. eremita* have not been found in Norway during the last 100 years. During the 19th century, the species was noted from Drammen (Siebke, 1875) and Asker (Strand, 1960; Kvamme & Hågvar, 1985). There are no specimens from Drammen or Asker in the zoological museums of Norway today, but an adult specimen in the collection of Zoological Museum in Oslo is labelled "Ex. Coll. Norway. Einar Fischer" (Karsten Sund, pers. comm.). During the last few decades only fragments of adult specimens, probably of very old origin, have been found. They have all been collected in hollow oaks at a third locality, on Rauer Island near Fredrikstad (Strand, 1960; Zachariassen, 1981; Hanssen & Hansen, 1998).

Several collectors have searched for the species during the last twenty years, but the negative result has led to the assumption that the species has probably disappeared from Norway (Zachariassen, 1981; 1990; Hanssen et al., 1985). On the Norwegian Red List (Anonymous, 1999) the species has been given the category "Extinct?". *O. eremita* was one of ten invertebrate species proposed for protection nation-wide according to the Nature Conservation Act (Anonymous, 1994). However, finally *O. eremita* was not protected according to this act, because it was assumed to be regionally extinct (Øystein Størkersen, Directorate for Nature Management, pers. comm.).

Suitable habitats for *O. eremita*, such as hollow trees of oak (*Quercus robur*), beech (*Fagus sylvatica*) and lime (*Tilia cordata*), occur mainly in

the agriculture landscape in the county of Østfold and Vestfold. In addition, there are a few areas with stands of old oaks in woodland, especially in the hilly landscape around Lake Farrisvannet in Vestfold. The areas around Drammen and Asker are today, like all urban areas around the Oslofjord, heavily exploited and very few localities with hollow trees are left.

During the last decades, it is mainly huge oaks with great openings near the ground that have been investigated (Zachariassen, 1981; Hanssen et al., 1985; Hanssen & Hansen, 1998; Hanssen, 1999). Trees with entrance holes that are small or higher up are less studied in Norway and may possible contain undiscovered populations of *O. eremita*.

Poland (fig. 6)

The distribution area covers the whole of Poland, except for mountainous areas. The highest altitude where the species has been found is 885 m (Zakopane; Oleksa et al., 2003). In the east, where the species' occurrence is better known, it occurs in old trees in small groups along river banks, field roads, property borders, and sometimes in old orchards and parks. It has also been found relatively often in urban habitats such as old avenues, city parks and cemeteries. In broadleaved and mixed forest, *O. eremita* is rare but probably still present in older stands and wood margins, especially at sites difficult to reach. When saproxylic beetles were inventoried in thirteen nature reserves of Upper Silesia (former Katowice Province), *O. eremita* was found in three reserves (Szafraniec & Szołtyś, 1997; J. Michalcewicz, pers. comm.). In 10 x 10 km squares in the Niepołomice Forest (southern Poland), *O. eremita* was present in at least three out of six squares (P. Szwajko, pers. obs.). In northern Poland, an inventory from 1999–2003 between Elbląg, Ława, Susz, and the river Paszka (northern Poland), revealed that *O. eremita* occurred in 24 out of 37 investigated 10 x 10 km squares (A. Oleksa & R. Gawrołski, unpubl. data).

Oak (*Quercus robur*) is the most important host tree for *O. eremita* in Poland. Willows (*Salix* spp.) and lime trees (*Tilia* spp.) are often used and, rarely, fruit trees or common alders (*Alnus glutinosa*) are used, while there are only single reports from beech (*Fagus sylvatica*), ash (*Fraxinus excelsior*) and horse chestnut (*Aesculus hippocastanum*) (Pawłowski, 1961). In the Niepołomice forest, cocoons containing remains of larvae and adults of *O. eremita* have been found in Scots pine (*Pinus sylvestris*) (Oleksa et al., 2003).

In the second half of 19th century, *O. eremita* was probably still abundant and frequent in Poland. Contemporary authors (e.g. Letzner, 1871) reported it as being found relatively often. For that reason they did not list localities for *O. eremita*, in contrast with other beetle species that are more common today. *O. eremita* has lost most of its



Fig. 9. Distribution of *Osmoderma eremita* in Switzerland, Italy, Slovenia, Croatia and Bosnia–Herzegovina: ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later.

Fig. 9. Distribución de *Osmoderma eremita* en Suiza, Italia, Eslovenia, Croacia, y Bosnia Herzegovina, Italy, Slovenia, Croatia and Bosnia–Herzegovina: ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro en 1990 o posterior.

habitats today and is extinct in some areas (Szwako, 1992b). The species is included in local and national red lists (Szwako, 1992b; Pawłowski et al., 2002). Old trees have been removed in managed forests, along roads and in urban areas, regarded as a source of "pests and pathogenic fungi" or a danger for humans and vehicles. Many monumental trees, which are specially protected by law, have been "cured" by mechanical cleaning of the hollows and impregnating of the wood surface with pesticides (Szwako, 1992a). Such methods of "conservation" have been restricted due to Polish implementation of the Bern Convention and EU's Habitat Directive. New forest management methods promote preservation of some old, especially hollow, trees wherever possible. Localities where the species still exists have already been or will be protected under the recently started NATURA 2000. On the other hand, in many managed forests (including some forest

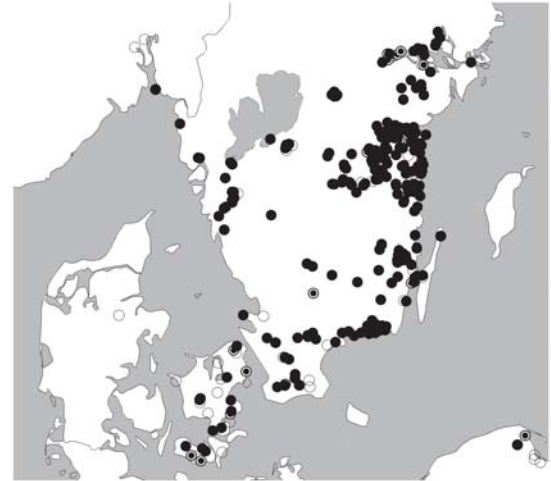


Fig. 10. Distribution of *Osmoderma eremita* in Norway, Denmark and Sweden: ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later.

Fig. 10. Distribución de *Osmoderma eremita* en Noruega, Dinamarca y Suecia: ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro en 1990 o posterior.

nature reserves) the wrongly understood "aesthetic mind" gives rise to further elimination of *O. eremita* habitats (Gutowski & Buchholz, 2000). As a result, other habitats, such as woods along fields, streams and lakes become more important for the survival of the species.

About 170 localities in Poland are known. Much of the information has originated from entomologists working mainly in the eastern part of Poland, which at least partly explains the lower density of findings from north–western Poland. To get a better picture of the whole situation in Poland, investigations in the western part of the country are desirable.

Portugal

O. eremita has never been recorded in Portugal (Tristão Branco, pers. comm.).

Rumania (fig. 5)

In Rumania, 27 localities with *O. eremita* are known. At ten of these, records have not been made since 1911 (Fleck, 1904–1906; Petri, 1912), which can be explained by the low search effort.

O. eremita occurs, for instance, in oak or mixed forests along the Danube alluvial plain and in beech or hornbeam mixed forests at the foot of the Carpathians. In many forests, trees with hollows are often removed because they are considered a potential danger.

Russia (fig. 7)

In western Russia, *O. eremita* has been found in the zone of nemoral and boreo-nemoral forest, in 18 different regions and in 6 republics. The species occurs mainly in hollow oak trees (*Quercus robur*), and less frequently in willow (*Salix* spp.), aspen and poplar (*Populus* spp.), lime (*Tilia cordata*), ash (*Fraxinus excelsior*), apple (*Malus* spp.), pear (*Pyrus communis*) and elm (*Ulmus laevis*) trees. Larvae have occasionally been found to develop in stubs.

For most parts of Russia we have only limited knowledge about the species' occurrence, but more is known regarding a few regions, such as Chuvashiya. At least 70 specimens were observed in Chuvashiya between 1988 and 2002. The species occurs mainly in oak woods along the Volga banks, from the western to the eastern border of the republic, in floodland oak woods along the Sura and in oak woods in the central and east-central parts of Chuvashiya. The height ranges from 70–200 m a.s.l. *O. eremita* has almost never been found in those wide areas in southern and south-western Chuvashiya that are covered with mixed forests, and it has not been found in the steppes in the south-west and south-east. In floodland oak woods near the Sura River in the protected zone of the Prisursky State Nature Reserve, Alatyr district, it is relatively easy to observe the beetle in hollow trees, which occur abundantly there.

O. eremita is decreasing in Russia because old broad-leaved trees are cut down. Some local populations (e.g., in some parts of Chuvashiya and Udmurtiya) are more or less safe because they are in reserves or other areas where the trees are not being felled. In all unprotected areas, the species is vulnerable due to mass cutting of old oaks. The species has been included in the Red Data Book of the Russian Federation (Nikitsky, 1983, 2001), USSR (Lopatin, 1984) and in some regional Red Data Books, e.g. of Bashkirsky ASSR (Boev et al., 1987), Tatarstan Republic (Muravickij & Kanitov, 1995), Moscow region (Kompantsev, 1998), Adygeya republic (Cherpakov & Bibin, 2000), Kirov region (Yuferev, 2001), Ryazan region (Ananyeva & Blinushov, 2001), Udmurtiya republic (Borisovsky, 2001), Leningrad region (Krivokhatsky, 2002), Mari El republic (Baldaev, 2002), and Stavropol region (Sigida, 2002). To preserve *O. eremita* and other species associated with ancient trees, regional branches of the Ministry of Natural Resources of Russia should restrict the permits to cut down old trees, especially oaks.

Data from specimens in museums and private collections have been collected. In most of these localities, we know that *O. eremita* is still present.

Serbia and Montenegro (fig. 5)

O. eremita is known from twelve localities in Serbia and five in Montenegro, at an altitude of 70–1,140 m a.s.l. Ecological data are scarce, but we know that in the protected area of Kapaonik, at Ćanac, an adult beetle was collected on an oak (Jankovič, 1972).

Slovakia (fig. 6)

As early as 50–70 years ago, *O. eremita* was reported to be declining in the present territory of the Czech and Slovak Republics (Fleischer, 1927–1930, Pfeffer et al., 1954). However, the beetle occurred at many sites in southern and central Slovakia and was locally not rare (Roubal, 1936). Since that time, nature in Slovakia has been modified by human activity, and changes in the landscape have mainly occurred in easily accessible lowlands and foothills. Numerous valuable habitats such as pasture woodlands, old trees growing in small groups, alleys and hedges as well as trees bordering rivers and streams have been lost. Nevertheless, this was not excessive compared to the rest of Europe (Zach, 2003); some habitats have been retained in the form of isolated fragments and local *O. eremita* populations have survived.

A distribution map of *O. eremita* was compiled by Jelínek (1992) using data from J. Roubal and L. Korbek and archive material from the Faunistic Section of the Czecho-Slovak Entomological Society. According to this map, there were 20 localities up to 1960. Most of them (16) were located in western, southern and central Slovakia. In the period 1960–1990, seven sites in southern and western Slovakia were recorded on a map, while there were no localities in central and eastern Slovakia. This might indicate a strong decrease in the number of *O. eremita* localities in Slovakia. However, when we compiled information about the present range of *O. eremita*, the beetle was recorded from more than 30 localities. Obviously, some of them were not included in the study by Jelínek (1992). The explanation for this can simply be that more information has been obtained since that time, although no one is currently studying the beetle in detail.

O. eremita occurs mainly in the following habitats: (1) oak pasture woodlands with scattered groups of trees or solitary trees; (2) floodplain forests with large trees. It mainly breeds in large willows, poplars and oaks—the latter in drier situations; (3) parks and alleys; (4) abandoned orchards, today a very scarce habitat; (5) mixed oak and pine forests; and (6) forest edges with large trees growing on south-facing slopes.

Oak (*Quercus robur*), lime (*Tilia* spp.), beech (*Fagus sylvatica*), birch (*Betula* spp.), hornbeam (*Carpinus betulus*), elm (*Ulmus* spp.), walnut (*Juglans regia*), chestnut (*Castanea sativa*), willow (*Salix* spp.) and fruit trees are known as host trees (Roubal, 1936). The beetle has also been found developing in Scots pine (*Pinus sylvestris*) at Zahorska nizina lowland, western Slovakia (T. Olsovsky, pers. obs.).

The advantage of polyphagy for Slovakian forest beetles in general (Whitehead, 2000) is, in the case of *O. eremita*, eroded by the ongoing removal of dying and dead trees. Large dead trees are not often being replaced by younger ones. This will cause local extinctions of *O. eremita* populations. In town parks, tree hollows in "unhealthy" trees are cleaned, and this may destroy populations. In the Slovakian Red-List, the species is categorized as "endangered" (Holecová & Franc, 2001).

Further data may be available from museums and private collections. Co-operation with researchers involved in bat studies carried out in tree hollows may reveal new *O. eremita* localities.

Slovenia (fig. 9)

O. eremita was first described by Scopoli (1763) when he was a physician in Idrija (Eastern Slovenia). Since that time it has been mentioned in faunas of different regions of Slovenia as infrequent (Scopoli, 1763; Siegel, 1866; Brancsik, 1871; Martinek, 1875). It seems that the species is distributed all over Slovenia where suitable habitats are present. Old willows (*Salix* spp.) are reported as the most common finding place, but also oak (*Quercus* spp.) and fruit trees are mentioned as habitat for the species (Scopoli, 1763; Siegel, 1866; Brancsik, 1871; Martinek, 1875). In the collections there are many very old specimens, but recent records are few, suggesting that the species has decreased. The reason is probably the same as in the rest of Europe—old fruit orchards as well as other old trees have become much rarer. The species is considered endangered by the Slovenian Red List (Anonymous, 2002). *O. eremita* has never been surveyed systematically in Slovenia.

Spain (fig. 8)

O. eremita seems to be very rare in Spain. It has been found along a narrow band in the northern part of the country running from the Picos de Europa in the west to Montseny (Barcelona) in the east. Apparently suitable habitats are found further west from its known Spanish distribution area but the species has not been reported there.

The main habitat for *O. eremita* in Spain is humid deciduous forest. Most records come from beech (*Fagus sylvatica*) forest in the mountains of the Pyrenees or Picos de Europa. In Navarra it

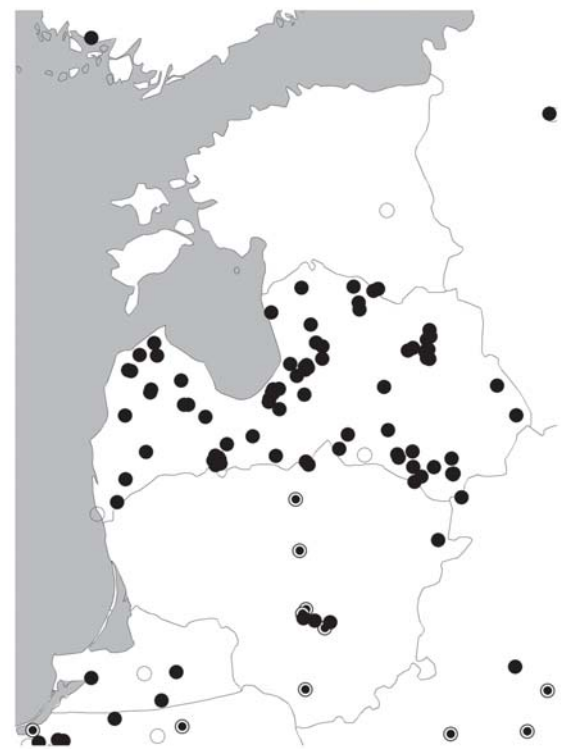


Fig. 11. Distribution of *Osmoderma eremita* in Finland, Estonia, Latvia, Lithuania and Kaliningrad (Russia): ○. Last record before 1950, or the time unknown; ◐. Last record 1950–1989; ●. Last record in 1990 or later.

Fig. 11. Distribución de *Osmoderma eremita* en Finlandia, Estonia, Latvia, Lituania y Kaliningrado (Rusia): ○. Último registro anterior a 1950, o fecha desconocida; ◐. Último registro entre 1950 y 1989; ●. Último registro en 1990 o posterior.

has been found in old forests of oak (*Quercus robur* and *Q. humilis*).

In most cases, adults have been found walking on old beech or oak trunks, in shaded and humid parts of the forest (Montada Brunet, 1946; San Martín et al., 2001; C. González, pers. comm.; G. Aguado & L. O. Aguado, pers. obs.). In a single case, an adult was found on an inflorescence of *Sambucus nigra* (Bahillo de la Puebla et al., 2002). The species seems to be absent from more anthropogenic environments such as bocages and urban parks. Adults have been observed mainly in the daytime but some captures have been obtained at night, using artificial light (San Martín et al., 2001).

In 1995–96, the information about all Spanish arthropods listed in the Habitat Directive of EU was gathered and distribution maps and available

biological information on *O. eremita* were published (Galante & Verdú, 2000). However, no comprehensive revision of entomological collections seems to have been carried out. Since then, new records have been published that extend the Spanish distribution area to the West (Bahillo de la Puebla et al., 2002; Ugarte San Vicente & Ugarte Arrue, 2002) and South (San Martín et al., 2001). These new records suggest that the species has been overlooked in the past, due to inefficient sampling methods or low sampling effort.

Sweden (fig. 10)

The highest concentration of known *O. eremita* localities in the world occurs in south-eastern Sweden. *O. eremita* occurs only in the southern part of Sweden, up to the northern limit for oak pastures. The main habitat is pasture woodlands with old oaks, especially near castles, estates and churches (Ranius, 2000). There are also some records from parks, avenues and deciduous forests (Antonsson et al., 2003). Oak (*Quercus robur*) is by far the most important tree species. Especially in the very south of Sweden, *O. eremita* has also been found in several other tree species, such as beech (*Fagus sylvatica*), ash (*Fraxinus excelsior*), lime (*Tilia chordata*), common alder (*Alnus glutinosa*) and horse chestnut (*Aesculus hippocastanum*) (Antonsson et al., 2003).

Old oaks were very common in the Swedish agricultural landscape until 200 years ago, but for a few decades in the early 19th century, farmers removed hundreds of thousands of old oaks from their land (Eliasson & Nilsson, 2002). It was mainly on land owned by the nobility where oaks were left. Today, ceased grazing is a severe threat to the oaks on pasture woodlands, mainly because the old trees suffer from competition and shading from the younger ones. Forest regrowth also changes the microclimate in the trees and many saproxylic beetles suffer from this (Ranius & Jansson, 2000).

About 30% of the localities are protected as nature reserves, and it is mainly the largest localities that are protected (Antonsson et al., 2003). The majority of localities are small, with only a few suitable trees situated more than one kilometre from other localities. At these sites the risk for local extinctions during the following decades is substantial. There are, however, a few localities with more than 100 suitable trees (e.g. Bjärka-Säby, Sturefors and Hallands Väderö). At these sites, measures are taken to preserve the hollow tree habitat. Therefore the extinction risk for *O. eremita* at a national level is probably low. However, there is still no long-term planning to maintain or increase the amount of habitat when the hollow trees present today become too old.

Ten years ago, 25 localities with *O. eremita* were known, while currently this figure is 270, if a

locality is defined as a site with records of living adults, larvae, fragments of adult body parts, or excrements situated at least 1 km from other localities. In a recent paper, data were compiled from field inventories conducted in 1993–2003 (Antonsson et al., 2003). Totally, pitfall traps had been used at 401 localities and wood mould sampling at 104 localities. *O. eremita* was found at about 30% of these localities. All larger Swedish museum collections have been gone through (Antonsson et al., 2003). Research on the ecology of the beetle has been conducted (e.g. Ranius, 2002b).

Switzerland (fig. 9)

During the last few decades, all but one record of *O. eremita* in Switzerland are from the town of Solothurn. There, the species has been found in lime trees (*Tilia* spp.) in alleys and in a park near a castle (Vögeli, 2002). There are still many old trees in alleys and parks in the locality, but some are threatened due to conflicts with public safety. One recent record is from the region of Brusio, near the Italian border, where there are hollow willows (*Salix* spp.) and chestnut trees (*Castanea sativa*) (P. Audisio, pers. obs.).

There are several old records from other localities in Switzerland (Allenspach, 1970). In the early 20th century the species was described as "rare, although present throughout the lowlands of Switzerland" (Stierlin, 1900). Data on the specimens in Switzerland's museums and many private collections have been collected. There were no more than 80 specimens collected in Switzerland during the last 150 years. No inventories focused on *O. eremita* have ever been conducted.

Turkey (fig. 5)

We only know one record of *O. eremita* from Turkey: in 1994, Dr. Sobotan found the beetle in KeÇan, in the European part of Turkey.

Ukraine (fig. 7)

In Ukraine, *O. eremita* is rare and local, and included in the Red Data Book (Yermolenko, 1994). The species has been found at 30 localities (Belke, 1859; Hildt, 1893; omnicki, 1875, 1886, 1903; Rybiński, 1903; Savchenko, 1933, 1934; Medvedev, 1960; Yermolenko, 1994; Chumak, 1997; Kapeliukh, 1999; Rizun et al., 2000). The majority of findings are from the zone of broad-leaved Central-European forests and the forest-steppe zone.

Only at six localities do we know that *O. eremita* is still present: (1) an oak-dominated (*Quercus robur*) forest with lime (*Tilia cordata*), maple (*Acer platanoides*), ash (*Fraxinus excelsior*) and elm

(*Ulmus glabra*) trees near the town of Sambir, (2) Kamianec'-Podil's'kyi, which is a broad-leaved forest dominated by oak (*Quercus robur*) and hornbeam (*Carpinus betulus*) with cis-mediterranean species such as *Sorbus torminalis*, *Viburnum lanatana* and *Scutellaria altissima*, (3) Slovianohors'k, in an oak (*Quercus robur*) forest with ash (*Fraxinus excelsior*), *Acer campestre*, lock elm (*Ulmus carpinifolia* var. *minor*) and cis-mediterranean and steppe species, (4) at Kuzij, in the Carpathian Biosphere Reserve, in a beech (*Fagus sylvatica*) forest with silver fir (*Abies alba*), Norway spruce (*Picea abies*), sycamore (*Acer pseudoplatanus*), hornbeam (*Carpinus betulus*) and durmast oak (*Quercus petraea*), (5) four localities near the town Chernihiv in the northern part of Ukraine, (6) near the town Kiliia in the Odesa region, where a few beetles have been observed flying around old *Salix* trees.

Conclusions: the future for *O. eremita*

In this study, we have collected records of *O. eremita* from 2,142 localities in Europe (fig. 4). However, *O. eremita* has probably already become extinct from many of these; the beetle has been found since 1990 only at 919 of the localities. Out of these 919, at 79 only excrements have been found and at 96 only remains from dead beetles have been found. For these 175 localities we can not rule out the possibility that the species has already become extinct. On the other hand, there are many unknown localities that have yet to be discovered. Everywhere in Europe it seems that the majority of localities with *O. eremita* are small and isolated. For that reason we should expect many local extinctions in the future, even though the hollow trees that are left will be protected. This is especially the case in regions where habitat loss and fragmentation have occurred recently (for instance in France, Eastern Germany, Slovakia and Czechia); in Sweden, where the main loss of suitable trees occurred in the 19th century, *O. eremita* has already disappeared from some, but not all, of the smaller sites (fig. 2). In some countries (such as Denmark), all localities are small and the risk for regional extinction is considerable. In other countries (e.g. France, Sweden, Latvia and Austria) there are also a few larger localities where *O. eremita* may also survive in the long term if the sites are properly managed.

O. eremita still occurs in almost all European countries but is absent from the boreal region, the British Isles and most of the Iberian peninsula. *O. eremita* seem to have decreased in all European countries. Relatively high densities of localities occur in Central Europe (northern Italy, Austria, eastern Germany, Czechia and southern Poland), some parts of Northern Europe (south-eastern Sweden, Latvia) and France. Perhaps there are also many localities in the Balkans, but searching efforts have been very low there during the last few

decades. In some regions in north-western Europe, the species has become extinct or may occur at a single locality (Norway, Danish mainland, the Netherlands, Belgium, north-eastern France). Bearing in mind the severe loss of old trees in Europe, it is perhaps surprising that *O. eremita* has not become extinct from larger regions. However, the species can survive in small relict populations over decades, and even if it is doomed to extinction it will take time before the species totally disappears from a region (Ranius, 2000).

O. eremita mainly occurs in habitats that have been used by man for a long time. However, there are also *O. eremita* localities in forests, such as in Spain, France, southern Italy, the Balkans, Slovakia and Germany. Many of the man-made habitats are destroyed due to changes in agriculture. In Sweden as an example, pasture woodland suffers from forest regrowth due to ceased management, while the abandoned pollarding of oaks in France makes it difficult to produce suitable new trees for *O. eremita*. The beetle can also obviously survive in urban areas, but in many cases there are conflicts with public safety.

Our compilation of data supports the view that *O. eremita* is useful as an indicator and umbrella species as everywhere it is confined to hollow trees — a threatened habitat. There are a few observations of the beetle in stubs, but there is no indication that *O. eremita* populations could survive at localities with no tree hollows present. Moreover, the presence of *O. eremita* indicates a high species richness with many threatened species associated with old trees (Ranius, 2002a). The preservation of *O. eremita* involves three tasks that are of general importance for nature conservation in Europe today: (1) to preserve those small remnants of natural forest that still exist, (2) to preserve and restore habitats connected with historic agricultural landscapes and (3) to preserve any remaining small pieces of nature in urban areas. Thus, taking the measures needed to protect *O. eremita* will also contribute to solving many other current problems in nature conservation in Europe.

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Appendix. Localities with *O. eremita* recorded. In parenthesis, year for the latest record, type of finding (a. Alive, as larva or adult; r. Remains from adult body parts; e. Excrements). If the specimen was found alive, only "a" is written, and if remains from a dead adult but no living specimens were found, only "r", independent of whether there were other kinds of findings. Data from central and southern Italy were separated into the two questionable species *O. italicum* and *O. cristinae*.

Apéndice. Localidades en las que se ha registrado O eremita. Entre paréntesis, el año del último registro y tipo de hallazgo (a. Vivo, como larva o adulto; r. Restos de partes del cuerpo de un adulto; e. Excrementos). Si se encontró el espécimen vivo, se indica con una "a", y si permanecen en un individuo adulto muerto pero no se encontraron individuos vivos, se indica con una "r" independientemente de otro tipo de hallazgos. Datos del norte y sur the Italia se han separado en dos especies cuestionables, O. italicum y O. cristinae.

Albania

Maja e Kogamit (1936/a), Maja e Polocanit (1937/a), Okol (1939/a), Qafe Molle, near Tirana (1961/a), Qafe Shtame, between Tirana to Kruja (1959/a), Shkodër (Piani di Scutari) (1931/a), Tamara (1995/a), Theth, near Shkodër (1959/a).

Based on literature (Schulze, 1963; Murraj, 1962; Sparacio, 2001), specimens in the natural history museums in Trieste and Vienna and unpublished records by entomologists.

Austria

Burgenland: Geschriebenstein (before 1937), Zurndorf (before 1964); **Wien/Niederösterreich:** Feichsen near Purgstall (1954), Gars/Kamp (1974), Gries near Oberndorf (1964), the vicinity of Hainburg (2001), Herzogenburg (old, undated), Katzelsdorf near Neudörfel (1998), Laxenburg (2000), Mank near Melk (1961), Mistelbach (2002), Neunkirchen (old, undated), Obernberg/Inn (old, undated), Oberndorf/Melk (1964), Petzelsdorf near Purgstall (1987), Pitten near Aspang (old, undated), Plank/Kamp (1909), Pressbaum (old, undated), Purgstall (1992), the vicinity of Purgstall (1992), Purkersdorf near Wien (old, undated), Retz (before 1943), Sommerau near Wallsee (old, undated), Wien–Ebersdorf (old, undated), Wien–Lainzer Tiergarten (2002), the vicinity of Wien (old, undated), Wiener Neustadt (old, undated), Ybbsitz (1916); **Oberösterreich:** Alharting near Linz (1936), Alkoven near Eferding (1907), Aschach near Steyr (1945), Enns (1947), Freinberg near Linz (before 1879), Freistadt (before 1879), Grein (before 1879), Klendorf near Katsdorf (1994), Koppl near Leonding (1963), Kremsmünster (1940), Leonding (old, undated), Letten near Sierning (1970), Linz (1932), Linz–Donauauen (1944), Linz–Ebelsberg (1964), Linz–Scharlinz (1932), Linz–Kleinmünchen (1957), Linz–St. Florian (before 1879), Linz–St. Peter (before 1879), Linz–Treffling (1942), the vicinity of Linz (1943), Sierning (1963), St. Georgen/Gusen (1991), Stein near Steyr (1995), Steyr (1903), the vicinity of Steyr (1907), Steyregg near Linz (1952), Treffling near Linz (1942), Unterweikersdorf (before 1974), the vicinity of Urfahr (1952), Wels (1972), the vicinity of Wels (1973), Zell near Zellhof (1936); **Steiermark:** Frauental (1974), Gleichenberg (1963), Groß St. Florian (1973), Hollenegg (1977), Mureck (1913), Radkersburg (before 1875), Rassach near Stainz (1963), Schwanberg (1963), St. Johann near Herberstein (2003), St. Lambrecht (before 1865), Unterjahrung near St. Nikolai (1995), Weniggleinz (1973); **Kärnten:** Ebenthal near Klagenfurt (before 1899), Ferlach (before 1854), Gailtal (before 1865), the vicinity of Hermagor (before 1936), Himmelberg near Feldkirchen (before 1886), Klagenfurt (before 1876), Kleblach (old, undated), Ledenitzen (1970), Metnitztal (before 1903), Rosegg/Drau (2002), Sattnitz (before 1899), Vellachtal (before 1855), Viktring (1952), Waidischgraben (1959), Wolfsberg (old, undated), Zellwinkel (1970); **Salzburg:** Anif near Salzburg (1990), Salzburg–Freisaal (1988), Salzburg–Gneis (1963), Salzburg–Hellbrunn (1936), Salzburg–Lehen (1964), Salzburg–Leopoldskron (old, undated), Salzburg–Maxglan (1931), Salzburg–Mönchsberg (1960), Salzburg–Morzg (1994), Salzburg–Nonntal (1929); **Tirol:** Dölsach near Lienz (1995), Dölsach–Gödnach (1983), Dölsach–Kapaunerwirt (1966), Dölsach–Stribach (1995), Lienz (1984), Nikolsdorf/Drau (1984), Oberlienz (1960), Ried im Zillertal (1960); **Vorarlberg:** Feldkirch (before 1912), Tisis (before 1912).

Based on an extensive literature search. Very old reports, dating back to the 19th century are incorporated, together with data from relatively recent faunistic catalogues (e.g. Franz, 1974; Geiser, 2001). Kreissl (1974), Zabransky (1998) and Mitter (2001) are the only coleopterological works that give specific information on *O. eremita* in Austria. Additional data have been obtained from numerous public and private collections.

Appendix. (Cont.)

Belarus

Brest region: Brest (1998), lake Beloe (2000); **Gomel region:** Meleshkovichi (1986); Khvoyensk (1987); **Grodno region:** near Volkovysk, near Novogrudok (1989), near Smorgon' (Zales'ye) (1991), Lunno (1998); **Minsk region:** Prusino (1984), Priluki (1987), Zhodino; **Mogilev region:** Gorki (1894); Sen'kovo (1887); **Vitebsk region:** near Vitebsk (1985).

Based on casual records that have either been published (Arnol'd, 1902; Alexandrovich & Pisanenko, 1991; Alexandrovich et al., 1996; Rubchenya & Tsinkevich, 1999; Solodovnikov, 1999; Lukashenya et al., 2001) or are findings preserved at museums in Minsk and St. Petersburg (Russia) and in private collections.

Belgium

Brabant: Vollezeel (1887), Wellen (1950); **Limburg:** Hasselt, Wideux, Sint-Truiden, Hoesselt, Maeseeyck (1885); **Liege:** Tihange, Jemeppe, Grâce-Berleur, Waremmes (1887), Loën (1926), Julémont (1932), Saint-André (1944), Warsage, Visé (1928), Vallée de la Berwinne (2002).

Based on the specimens in the collection of the Royal Belgian Institute of Natural Sciences and a record published by Janssens (1960). Other specimens collected during the last decades are in private collections.

Bosnia and Herzegovina

Babin Potok (before 1956), Drvar (1955), Foča (1913), Igman (before 1956), Ivan planina (before 1956), Kneževski Pale near Sarajevo (1957), Knježevina (1949/a), Laništa, Mostar (1929), Prenj Planina (1936), Prenj-Konjic (1969/a), Sarajevo (before 1956), Travnik (before 1956), Treskavica (1951), Tuhalska Bjelina (year?).

Based on old publications (Horion, 1958; Mikšić, 1955, 1957, 1959).

Bulgaria

Lozen (published in 1906), Melnik (1987/a), Rila (published in 1906), Stara Mountains (published in 1906), Vraca (published in 1906), Pirin Mts (1961), Nessebar, S. of Burgas (1961–63), Rilski Monastir, Rila (1963), Sofia (1966).

Based on literature (Nedelkov, 1906; Nüssler, 1986) and single specimens in private and museum collections.

Croatia

Istra: Štaliže (1982), Opatija (before 1914), Učka (1928); **Primorje:** Rijeka (before 1900), Draga (near Rijeka, 1905), Crikvenica (before 1957), Velebit (probably Paklenica glen, 1899), Paklenica (Mt. Velebit, 1892); **Otoci** (Quarner islands): Cres (Porozoni, 1976, Cres, 2000), Krk (2002); **Gorski kotar:** Zapef (1910), Moravice (before 2002), Lokve (1957), Plitvice lakes (2000); **Dalmacija:** Sinj (1902), Siverić (1920), Konavle (Radović, 1918); **Zagorje & Prigorje:** Klanjec (1904), Trnovec (1981), Zagreb (1953), Medvednica (1998), Paukovec (about 1900), Mraclin (1916), Peščenica (1961), Japetić (1996); **Slavonija:** Jankovac (1916), Pleternica (1906), Dilj (before 1906), Vinkovci (before 1906), Padeš (2000).

Based on specimens in Croatia's museums, literature (Depoli, 1938; Dobiasch, 1889; Koča, 1906; Mikšić, 1955, 1957, 1959; Müller, 1902; Novak, 1952; Sparacio, 2001) and personal communication with entomologists.

Czechia

Jihomoravský: Adamov (1991), Vyškov (1956), Slavkov u Brna (2002), Čelešice (1970), Nosislav (1978), Bítov (1964), Vranovice (1979), Znojmo (1949), Bulhary (1986), Lednice (2001), Břeclav (2000), Valtice (1989), Lanšhot (2002), Ladná (2001), Pohansko (1995), Nové Mlýny (2000), Čidlochovice (1985), Bítov-Kopaniny (1990); **Jiho.eský:** Blatná (1999), Písek (1977), Libčice (1954), Vodňany (1951), Veselí nad

Appendix. (Cont.)

Lu•nicí (1989), Hluboká nad Vltavou (2000), Vlkov (2001), Šev•tín (1997), Lomnice nad Lu•nicí (1956), Lu•nice (1989), Třebo• (2001), „ eské Bud•jovice (2002), Chlum u Třebon• (1998), Majdalena (2002), Nové Hrady (1982), Bavorovice (1998), Stará Hlína (1994), Vondrov (1998), „ eské Bud•jovice–„ eské Vrbné (1996); **Vyso•ina**: Chot•boř (1998), Lu•ice (1976), Nám•šť nad Oslavou (1992), Senorady (1938); **Karlovarský**: Strá• nad Ohří (1996); **Královehradecký**: Mlad•jov (1998), Sobotka (1949), Samšina (1995), Ji.ín (1999), Libá• (1991), „ eská Skalice (1969), Kopidlno (1989), Sb.Í (1997), Bohuslavice (1979), Dohalice (1951), Hradec Králové (2000), Opo.no (1990), Chlumeč nad Cidlinou (2001), Lib.any (1979), Třebechovice pod Orebem (1995), Týništ• nad Orlicí (2002), •d'ár nad Orlicí (2000), B•dovice (1999), Chábory (1993), Petrovice (1997), Ratibořice (1995), Brodek (1940), Hrádek (2001), Mokré–M•stec (1997), •eleznice (2002); **Liberecký**: Stvolínky (1979), Mimo• (1967), Ralsko (1980), Holany (1994), Zahrádky (2002), Doksy (1996), Bezd•z (1999), Rovensko pod Troskami (1977), Hrubá Skála (1982); **Olomoucký**: Píerov (1988), Prost•jov (1997), Tova.ov (1953), Kojetín (1971), Liboš (1990); **Moravskoslezský**: Osoblaha (2000), Opava (1990), Kravaře (1986), Dolní Lutyn• (2002), Ostrava (1992), Karviná (1992), Orlová (1930), Šenov (1962), Havířov (1967), Paskov (2000), Tlínec (1963), Píibor (1987), Hukvaldy (1998), Antořovice (1990), Linhartovy (1993), Dolní Suchá (1965), Lu.ina (1966), Stříte• (1959), Bohumín–Starý Bohumín (2002), Dolní Bludovice (1993), Ostrava–Šilheřovice (1995), Ostrava–Třebovice (1990), Louky nad Olší (1990); **Pardubický**: Vysoké Chvojno (1999), Sezemice (1956), Kun•tice (1999), Pardubice (1999), •amberk (1987), Zdechovice (1979), Újezd u Chocn• (2001), Píelou...(2001), Choltice (1998), Lipoltice (1932), Choce• (1984), Uhersko (1931), Chrudim (1997), Heřmanuv M•stec (1996), Vysoké Mýto (1960), Tlěmořnice (1997), Lu•e (1944), Nasavrky (1997), B•stviná (1995), Litomyšl (1954), Svitavy (1951), Moravská Třebová (2000), Brte...(1978), Kochánovice (2000), Slatiány (1988), Postolov (1946); **Plzeňský**: •ihle (1961), Plze• (1999), Kornatice (1991), Horšovský Týn (1991), Diana (1985), Plze•–Záb•lá (1998), Lopata u Št'áhlav (1992); **Praha**: Lochkov (1956); **Stredo.eský**: B•lá pod Bezd•zem (1983), Lib•chov (1971), Býkev (1998), Hořín (1971), Velvary (1997), Kutrovice (2001), Veltrusy (2002), Kvílice (2000), Slaný (1985), Jabkenice (1994), •i•ice (1998), Ro•d'alovice (2001), Lou.e• (1994), Sme.no (2001), Ruda (2001), Lány (1995), Nymburk (1941), Písty (2001), Skryje (1989), Bernardov (1996), Dobříš (1992), Hluboš (1980), Sob•lišín (1994), Vlašim (2001), Drchkov (1999), Nové Ouholice (1983), Pam•tník (1976), Podkost (1970), Ka.ina (1997); **Ústecký**: Osek (2002), Telnice (1959), Teplice (1990), Lib•šice (1975), Ploskovic (2001), Litom•lice (2000), Chomutov (1996), Terezín (1981), Klášterec nad Ohří (1973), Třebenice (1953), Údlice (1981), Drou•kovice (1988), Krásný Dvur (2001), Petrohrad (2000), Ľ edhošt' (1975), Dubí (1980), Mšené (1909), „ ervený Hrádek (1965); **Zlínský**: Chropyn• (1976), Tluma.ov (1974), Kn•pole (2002), Postoupky (1914).

Presented data are based on material deposited in collections of larger museums and private collectors, records published in regional literature and made complete with records mentioned by Kollar (2000).

Denmark

Falster: Korselitse (1938/a); **Lolland**: Keld Skov (1980/a); Bremersvold (1910/a), Kristianssæde (1981/a), Maribo–area (1881/a), Krenkerup Haveskov (1999/a), Maltrup Skov (1999/a), Halstedkloster Dyrehave (1999/a); **Zealand**: Oreby Skov (1999/a), Lekkende Dyrehave (1999/a), Nysø at Præstø (1901/a), Vemmetofte Strandskov (1953/a), Herlufsholm (before 1850/a), Vemmetofte Dyrehave (1999/a), Suserup Skov (1848/a), Vallø Dyrehave (1999/a), Egevang at Sorø (1991/a), Sorø Sønderkov (1999/a), Svenstrup Dyrehave (1859/a), Lerchenborg (before 1850/a), Boserup Skov (before 1850/a), Bognæs Storskov (1999/a), Charlottenlund Skov (1965/a), Jægerspris Slotshegn (1890/a), Fredensborg–area (1879/a), Gribskov, Ostrup Kobbøl (about 1970/a), Hellebæk Skov (1990/a); **Jutland**: Fusingø Skov (1886/a).

Based on specimens in museums and private collections and recent inventories (Martin, 1993, 2002). In the collections, there were about 150 specimens which have been collected since 1850 at 28 localities.

Estonia

Tartu (19th century/a), Koikküla (1997/r), Koiva woodland (Tsirgumäe, 2002/a; Vaitka, 2003/a).

Based on literature (Süda, 1998; 2003), private collections (I. Süda, H. Ōunap) and the collection of the Institute of Zoology and Botany, Estonian Agricultural University.

Appendix. (Cont.)

Finland

Ruissalo, near Turku (2002, a).

Based on a report by Landvik (2000) and personal communication with Finnish entomologists.

France

This list is not complete, but presents some localities that are large or recently recorded.

Oise department: Forest of Compiègne (1980); **Orne department:** hedge network of La Cochère (2001/a), apple orchards of Gacé (2003/r), hedges network of Godisson (2002/a), hedges network of Barville (2000/r); **Mayenne department:** hedge network of Pré en Pail (2001/r), hedge network of Evron (2001/r), hedge network of Torcé Vivier en Charnie (2001/r); **Sarthe department:** hedge network of Chassé (2000/r), chestnut orchards of Ecommoy (2003/r), chestnut orchards of Pontvallain (1999/r), hedge network of Vaas (2001/r), forest of Bercé (1996); **Indre et Loire department:** hedge network of Villebourg (2000/r); **Maine et Loire department:** hedge network of Blaison Gohier (2000/r); **Seine et Marne department:** forest of Fontainebleau (2003); **Bas-Rhin department:** forest of Herrenwald (year?); La Bruche (Strasbourg; 2003/a); **Indre department:** hedge network of Saint Benoît du Sault (2002/r); **Allier department:** Forest of Tronçais (1980); **Corrèze department:** Meymac (2001); **Aveyron department:** hedge network of Salles la Source (2002/a), hedge network of Cannet de Salars (2002/r); hedge network of Pierrefiche (2002/r); **Hérault department:** Cévennes (1998/a), Rousses (1998/a), forest of Marquaires, (2002/a); **Pyrénées Atlantiques department:** forest of Sare & Saint Pée (1999/a); **Landes department:** forest of Landes (partly also in Pyrénées Atlantiques, Gironde, Lot et Garonne departments, 1970); **Pyrénées Orientales department:** forest of Massane & Albères orientales (1999/a); **Var department:** forest of Maures (2000), forest of Sainte Baume (partly also in Bouches du Rhône department, 2003/a).

The localities on the map are based on published records (compilation by J. M. Luce in Blandin et al., 1999; Landemaine, 2003; Tausin, 2000; 2002), surveys conducted by H. Brustel in 2002 in the Aveyron department, the Entomological Society of Limousin (Corrèze department), and Office de Génie Ecologique by J. F. Asmodé, P. Orabi and V. Vignon (Indre–et–Loire, Mayenne, Orne, Sarthe departments) and personal communication with many entomologists (e.g. L. Baliteau, J. J. Bignon, L. Chabrol, R. Dohogne, F. Hunault, C. Jarentowski, L. Malthieux, P. Stallegger, L. Valladares and Y. Vasseur).

Germany

Sachsen (Saxony): southern Dresden (Pirna, Heidenau–Großsedlitz, Pillnitz, 2000/a), Dresden (city, Dresdener Heide, Pesterwitz, Weißig, 2003/a), Radebeul (Hermsdorf, Moritzburg, 2003/a), between Dresden and Meißen (different side valleys of Elbe river, 2003/a), Meißen (city, Robschütz, Miltitz, 2003/a), between Meißen and Lommatzsch, mainly in fruit plantations (Leutewitz, Sieglitz, Käbschütz, Seebischütz, Seilitz, Piskowitz, Zehren, Zöthain, Niedermuschütz, Zscheilitz, 2003/a), northern Meißen (Diesbar–Seußlitz, 2003/a), Zeithain (1990/a), Zabeltitz (2001/a), southern Torgau (Graditz, 2003 r), Delitzsch (Storkwitz, 2003/r, Wölkau, 2000/r, Jesewitz, 2002/a, Gotha [Sachsen] 2002/r), Leipzig (city, floodplain forest, Burgaue, Dösen, 2001/a), Lindenthal (2003/a), Dübener Heide (Pressel, 2002/r, Falkenberg, 2002/a, Weidenhain, 1993/a, Trossin, 2003/r, Roitzsch, 2003/r), Dahleener Heide (Dahlen 2003/a), Mutzschener Wasser (Mutzschen 2002/a, Gastewitz 2002/r, Wiederoda, 2002/a), Mulde floodplain between Wurzen and Bad Düben (Thallwitz 1998/a, southern Eilenburg 1993/a, Zschepplin, 2002/r, Hohenprießnitz, 2003/r, Bad Düben, 2003/r), southern Leipzig (Zwenkau, 2003/r), Niederlausitz (Niederspreer Teichgebiet, 2002/a), Weißwasser (1986/a).

Based on information from Detlef Bernhard (pers. comm.), Jörg Lorenz (pers. comm.), Angela Mann (pers. comm.), Stegner (2002) and Ulrich Zöphel (Sächsisches Landesamt für Umwelt und Geologie).

Sachsen–Anhalt (Saxony–Anhalt): Gatersleben (1952), Rothenförde (1981), Stackelitz/Fläming (1989/r), Steckby (NSG 'Steckby–Lödderitzer Forst', 1995/a), Zerbst (city, 1995/a), Bernburg (Kesselbusch, 1988/a), Brucke (Wiese nahe Saale, 2000/a), Kustrena (Pfuhscher Busch, 1988/r), Plötzkau (NSG Plötzkauer Auenwald, 1996/a, near Autobahn, 2000/a, near the sport ground, 2000/a), Bad Kösen (1934), Freyburg/Unstrut (Schloßberg an der Neuenburg, 1968/a), Naumburg (oberer Rand vom Mordtal, 1934, Hallischer Anger, 1934, around Naumburg, 1944), Marke (1955), Dessau (several years, Luisium 1995/a, Kornhaus

Appendix. (Cont.)

1988/r, Mosigkauer Heide 1950, Sieglitzer Berg 1989/r, Leiner Berg 1999, Becker Bruch 2000/r, Kühnauer Heide 1978/a, Dessau–Waldensee 1988/r, Roßlau (near Elbe river 1996), Halle (city, 1950/a, Dölauer Heide, 1988/a, Peißnitz 1998, Halle–Neustadt, Saaleaue, 1987/a), Burg (NSG Bürger Holz, 1993/a), Cöthen (=Köthen 1889), Köthen (city, 1993/r), Diebzig, 1995/r), Diesdorf (Mosigkauer Heide, 1992/r), Magdeburg (1950, Magdeburg–Pechau: NSG Kreuzhorst, 1992/a), Eisleben (Landwehr, Amsdorf, 1912, Himmelshöhe, 1950), Frankleben (1983), Ballenstedt (1987/a), Quedlinburg (city, 1975, Brühl, 1982/a, Altenburg 1988/a), Schönebeck (Glinde, 1927, Grünewalde, 1925), Iden (1978), Stendal–Wahrburg (city, 1995/a), Dieskau (1900), Döllnitz (1987), Röpzig (1898), Wettin (1900), Pretzsch (Dübener Heide, 1942), Althaldensleben (2000, the landscape park, 1997/), Breitenbach near Zeitz (1982), Haldensleben (Alteichenbestand, 1998/e), Hundisburg (Barockgarten, 1997/r), Trebnitz near Zeitz (Pötewitz–Ahlendorf, 1987/a).

Based on information from Peer Schnitter (Landesamt für Umwelt, pers. comm.).

Thüringen: Ummerstadt (1905), Burgk/Saale (Schloss, 2002), Meiningen (1851), Greiz (1910), Gössnitz/Schmölln (1932), Schmölln (1987/a, Sprotteau, 2002/r), Posterstein (2002/a), Ronneburg (1936), Gera (1983/r), Gösdorf/Altenburg (2002/a), Großmecka (Tautenhain, 2002/r), Ziegelheim (1999), Altenburg (1998/a), Breesen/Altenburg (2002), Lossen/Altenburg (Deutscher Bach, 2002/r), Mockzig (2002/a), Nobitz/Altenburg (1978), Zschaschelwitz/Altenburg (1999), Mehna (Kleiner Gerstenbach, 2003/a), Tegkwitz (2003/a), Göhren (2003/a), Lossen (2003/a), Breesen (2003/a), Schwanditz (2003/a), Gimmel/Schmölln (2002), Starkenberg (1971), Bad Köstritz 1990/a), Gera (Milbitz, 1937, Roschütz, 1995/a; Stublach, 1951, Thieschitz, 1996/r, Tinz, 1931/a), Pohlitz (1993/a), Bad Klosterlausnitz (1995/a), Eisenberg (Beuche, 1966, Rodigast, 1968), Etzdorf/Eisenberg (1955/a), Gösen (1988/a), Hainspitz (1996/a), Krossen/Eisenberg (1993/a), Bürgel (1993/a), Ilmsdorf/Bürgel (1993/a), Tautenburg, Hohe Lehde (1997), Waldeck (Schloßgrund, 1986), Jena (city, 1979, Löbstedt, 1999/a, Paradies, 1921/a; Zwätzen, 1994), Weimar (Webicht 1934/a), Erfurt (1843), Gotha [Thüringen] (Großer Seeberg, 1896), Eisenach (1894), Eisenach–Siebenborn (1958), Saaleck/Bad Kösen (Saaleaue, 2002), Harras/Schmücke (1909/a), Schlotheim (1862/a), Volkenroda/Mühlhausen (1873/a), Mühlhausen (1862/a), Ichstedte (2001/a), Bad Frankenhausen (1900, Kl.Wipper, 1963), Kyffhäuser (Südabfall, 1934/a), Sondershausen (1854), Krimderode/Nordhausen (1934), Nordhausen (1934), Rüdigsdorf (1934).

Based on information from Frank Fritzlar (Thüringer Landesanstalt für Umwelt und Geologie, pers comm.) and Andreas Weigel (1995; 1996; 2000, pers. comm.).

Mecklenburg–Vorpommern (Mecklenburg–Western Pomerania): Rostocker Heide (NSG Heiligensee, 1992/r), Schlemmin (2002/r), Groß Markow (2001/a), Pohnstorf near Teterow (2001/a), Hohenbüssow near Alt Tellin (2002/a), Klein Wokern (2002/r), Teterow (1993/a), Hagensruhm near Teterow (1991/a), Hohen Mistorf (1991/a), Rothspalk near Langhagen (2001/a), Karstorf (2001/a), Basepohl (2001/r), Ivenacker Eichen (2001/a), Burg Schlitz near Teterow (2001/a), Rothenmoor near Teterow (2001/a), Müritzer See, Waren near Blücherhof (1994/l), Kittendorf (2001/a), Neuenkirchener Wald near Luisenhof (1997/a), Heinrichsruh (Park, 2002/a), Christiansberg near Ahlbeck (2001/a), Crivitz east from Schwerin (2002/a), Torgelow near Waren (2002/l/r), Neubrandenburg (Broder Holz, 1970/a, Fünf Eichen, 1985/a, Markt, 2002/a), Viereck (2001/a), Eulenspiegel west from Wendfeld (2003/r), Pritzier (2001/a), Ludwigslust (Schlossgarten, 1996/a), Neustrelitz (Tiergarten, 2001/a), Weisdin (2001/a), Serrahn (1990/a), Heilige Hallen (2002/r), Groß Mohrsdorf (1984/r), Devener Holz near Demmin (1985/a), Mueß near Schwerin (Reppin, 1980/a), Brantensee (1998/r), Bennin near Hagenow (1988/a), Banzin near Hagenow (1981/a), Kuppentin (1988/a), Hohenzieritz (Schlosspark, 2002/r), Burg Stargard (Klüschenberg, Burgberg, 1988/a), Usadel (2002/r), Feldberg (2002/r), Sprockfitz–See (am Staugraben, 2002/r), Wokuhl 2001/r), Prosnitz near Stralsund (19th century/a), Bad Doberan (1918/a), Teufelsmoor near Sanitz (1977/l), Greifswald (Elisenhain, 1966/a), Ückeritz (Insel Usedom, 1971/a), Bützow (Linden am Wall, 1907/a), nördlich Kamminke (Golm, 1974/a), Vollrathruhe (Schlosspark, 1882/a), Zettemin near Malchin (1941/a), Gallin (1969/a), Feisneck–See near Waren (1979/a), Rothemühl (Forst, 1937/a), Grabow (1874/a), Insel Vilm (1999/r to be proved).

Based on Ringel et al. (2003).

Brandenburg: many localities with findings since 1990, especially in the northern part (Uckermark). Some localities with recent records in southern Berlin around Potsdam (Sancouci) (Möller & Schneider, 1992; Schaffrath, 2003b).

Appendix. (Cont.)

Berlin: localities with recent records (since 1990) in the southwest (Grunewald) (Müller, 2001; Schaffrath, 2003b).

Schleswig–Holstein: several localities in the eastern part before 1980, only one since 1990 (Schaffrath, 2003b).

Hamburg: only records before 1980 (Schaffrath, 2003b).

Niedersachsen (Lower Saxony): several localities in northeastern Lower Saxony (Göhrde region) since 1990, some localities with recent records in central Lower Saxony (Schaffrath, 2003b).

Bremen: some localities since 1990 (Schaffrath, 2003b).

Nordrhein–Westfalen (North Rhine–Westphalia): several localities before 1980, only a few localities in the Rhine region with records between 1980 and 1989 (Schaffrath, 2003b).

Rheinland–Pfalz: only at a few localities in western parts before 1980 and some between 1980 and 1989 (Schaffrath, 2003b).

Saarland: at two localities since 1990 (Schaffrath, 2003b).

Hessen (Hesse): many localities before 1980, and also at many localities since 1990 especially in the north and the south (Rhine–Main–region) (Schaffrath, 2003b).

Baden–Württemberg: many of localities with recent (since 1990) records in central Baden–Württemberg (around Stuttgart, Neckar region). One locality in the south (Rhine valley) (Schaffrath, 2003b).

Bayern (Bavaria): some recently discovered localities (since 1990) in regions with river valleys (Main, Donau). A big area with *O. eremita* is situated in the Spessart region (Schaffrath, 2003b).

Greece

Aisimi (= Essimi) (1963/a), Akarnanika Ori (before 1886), Elis (before 1886), Euboea (before 1886), Katara Pass (1998/a), Katerini, Meteore (1996), Mount Athos (1994), Mount Mavrovouni (1994), Mount Olympos (1994), Mount Ossa (1994), Mount Ossa, NE slope, near Kokkinonero (1979), Mount Taygetos (before 1886), Pessani, near Alexandroupolis (1994), Vrontou (1996), Nomos Larisis (Spilia, 2003/a, Omolion, 1991/a, Stomion, 2003/a), Nomos Ioanninon (Vrosina, 2003/a), Nomos Pierias (Katerini, 1991/a).

Based on published records (Oertzen, 1886; Mikšif, 1959; Tauzin, 1994b; Sparacio, 2001) and unpublished records by e.g. H. Brustel (pers. comm.).

Hungary

Baranya: Bár (1964/a); **Bács–Kiskun:** Bács (1939/a), FoktÁ (1945/a), Kalocsa (a); **Borsod–Abaúj–Zemplén:** Dédestapolcsány (1949/a); **Győr–Moson–Sopron:** GyÅr (1988/a), GyÅrzámoly (1973/a), Hédervár (1949/a); **Heves:** Gyöngyös, Kékes (1953, a); **Nógrád:** Diósjenő (a); **Pest:** Budapest, Pestimre (a), Kemence (1954/a), Szigetcsép (a); **Zala:** Zalaszentő (1957/a).

Based on specimens in the Natural History Museum of Hungary (about 20 specimens). We also went through collections of other institutions (e.g. Inst. of Forest and Wood Protection, Univ. of West–Hungary) and private collections (e.g. Vida's). They contained a few specimens; however, most of them were unlabelled or only from the neighbourhood.

Italy

Osmoderma eremita

Valle D'Aosta: Aosta (Aosta, year?/a); **Piemonte:** Torino (1968/a, Baudenasca, loc. Paglieri near Pinerolo, 1968/a, Macello, year?/a, Buriasco, year?/a, Carmagnola, 1995/a, Moncalieri, 1977/a, Leini, 1974/a, Mirafiori, 1949/a, Stupinigi, 1944/a, Santa Margherita, 1924/a), Vercelli (1914/a), Novara (1983/a, Cameri, 1983/a), Alessandria (Frugarolo, 1906/a, Serravalle Scrivia, 1945/a, Piovera, 1945/a, Cassano Spinola, 1905/a, Alessandria, 1982/a, Pontecurone, 1984/a, Spinetta Marengo, 1993/a, Rivalta Scrivia, 1971/a, Vignole Borbera, 1967/a, Cabella Ligure, 1989/a, Acqui Terme, year?/a), Cuneo (1987/a, Canale, 1998/a, Entracque, 1965/a, Saluzzo, 1978/a, Borgo San Dalmazzo, 1958, Cherasco, 1989/a, Mondovì, 1977/a, Ormea, 1993/a, Genola, year?/a, Verzuolo, 2000/a, Fossano, 2001/a, Salmour, 2002/a) Cicogna (Verbania; 1997/a); **Liguria:** Genova (Val d'Aveto, Magnasco, 1986/a), Savona (Toirano, 1984/a); **Lombardia:** Sondrio (Lovero Valtellino, 2000/a, Tovo di Sant'Agata, 1997/a, near Grosio, 2000/a, Tirano, 1995/a), Brescia (1982/a, Alfianello, 1977/a, Leno, 2001/a,

Appendix. (Cont.)

Remedello, 1995/a, Visano, 2000/a, Gottolengo, 1996/a, Gambara, 1993/a), Bergamo (1941/a, Casazza, 1971/a), Lecco (Mount Barro above Galbiate, 1978/a), Como (1931/a, Erba, 1987/a), Varese (Palude Brabbia, year?/a, Cocquio Trevisago, 2000/a), Milano (1966/a, Meda, 1897/a, Turate, 1931/a, Baggio, 1928/a, Gessate, 1980/a, Monza, year?/a, Paderno Dugnano, 1962/a, Corbetta, 1990/a), Cremona (1987/a, Ostiano, 1994/a, Robecco, 1979/a, Pandino, 1972/a), Mantova (1950/a, Bosco Fontana, 1949/a, San Biagio near Bagnolo S. Vito, year?/a), Pavia (1975/a, Voghera, 1965/a, Stradella, 1987/a, Mirabello di Pavia, 1972/a, Villalunga, 1975/a, San Genesio, 1972/a); **Trentino–Alto Adige**: Bolzano (probably 1890, Brunico, probably 1930), Prato allo Stelvio (probably 1890), Trento (1933/a, Borgo Valsugana, 1930/a, Ischia Podetti near Pergine Valsugana, 1929/a, Val Sugana, 1930/a, Val d'Adige Inferiore, 1927/a, Vela di Trento, 1960/a, Pinzolo, 1940/a, Vigo Anaunia near Ton, 1934/a, Lago di Terlago, 1965/a, Rovereto, year?/a, Pergine, year?/a, Cles, year?/a, Rallo, 1934/a, Villa–Agnedo, 1933/a, Nogaré, 1880's/a, Madrano, 1880's/a), Bolzano (probably 1890, Brunico, probably 1930, Prato allo Stelvio, probably 1890, Appiano, 1930/a, Varna, 1984/a, Ora, 1984/a, Val Venosta, Silandro, 1951/a, Seiser Alm (= Alpe di Siusi), 1996/a, Salorno, 1880's/a, Bronzolo, 1860's/a, Lana, 1860's/a, Gudon, 1860's/a, Ciardes, 1860's/a); **Veneto**: Venezia (Mestre, 1973/a, Carpenedo, 1971/a, Chirignago, 1936/a, Marghera, 1955/a, Sega di Gruaro, Reghena river, 1993/a, Gai di Gruaro, year?/a), Padova (1972/a, Rosara di Codevigo, 2002/a, Codevigo, 2002/a, Lovertino, 1986/a, Montagnana, 1925/a), Vicenza (La Rotonda, 2000/a, La Commenda, 1992/a, Arcugnano, 1974/a, Lago di Fimon, 1972/a, Altavilla Vicentina, 1999/a, Monteviale, loc. Biron, 1959/a, Albettone, year?/a), Treviso (Mogliano Veneto, 1972/a, Asolo, year?/a, Il Montello above Giavera, year?/a), Belluno (loc. Mussoi, 1973/a), Verona (Boschetto, 1926/a, Bosonetto, 1928/a, Mambrotta, 1926/a); **Friuli–Venezia Giulia**: Trieste (Boschetto near Longera (=Bosco Farneto), 1953/a, Valle delle Noghère near Aquilinia, 1921/a, Cattinara, year?/a), Udine (Pontebba, 1895/a, Parco delle Prealpi Giulie near Resia, 1995/a); **Emilia Romagna**: Bologna (2000/a, Sala Bolognese, 1978/a), Reggio Emilia (Campegine, 1989/a, Calerno, 1986/a, Castelnuovo, 1986/a, Cadelbosco di Sotto, 1989/a, Massenzatico, 1990/a), Modena (Sestola, 2000/a), Ravenna (Bagnacavallo, 2000/a, Massa Lombarda, 1974/a, Lugo, 1977/a, Fusignano, 1968/a, Barbiano, 1992/a, Russi, 1973/a, Granarolo Faentino, 1956/a, Faenza, 1984/a, Sant'Agata sul Santerno, 1984/a, Cotignola, 1897/a), Ferrara (Argenta, 1995/a), Piacenza (2001/a, Ferriere, year?/a, Olmo near Bettola, 1989/a, Castel San Giovanni, 1970/a, Piacenza, Le Mose, 1963/a), Parma (1990/a, Collecchio, 1980/a, Fontanellato, 1981/a, Calestano, 1891/a), Forlì (Balze di Verghereto, 1990/a, Monte Fumaiolo, year?/a, Verghereto, 1976/a, Alpe di San Benedetto, above San Benedetto in Alpe, 1990/a); **Toscana**: Firenze (1972/a, Firenze, Parco Le Cascine, 1954/a, Firenze, Badia Della Valle, 1985/a, Panzano, 1925/a, Marradi, 1971/a), Prato (La Badia, 1996/a), Livorno (a), Lucca (year?/a, Porreta, 1942/a), Grosseto (Poggio Cavallo, 1932/a, Semproniano, 1976/a); **Umbria**: Perugia (Norcia, 1954/a, Avendita, 1966/a); **Lazio**: Viterbo (Vignanello, 1998/a), Rieti (Cittaducale, 1966/a, Poggio Mirteto, 1920/a), Roma (Roma, Bufalotta, 1970/a, Roma, Villa Doria Pamphili, 1987/a, Roma, Villa Borghese, 2001/a, Castel Porziano, 2001/a, Castel Fusano, 1970/a, Olevano Romano, 1919/a); **Abruzzo**: L'Aquila (Fontavignone, near Rocca di Mezzo, 1971/a, Pescasseroli, 1971/a, Tagliacozzo, 1954/a, Pizzoli, 1980/a, Monti Simbruini, Intermesoli, between Pereto and Cappadocia, 1965/a, Pereto, 1996/a, Val Dogana near Camporotondo di Cappadocia, 1996/a, Zompo dello Schioppo falls above Morino, 1997/a, Pile, 1972/a, Costa Masciarelli, 1991/a, Preturo, year?/a, Sulmona, 1990/a, Parco Nazionale d'Abruzzo, between Opi and La Camosciara, year?/a, Gran Sasso, Vallone Venacquaro, 1991/a), Pescara (Valle Peligna, Popoli, 1990/a), Chieti (Scerni, 1964/a, Parco Nazionale della Majella, Montenerodomo, 2003/a).

Osmoderma "italicum"

Campania: Caserta (Vitulazio, 1911/a), Napoli (Isola di Procida, 1975/a), Salerno (Vallo Lucano, S. Biase, 1912/a); **Puglie**: Foggia (Anzano, 1987/a); **Basilicata**: Potenza (Terranova di Pollino, 1983/a), Potenza (San Severino Lucano, 1998/a, Pietrapertosa, 1971/a, Viggiano, 1964/a, Monte Pollino, La Catusa, year?/a); **Calabria**: Cosenza (Timpone del Vaccaro between Morano Calabro and Orsomarso, 2001/a, Decollatura, 1992/a, Serra San Bruno, 1988/a), Reggio Calabria (Delianova, 1989/r).

Osmoderma "cristinae"

Sicilia: Palermo (Madonie, Piano Zucchi, 1992/a, near Castelbuono, 1860/a, Gibilmanna, 1997/a).

Based on specimens in Italian museums and many private collections. We have gathered information on 500 specimens collected during the last 150 years.

Appendix. (Cont.)

Latvia

Aizkraukles raj.: Daudzese env., Baibas house 1 km W (2002/e); Erber>e, parks (2002/a); **Bauskas raj.:** Budberga, aleja (2001/rs); Jaunsaule (2001/e); Ozold-rzs NPA (2002/ a); **C' su raj.:** Gaujas NP, Ieriš, aleja (2001/a); Gaujas NP, Raskums-Auciems (2003/a); Gaujas NP; Ungurmui•a (2002/a); Gaujas NP, Ska-upes (2003/a); **Daugavpils raj.:** Bebrene (parks, 2002/a); Daugavas loki NPA (2002/ a, Naujene, Jezupovas parks, 2002/a), Dinaburgas pilskalns 3,5 km no Naujenes (2002/a); Eglaines me•i NPA (2002/a); Naujene, gravis (2000/a); Pilskalnes Siguldi•a NPA (2002/a); Silenes NPA, Ilgas, mui•as parks (2001/a); Vabole, parks (2001/a); Vi•i (2001/a); **Dobeles raj.:** B' nes vm. (kv 103, nog. 1, 2001/e, kv 121, nog. 18, 2001/e, kv 127, nog. 9, 2001/e, kv 129, nog. 8, 2001/e, kv 131, nog. 16, 2001/e, kv 131, nog. 17, 2001/e), Dobeles (kv 113, nog. 7, 2001/e); **Gulbenes raj.:** Jaungulbenes vm. (kv 852, nog. 2–3, 2001/a, kv 871, nog. 12, 2001/a), Litenes vm. (kv 159, nog. 19, 2001/a), Pededzes lejtece NPA (at V•i vill., 2003/a, Silinieki, 2003/a), Pededzes ozolu audze NPA (2002/a), Pirts•a–L• atteka NPA (2002/a), Sitas un Pededzes sateka NPA (2002/a); **J' kabpils raj.:** } be-i NPA (2001/ a), Dunava, parks (2002/a), Rube•i, parks (Rubenes pagasts) (2002/a), Sauka NPA (2002/e), Slates vm. (kv 20, nog. 11, 2001/e); **Jelgavas raj.:** Jelgava (Ozolpils parks, 2001/rs); **Kuld•as raj.:** Edole (parks, 2002/a), Rudbar•u vm., kv 316, nog. 10 (2001/e); **Liep-jas raj.:** Dunika NPA (2001/a), Pape NPA, Pape (2001/a), Priekules vm., kv 397, nog. 8 (2001/e); **Limba•u raj.:** Augstroze NPA (2001/a); B•i•u pils parks (2002/a), Burlaku p-avas NPA (2002/e), Salacas ieleja NPA (2002/a), Sv' tupes ozolu audze NPA (2002); **Ludzas raj.:** Istras ezers NPA (2002/a), Ludzas vm. (kv 126, nog. 5, 2001/e); **Madonas raj.:** Kalsnavas vm., kv 167, nog. 14 (2001/a); **Ogres raj.:** Lielie Kangari NPA (2001/a); **R•a city:** center, kan-lmalas parks (1995/a), Ark-dija parks (1999/a), Jaunciems NPA (2002, rs), Me•aparks (1994/a), Saulesd-rzs (2002/a); **R•as raj.:** Doles sala NPA (2001/a), Gaujas NP (Krimulda, sanatorija, 2001/a, Krimuldas bazn•a, parks, 2001/a, Sigulda, at Siguldas castle (1991/a), Liel-Baltezera salas NPA (2001/e), In. ukalna apk., Krusti•i); **Talsu raj.:** Dundaga (2000/a), Ra-upes ieleja NPA (2001/a), Si•eres NP, Si•ere (2000/a), Talsu pauguraine NPA (2002/a); **Tukuma raj.:** Abavas ieleja NPA (2002/a), Irlavas vm., kv 200, nog. 9 (2001/e); **Valkas raj.:** Valkas vm., kv 105, nog. 1 (2001/e), Vijciema vm., kv 234, nog. 9 (2001/e), Zieme-gaujas paliene PNV (2002/a); **Valmieras raj.:** Mazsalaca, skolas parks (1970/a); **Ventspils raj.:** Moricsala SNR (2001/a), Popes vm. (kv 66, nog. 3, 2001/e, kv 90, nog. 32, 2001/e), Usma (Usmas tautas skola, 2001/a).

Based on literature, insect collections (museums and private) and field surveys. In the collections there were about 55 specimens collected during the last 155 years. Field surveys have mostly been conducted during the last four years.

Lithuania

Ignalina: Did-iagirio forest (2000); **Kaišiadoriai:** Kruonis (1988); Str-vinink•a forest (2002); **Kaunas:** Gerv•nupis (1997); Kaunas (2001); Kleboni•kis (1976); Lap•s (1963); **Kedainiai:** (1963); **Lazdijai:** Meteliai (1980); **Marijampol•** (1963); **Panev•nys:** Gringali•a forest (1987); **Pasvalys:** Joni•kis (1983); **Plung•**; **•ilal•**; **Telšiai;** **Trakai:** (1978).

Based on specimens in Kaunas T. Ivanauskas Zoological Museum at The Lithuanian University of Agriculture and many private collections. 27 specimens were recorded from the last 80 years.

Macedonia

Tetovo (1941).

Based on Mikšif (1955). The specimen is preserved in the Natural History Museum of Beograd (L. Protif, pers. comm.).

Moldova

Bender: settlement Bender (1917).

Based on Neculiseanu & D|nil| (2000).

The Netherlands

Gelderland: Arnhem (1897), Beek (before 1910), Nijmegen (1886), Wehl (before 1887), Wisch (before 1926), Zutphen (1853); **Zuid-Holland:** Den Haag (dubious record, before 1893); **Limburg:**

Appendix. (Cont.)

Gronsveld (1907), Houthem (1904), Limmel (before 1892), Maastricht (1876–1903), Oud–Vroenhoven (before 1887), Valkenburg (1902), Wijnandsrade (1946).

Based on examination of the major Dutch private and museum collections. Also the faunistic literature was checked for additional data (Huijbregts, 2003). In total, 23 *O. eremita* specimens from 14 localities were collected between 1870 and 1946.

Norway

Akershus: Asker (19th century/a); **Buskerud:** Drammen (before 1875/a); **Østfold:** Rauer near Fredrikstad (1997/r).

Based on literature, summarized in Hanssen (1999).

Poland

Pobrzeże Bałtyku (Baltic Coast): Woliński National Park (before 1951), Puck (1979/a), Wejherowo (about 1995/a), Sopo (turn of 19th/20th century), Oliwa (turn of 19th/20th century), Gdańsk (turn of 19th/20th century), Elbląg (turn of 19th/20th century), Kadyny (1957/a); **Pojezierze Pomorskie (Pomerania Lake Region):** Bierzwnik near Choszczno (1954/a), Bielinek nad Odrą reserve near Cedynia (1985/r); **Pojezierze Mazurskie (Masurian Lake Region):** Area between Elbląg, Iława, Susz and the river Paszka (2003/a); Wbrzeźno (turn of 19th/20th century), Brodnica forest district (before 1961), Morąg (before 1945/a), Ostróda, Jedwabno, Kątrzyn (turn of 19th/20th century), Gądynie near Młynary (1993/a), Bartoszyce (1995/a), Lipowo near Piecki (2000/a); **Nizina Wielkopolsko–Kujawska (Wielkopolska–Kujawy Lowland):** Kostrzyn (1918/a), Rawicz, Poznań–Dębina (before 1922/a), Rogalin, Krajkowo near Mosina (1993/a), Sułów near Milicz (1962/a), Ostromecko (2002), Toruń (turn of 19th/20th century), Las Piwnicki reserve near Toruń (2002/a), Ciechocinek vicinity (1967/a); **Nizina Mazowiecka (Mazovian Lowland):** Warszawa (Las Młociński, Las Bielański, 1956/a), Saska Kępa (before 1962), Ursynów (before 1993/a), Sokołocin near Piaseczno (before 1963), Sucha Szlachecka near Białostrzegi (1995/a), Józefów (before 1975/a), Trzebież near Magnuszew (1994/a), Puszcza Kozienicka (before 1998/r), Zosin near Ustronie (before 1975/a); **Podlasie (Podlasie):** Sitniki near Siemiatycze (about 1980/a), Liszna near Świątynice (1995/a); **Puszcza Białowieża (Białowieża Primeval Forest):** Dwinoroje near Narewka (1988/a), Białowieża National Park (1987/a); **Dolny Śląsk (Lower Silesia):** Wrocław (before 1929), Brzeg (1982/a) Ziemięłowice near Namysłów (19th century), Pokój (1992/a); **Wzgórza Trzebnickie (Trzebnickie Hills):** Topolno (19th century), Trzebnica (1975/a); **Górny Śląsk (Upper Silesia):** Zawadzkie (1931/a), Racibórz, Łubowice near Racibórz, Rudy near Kujawia Raciborska (before 1856), Łubowice reserve (1996/a), Rudziniec (2003/a), Tworków near Krzyżanowice (1949/a), Baranowice near Łubowice (1983/a), Murcki (before 1945/a), Pszczyna (1986/a), Chwałek (1923/a), Zaborze near Oławy (1903/a), Bukowica reserve (2002/a), Lipowice reserve (2001/a), Pasaż near Chrzanów (1974/a); **Wyżyna Krakowsko–Wieluńska (Kraków–Wieluń Upland):** Złoty Potok (about 1976/a), Blachownia near Czarnostochowa (before 1908), Krzeszowice (1988/a), Czarna k. Krzeszowic (1907/a), Karniowice near Zabierzów (before 1945/a), Ojców (1974/a), Modlnica (1977/a), Skawina Kmity near Szczyglice (1970/a), Piekary near Liszki (1997/a), Skawina (1925/a), Michałowice near Kraków (1937/a), Kraków (1928/a), Kraków: Bielany (1968/a), Las Wolski (1952/a), Salwator (1994/a), Zwierzyniec (1917/a), Pasaż (before 1950); **Wyżyna Małopolska (Małopolska Upland):** Las Łagiewnicki reserve near Łagiewniki–Smolarnia (1996/a), Subina near Kuluszki (1984/a), Spała near Inowrocław (1949/a), Zagnańsk (1991/a), Jankowice (1990/a), Książ Wielki (1985/a), Mianocice near Miechów (1872), Miechów forest district (before 1961), Kocmyrzów near Luborzycza (1953/a), Nowe Brzesko (1985/a), Ziemięłowice near Kazimierza Wielka (before 1975/a), Czyżowice near Kazimierza Wielka (1999/a), Bronowice near Puławy (before 1950/a), Puławy (before 1915); **Góry Dwińskie (Dwińskie Mountains):** Dwiński National Park (before 1958); **Wyżyna Lubelska (Lublin Upland):** Parchatka near Puławy (before 1950/a); **Roztocze (Roztocze):** Zwierzyniec (1908/a), Kosobudy (1943/a), Ulów (published 1913/a), Hrebenne (1988/r); **Nizina Sandomierska (Sandomierz Lowland):** Kraków (Rakowice, 1912/a), Grzegórzki (1937/a), Puszcza Niepołomska (near Kołomyże reserve, 1999/a), Ispina (1993/a), Lipówka reserve (1999/a), near Hysne (1997/a), Dębowa (1993/a), Lubasz near Szczucin (1937/a), Bukowiec near Szczucin (1938/a), Tarnów (before 1950), Kotowa Wola near Zaleszany (1879), Rozwadów near Stalowa Wola (before 1950), Rzeszów and vicinity (before 1869), Jarosław (1973/a), Przemyśl (1985/a); **Sudety Zachodnie (West Sudetes):** Jelenia Góra–Cieplice (1999/r); **Beskid Zachodni (West Beskid):** Skoczów (2001/a), Pierńbiec near Skoczów (2000/a), Ływiec (1985/a), Jeleńnia (1967/a), Dłeszowice (1990/a), Brzeźnica near Wadowice (1982/

Appendix. (Cont.)

a), Kalwaria Zebrzydow. (1944/a), Kraków (Ró•ka, 1998/a), Sieraków near Dobczyce (1909/a), Fajkowiec near Gdów (1927/a), Stadniki (1992/a), Melsztyn (1997/a), Lipnica Murowana (1994/a), Bieńnik (about 1970/a), Zakliczyn vicinity (1966/a), Roztoka near Zakliczyn (1987/a), Wróblowice near Zakliczyn (1977/a), Janowice near Pleńna (1986/a), Ci•dkowice (1987/a), Nowy S•cz (1933), Popowice near Stary S•cz (2000/a), Tarnowiec (1996/a); **Kotlina Nowotarska (Nowy Targ Valley)**: Zakopane (1922/a); **Beskid Wschodni (East Beskid)**: Kończyce (1986/a), Markowa near °a½ut (1984/a), Dukla (1991/a), Barwinek near Dukla (1988/a), Sanok (1970), Przemyń (before 1885/a).

Based on former published data compiled by Burakowski et al. (1983) and Szwajko (1992b), recent literature (Borowski, 1993; Chmielewski et al., 1996; Burakowski, 1997; Kalisiak, 1997; Krell, 1997; Szafranec & Szostys, 1997; Kowalczyk & Zieliński, 1998; R•biń, 1998; Zaj•c, 1998; Byk, 1999) recent field inventories (Oleksa et al., 2003), and surveys of museums (Museum and Institute of Zoology PAS, Warszawa; Museum of Natural History, Institute of Systematics and Evolution of Animals PAS, Kraków; Upper Silesian Museum, Bytom; Department of Forest Entomology, Agricultural University, Poznań) and private collections.

Rumania

Braşov: Braşov (before 1912), Cincu (before 1912); **Cluj**: Cheile Turzii (1969), Baci (Cluj–Napoca, 1994); **Dolj**: Caracal (1969), Bucov•u (1968), Lintesti (1967), Leamna (1969), Racovi•u (1985), Craiova (1968, Banu M•r•cine, 1968), Negoiu (1966), Salcia (1970); **Gorj**: C•rbune•i (1967), Cheile Sohodol (1999), Tismana (1965); **Hunedoara**: Hal•g (before 1912), Deva (before 1912), Brad (before 1912); **Mehedin•u**: Ol•ne•i (1954), Schitu Topolnicei (1992); **Mureş**: Sighişoara (before 1912), Reghin (before 1912), **Sibiu**: Sibiu (before 1912), F•g•raş (before 1912), Mediaş (before 1912).

Based on literature (Petri, 1912; Fleck, 1904–1906; Tauzin, 1994b; Sparacio, 2001) and unpublished records.

Russia

Kaliningrad region: Kaliningrad (1992/a), Pravdinskiy district (Podlipovo village, 1994/a), Chernjakhovsk (1997), Polesk district (1985–1995/a); **Leningrad region**: Luga district (Ploskoye Manor, 1916/a, Preobrazhenskaya railway station, 8 km down the Luga River, 1915/a, Tolmachyovo railway station, 1995/a), Apraksin Bor village near the border to the Novgorod region (1960–80); **Novgorod region**: Chudovo (1975/a); **Moscow region**: Podolsk district (Drovnino, 1950/a), Pokrovskoye village (1930–1950/a), Serpukhov (1935–1955/a), Serpukhov district (Luzhki village vicinities, 1993/a), Serpukhov district (Prioksko–Terrasny Reserve, 1992–93/a), Ozyory district (near Belye Kolodezi village, ?1993), Kashira (1986); **Kaluga region**: Kaluga (1912/a), Krasnaya Gorodnya (mid–1930's/a), Tarusa (1954/a), Kozelsk district (Podborki village vicinities on the right bank of the Zhizdra River near the border of Tula region, 2002/a), Petrovskoye village (1929/a); **Tula region**: Tula (1920's/a), Mishnevo (1950–2000/a), Okorokovo (1950–2000/a), Cherepet (1950–2000/a), Orlovo (1950–2000/a), Selivanovo (1950–2000/a), Kosaya Gora (1950–2000/a), Yasnaya Polyana (1950–2000/a), Leninsky (1950–2000/a), Dalmatovka (1950–2000/a), Yegnyshevka (1950–2000/a), Velegozh (1950–2000/a), Khoroshevka (1950–2000/a), Komarki (1950–2000/a), Rassvet (1950–2000/a), Bolshoye Triznovo village vicinities, north from Krapivna (1950–2000/a), Yefremov district (south from Koltsovo, 1930's/a), Plavsk district (Molochnyye Dvory village, 1984/a); **Ivanovo region**: Yuzha district (Kholuy settlement, 1987/a); Pestyaki district (the Lugh River bank, Demidovo village vicinities, 1997/a); **Ryazan region**: Ryazan (1970/a), Ranenburg district (St. Kassatkina, 1900–1950), Dankov district (Gremyachka, 1930–60/a), Oksky Reserve (1990–2000/a), Shatsk district (Kashirino village, 1985–2000/a); **Mordoviya republic**: Mordovsky Reserve (1950–1990/a); **Tatarstan republic**: Kazan (1900–1950/a), Zelenodolsk district (Raifskoye Forestry, 1980–1995/a), Laishefsk district (Saralovskoye Forestry, 1995/a); **Nizhny Novgorod region**: Vetluga district (Kaksha River, 1950–80/a); **Ulyanovsk region**: Bolshoy Kuvay village vicinities, in a floodland wood on the Sura River bank (1967/a), Poljanki village (1950–1990/a), Inzenskiy district (Argash village, 1950–1990/a); **Voronezh region**: Ostrogozhsk district (Shubnoe village vicinities, 1963/a), Borisoglebsk and Tellerman forestry, 1970–1997/a); **Penza region**: Penza (1900–1950/a), Nizhnelomskiy district (3 km NW from Golitsino, 1999); **Samara region**: Zhigulyovsky Reserve (Bakhilova Polyana village vicinities, 1999/a); **Saratov region**: northwestern parts of the region near the borders of Voronezh, Tambov and Penza regions (1980–1995/a); **Bashkortostan republic**: Ufa district (1989/a), Birs (1918/a), Nagayevo village

Appendix. (Cont.)

(1988/a); **Voronezh region:** Ostrogzhsk district (Shubnoe village vicinities, 1963/a), Borisoglebsk and Tellerman forestry, 1970–1997/a); **Belgorod region:** reserve «Belorechiye», 1985–2002/a, vicinity of Valujki, 1975/a; **Chuvashiya republic:** Morgaushi district (Kadikasy village, 1900–1950/a), Shemursha district (Asanovo village vicinities (1900–1950/a), Transvolga, Cheboksary district (Kuvshinka, 1900–1950/a, Khyrkasy village vicinities, 1900–1950/a, Cheboksary city and its vicinities, 1960–1985/a, Proletarsky settlement vicinities, 1980–2000, Tokhmeyevo village vicinities, 1980–2000/a, Shomikovo village vicinities, 1980–2000/a), Novocheboksarsk city and its vicinities (1980–2000/a), Morgaushi district (Ilyinka village vicinities, 1980–2000); Shumerlya district (Lake Urgul vicinities, 1980–2000/a), Alatyr district (4.5 km SWW from Atrat village, 1980–2000/a, Ivankovo–Lenino village vicinities, 1980–2000/a, Alatyr vicinities, 1980–2000/a, across the river near Sursky Maydan village, 1980–2000/a, 7 km SE Ivankovo–Lenino village, 1980–2000/a, Mezhdurechye village, 1980–2000), Kozlovka district (village Kurochkin vicinities, 1980–2000), Yantikovo district (Indyrchi village vicinities, 1980–2000/a, Chuteyevo village vicinities, 1980–2000/a), Tsvilsk district (Taushkasy village vicinities, 1980–2000/a), Kanash city vicinities (1980–2000/a), Mariinsky Posad city (1980–2000/a), Mariinsky Posad district (8 km east from Novocheboksarsk city, 1980–2000/a), Mariinsky Posad district (Sotnikovo village vicinities, 1980–2000/a), Mariinsky Posad district (Yuryevka village vicinities, 1980–2000/a) Mariinsky Posad district (Anatkasy village vicinities, 1980–2000/a), Poretskoye village vicinities, across the Sura River (1980–2000/a); **Mari El republic:** the «prisurskikh» broad-leaved forests near the lake Tair (1991), flood-lands of the river of Bolshaya Kokshaga, lower Storozhilsk (2000), Gornomariysky district (Novaya Sloboda village vicinities, 1985–2002/a), Transvolga, 2 km south from Kokshamary (1985–2002); **Udmurtiya republic:** Vavozh district (Gulyayevskoye village, the Vala River floodland, 1990–2002/a, Vavozh village, the Vala River floodland, 1990–2002/a), Kizner district (Krymskaya Sludka village, the Vyatka River floodland, 1990–2002/a), Alnashi district (Kuzebayevoye village southern slope, 2002), Malaya Purga district (Malaya Purga village, the Postolka and the Izh common floodland (1990–2002/a), Izhevsk city (1960's); **Kirov region:** Kilmez district (Tautovo village, floodland in the Kilmez River valley, 1990–2000, Karmankino village, floodland near the mouth of the Vala, 1990–2000), Malmuzh (1900–1950); **Orenburg region:** Buzuluk district (Beloyarka vicinities, 1900–1950/a); **Krasnodar region:** Yeysk (1900–1950); **Adygeya republic:** Maykop region (1900–1950); **Stavropol region:** southern part of the region (1980–2000).

When time intervals are given it means that time for the last finding is uncertain. Based on data from specimens in museums (especially Zoological Museum of Moscow Lomonosov state University, Zoological Institute RAN in St. Petersburg) and private collections compiled in 1982–2002. There were about 200 specimens collected from 112 localities since 1870. Data also from literature: Ananyeva & Blinushov (2001), Anikin (1996), Baldaev (2002), Bolshakov & Dorofeev (2002), Borisovsky (2001), Kozlov & Oliger (1960), Krasnobayev et al. (1992), Krivokhatsky (2002), Lebedev (1906), Medvedev (1960), Muravickij & Kanitov (1995), Sigida (2002), Egorov (1994, 1995, 1996a, 1996b, 1996c, 1997, 1998a, 1998b, 1999, 2000a, 2000b, 2000c, 2001), Gusakov (unpubl. data) and Dedukhin (unpubl. data.)

Serbia and Montenegro

Serbia: Avala (1941), Fruška gora (year?), Kopaonik–Šanac (1956), Kragujevac (1948), Majdanpek (before 1956), Peč (1909), Rogot (1905), Ruma (year?), Valjevo (1963), Veliko Gradište (1956), Paraćin (1918), Zlatibor (1929); **Montenegro:** Radovič (1918), Sutorman (before 1956), Vu. a (1951), Glavati. i. fi (1977).

Based on literature (Mikšič, 1955, 1957; Sparacio, 2001).

Slovakia

(Recent records include a few specimens of both adults and larvae)

Banska Bystrica: Banska Bystrica town (1986); **Banska Stiavnica:** Banska Stiavnica town (1992); **Bratislava:** B–Petrzalka–Lido (1992–1993), B–Lamac (1995–2002), B – Raca (1995–2002), Devinska Kobyla (1995–2002), Kopac (1995–2002), Ivanka pri Dunaji (1995–2002), Jur pri Bratislave (1995–2002), NR Jursky Sur (1995–2002); **Dunajska Streda:** Gabčíkovo (1977), Dunajska Streda (1995–2002); **Galanta:** Galanta (1995–2002); **Krupina:** Krupina (1936), Dobra Niva (1995–1997); **Levice:** Batovce (1936), Kalna nad Hronom (1974, 1 spec. coll. Levice museum), Levice (1995–2002), Cajkov (1995–2002); **Lucenec:** Lucenec (1936), Filakovo (1994); **Malacky:** Plavecký Štvrtok (1990), Malacky

Appendix. (Cont.)

(1995–2002), surroundings of Morava river (1995–2002); **Nitra**: surroundings of Nitra (1990–1995); **Pezinok**: Pezinok (1995–2002), Modra (1995–2002), Pila (1995–2002); **Rimavska Sobota**: Rimavska Sobota (1994), Gemer (1936); **Sahy**: Plastovce (1995–2002); **Senec**: Senec (1995–2002); **Sladkovicovo**: Sladkovicovo (1995–2002), Puste Ulany (1995–2002); **Smolenice**: surrounding forests (1995–2002); **Solosnica**: Plavecke Podhradie (1995–2002), Plavecky hrad (1995–2002), Plavecky Mikulas (1995–2002), Prievaly (1995–2002); **Stupava**: (1995–2002); **Sturovo**: Muzla (1936), Kamenica nad Hronom (1995–2002); **Trencin**: Motesice (1936); **Velky Krtis**: Modry Kamen (1936).

Older records are based on the literature (Roubal, 1936), the latest records come from nine Slovakian entomologists. Especially Milan Strba has given much information.

Slovenia

Trenta (1967), Koper (1932), Trnovo ob So. i. (1990), Ajdovš. ina (1900), Kodreti (2003/a), Bohinj (1923), Bohinj (Ukanc, 1996/a), Bohinj (Rib. ev Laz, 1934, Voje valley, 1930, Bohinjska „ ešnjica, 1931), Nomenj (1877), Mojstrana (Kot, 1936), Radovljica (1886), Brezje pri Dobrovi (1980/a), Ljubljana (1953), Ljubljana–Tivoli (1991), Ljubljana–Mestni log (1890), Dragomelj (Lukovica pri Brezovici, 1988), Kamnik–Center (2000/r), Kamnik–Graben (1999/r), Zgornji Tuhinj (1957), Dolenjske Toplice (Soteska, 1912), Mokronog (1952), Rekštanj (1911), Bre. ice (1933), Kalobje (1927), Pod. etrek (1931), Gornja Radgona district (1875); **Records with no detailed locality given**: "Carniolia" (1763, 1866, 1911), "Steiermark" (1871).

Based on specimens in the Slovenian Museum of Natural History (PMSL) and collection of the Institute of Biology CSR SASA. The data were obtained also from literature (Scopoli, 1763; Siegel, 1866; Brancsik, 1871; Martinek, 1875; Mikšif, 1955) and personal communications with several entomologists.

Spain

Álava: Heredia (2001); **Barcelona**: Macizo del Montseny (1945); **Cantabria**: Camaleño (Llaves, 1996); **Gerona**: mentioned for the province without giving any specific locality; **Huesca**: Valle de Ansó (1983), Valle de Hecho (1982), San Juan de la Peña (1960); **León**: Soto de Sajambre (1980); **Lérida**: Valle de Arán (1962); **Navarra**: Andía, Aralar, Valle de Lana, Valle de Santesteban, Regata del Bidasoa; **La Rioja**: Villoslada de Cameros; **Guipuzcoa**: Aralar Natural Park near Beasain (Ezkalusoro, 2003/a).

Based on literature (Montada Brunet, 1946; Baguena Corella, 1967; Galante & Verdú, 2000; Bahillo de la Puebla et al., 2002; Ugarte San Vicente & Ugarte Arrue, 2002; San Martín et al., 2001; Martínez de Murguía et al., 2003).

Sweden

Blekinge: **Karlshamn**: Stensnäs (1997/a), Tärnö (2001/e); **Karlskrona**: Agdatorp (1998/e), Arpö (1997/a), Gullberna (1997/a), Haglö (2000/a), Karlskrona stad (2000/e), Lorentsberg (2000/a), Lyckeby ekbacke (2000/a), Kummelns gravfält, Augerum (1998/a), Marielund (2000/e), Stora Boråkra (1997/e), Stora Vörta, Skärva NR (1998/a), Verkö (2001/a); **Ronneby**: Almö (1995/a), Aspan (1997/r), Blötö (1998/r), Förkärla–Vambåsa (1998/r), Grindstugan (2001/a), Göhalvön (1998/a), Kvalmsö (1998/e), Vångsö (1997/e), Hundsjö (1997/e), Johannishus–åsarne (2001/a), Slädö (1998/a), Tromtö (2001/a), Östra Råholmen (2000/r), Vagnö (1998/a), Vambåsanäs (2001/a), Vermansnäs (1998/a); **Sölvesborg**: Valje halvö (1998/a). **Halland**: **Kungsbacka**: Börsås, Rossared (1999/a); **Laholm**: Hasslöv (1758/a); **Jönköpings län**: **Tranås**: Ekberget, Tranås (1998/e), Näs, Valen (1998/e), Åbonäs (1998/e), Botorp at Noen (1997/a); **Kalmar**: **Borgholm**: Böda prästgård (1995/e), Halltorps hage (1997/a), Högsrum, Ekerum (1940/a); **Emmaboda**: Vissefjärda kyrkby (1999/a); **Högsby**: Barnebo–Böta kvarns area (1999/a), Fagerhults prästgård (1999/r), Flaspölerum (1999/a), Hultsnäs inäga, Hornsö kronopark (2001/r), Hornsö (Hundströmmen–Strömsholm) (2001/r), Långemåla kyrka (1999/a), Långemåla (Ruda lund–Åsebo) (1999/a), Sjötorp, Hornsö (2000/a), Ullefors, Hornsö (2001/r), Värlebo (1999), Sadeshult (2000/e); **Kalmar**: Björnö (1995/a), Halltorp (1947), Kristinelund (1996/e), Lindö (1996/a), Värnanäs (1996/e), Värnsnäs (2000/a); **Nybro**: Madesjö area (1999/a), Nygård–Koppekull (2000/r); **Oskarshamn**: Oskarshamn (1997/r); **Mönsterås**: Ems herrgård (1995/a), Strömserum (1997/a), Södra Skärshult (1995/a); **Västervik**: Sandvik–Lövvik (1998/e), Forsby (1998), Ankarsrums säteri

Appendix. (Cont.)

(1997/a), Blekhem (1997/e), Dynestad (1998/a), Garpedansberget, Gamleby (1998), Vinäs, SE from Ukna (1998/e), Grundemar (1997/r), Gränsö (1997/a), Hammarbadet, Gamleby (1997/e), Helgerums slott (1997/a), Hjortkullen (1998/e), Hummelstad gård (1997/r), Kasimirsborg, Gamleby (1997/a), Norringe, Odensviholm (1997/a), Piperskärr, Gränsö (1998/a), Holmhult, Rånestad (1997/a), Stjärneborg, Blankaholm (1998/e), Värnvik, Segersgårde (1997/e); **Kronoberg: Ljungby:** Toftaholm (1998/a), Engaholms gods (1996/r), Hovmantorps säteri (2000/a), Byvärma (1987/e), Yxkullund (1997/a); **Skåne: Båstad:** Hallands Väderö (2002/a); **Eslöv:** Vedelsbäck, Stehag (1897/a); **Hässleholm:** Mölleröds kungsgård (1998/e), Sörbytorp (1998/a); **Hörby:** Fulltofta (1995/r); **Höör:** Bosjöklöster (1994/r); **Klippan:** Herrevadsklöster (1850/r); **Kristiansstad:** Hanaskog (1998/a), Torsebro (1998/a), Vanås gods (1998/a), Trolle-Ljungby (1881); **Lund:** Degerberga gård, SV Hækkeberga (1998/a); **Simrishamn:** Esperöd (1860/a); **Sjöbo:** Bellinga gods (1970's/a, 1998/e), Övedsklöster (1998/a); **Svedala:** Kråkenäs, Torup (1998/r); **Tomelilla:** Örup (1936/a); **Stockholm:** **Värmdö:** Ståksjön, Gustafsberg å Werdön (1884/a); **Södermanland: Flen:** Lagmansö (1998/a), Sparreholm (1996/a), Mjälby kvarn (1994/a), Tuna (1995/a); **Strängnäs:** Aspö (2001/a); Harpsund (2001/a), Hjorthagen, Gripsholm (1997/a), Strängnäs (a); **Gnesta:** Herröknanäs (1997/a); **Nyköping:** Djurgården, Åboö at Båven (1997/r); **Uppsala: Enköping:** Fånö (2000/e), Hacksta, Sävsta äng (2000/r), Sissshammarsviken (1998/e), Strömsta (2001/r); **Håbo:** Hjulsta säteri (1996/a), Biskops Arnö (2002/a); **Uppsala:** Viks slott, Balingsta (2001/r); **Västmanland: Hallstahammar:** Billingen, Strömsholm (1960's/a), Österängen, Strömsholm (1997/r), Tidö slott (1960's/a); **Kungsör:** Kungsör (1996/r); **Västerås:** Fullerö (1969/a), Ryttern (1952/r), Ängsö slott (2000/r); **Västra Götaland: Alingsås:** Alingsås (1884), Vikaryd (1996/e), Östad (2001/r); **Borås:** Backa NR, Ljushult (1996/r); **Götene:** Hjälsäter, Kinnekulle (1997/r), Munkängarna, Kinnekulle (1997/r); **Härryda:** Råda säteri (1978/r); **Lerum:** Gullringsbo, Aspens station (1998/a), Lerum (1999/a), Nääs, Öjared and Kärrbogårde (1998/a), Östra Öjared, (1996/r); **Skara:** Öglunda (a); **Skövde:** Lilla Kulhult, Lerdala (1997/r), Lerdala gård (1997/e), Sparresäter (1995/r); **Tanum:** Krageröd (1996/a); **Tranemo:** Hofsnäs-Torpa (1998/a), Långhem (1955/a); **Trollhättan:** Häggsjöyr (1996/r); **Uddevalla:** Gullmarsbergs säteri (1996/r); **Vänersborg:** Fristorps Gransjö, Hunneberg (1996/r), Storeklev, Hunneberg (1996/e), Västra Tunhem (1995/a); **Örebro: Hallsberg:** Broby äng (2000/a), Geråsen, Viby (1998/r), Nalaviberg (1996/a), Värnsta (1998/a), Ekåsen, Bärstad (1996/a); **Lekeberg:** Trystorps ekäng (1998/r); **Östergötland: Boxholm:** Boxholms säteri 2000/e), Lagnebrunna (1997/r), near Svartån-Lillån (2000/e); **Finspång:** Ekön (1998/a); **Kinda:** Västra Eneby (1997/a), Söderö (1996/a), Kisa (1931/a), Kleven, south from Ämmern (2000/r), Vada (1996/a), Kopperarp (1997/e), Stormtorna and Väsby, Oppeby (1996/a), Norrö (1996/a), Valla and Aska, Hägerstad (1996/a), Ryttaesten, Medelö (1996/a), Råsö (1996/a), Räckeskog, Hamra and Bällinge (1997/a), Röberga (1996/r), Sommenäs ekängar (1934/a), Tempelkullen (2002/a); **Linköping:** Smedstad (1996/a), Bestorp (1949/a), Bjärka-Säby (1998/a), Brokinds skola (1998/a), Gunnarsbo (1994/e), Kvillabro (1995/e), Labbenäs, Stafsäter (1995/a), Sätra, Götörp and Mårstorp) (1998/a), Norrhagen, Örtomta (1997/e), Norrängen, Bestorp (1998/e), Ringetorp (1990/e), Skaggebo (1998/a), Skeda (1952/a), Sturefors (1998/a), Sveden, Landeryd (1999/a), Tinnerö (1997/a), Tomåla (1990/e), Vårdsnäs (1995/a); **Mjölby:** Solberga (1995/a); **Norrköping:** Borg (1996/a), Ryttaoretörpet (1997/e), Bråborg (1995/a), Roteberg (1997/e), Kimstad (1997/e), Stora Runken (1997/e), Händelö (1995/a), Hästö, Arkö (1990/a), Norrköping (Ingelsta, Vilhelmsberg) (1997/a), Norrköping (Ektorp, Fiskeby and Leonardsberg) (1995/e), Jämjö (1999/e), Krusenhov (1998/a), Kvillinge (1997/e), Ljusfors, Skärblacka (1996/a), Löfstad slott (2000/a), Mauritzberg (1997/e), Malmölandet (2001/a), Mem (1890/a), Viaborg (1997/e), Norsholm (1996/a), Ravsnäs (1999/a), Rundstorp (1997/a), Almstad, Tingstad (1997/e), Ugglö, Kättinge (1997/e), Ågelsjön (2001/e), Asplången (1997/e); **Söderköping:** Djursö (1997/a), Drothem (1952/e), Eknön (1997/a), Gäverstad (1999/r), Jätteberget (1998/e), Korsnäs (1998/a), Ramsdalskorset (1997/e), Torönsborg (1956/a), Simpholmen (2002/r), Stegeborg (1998/a), Ängelholms gods (1997/a); **Valdemarsvik:** Breviksnäs (1995/e), Ekeberga, Östra Ed (1997/e), Fyllingarum (1997/e), Fågelvik, Finntorps borgruin (1997/a), Gryt (1997/e), Gusum (19th century/a), Harsbo-Sverkersholm (1997/a), Kvädö-Åsvikelandet (2002/r); **Ydre:** Rosebo, Torpön (1997/a), Smedstorp (1997/e), Sund (1996/a), Torpa (1997/a); **Åtvidaberg:** Bredal, Hannäs (1997/r), Ekhult-Skårdala (1997/a), Hägerstad slott (1997/a), Orräng (1995/a), Torp (1996/a), Åtvidaberg (Adelsnäs, Slefringe and Åtvidsnäs) (1997/a), Östantorp, Yxnerum (1997/e); **Ödeshög:** Älvarums udde, Omberg (1994/a, 1997/r).

Based on a recent publication (Antonsson et al., 2003) which collects data from field inventories, literature, specimens in Swedish museums and personal communication.

Appendix. (Cont.)

Switzerland

Basel–Landschaft: Allschwil (1960); **Basel–Stadt:** Basel (1847); **Bern:** Siselen; **Fribourg:** Fribourg (1935), **Genève:** Chêne–Bougeries (1906), Chêne–Bourg (1916), Collonge–Bellerive (1947), Dardagny (1961), Compesières near Genève, Malagnou near Genève (1956), Cologny near Genève (1918), Jussy, Plan les Ouates, Vernier (1921); **Graubünden:** Campascio near Brusio (1998), Chur (1864); **Schaffhausen:** Neuhausen–Rheinfall; **Solothurn:** Solothurn (2002), Langendorf (1967); **St. Gallen:** St. Gallen (before 1870), Sargans (before 1870), Werdenberg (before 1870); **Ticino:** Chiasso (1907), Lugano, Sonogno (1967); **Vaud:** Lausanne, Commugny (1947), Cudrefin, Gimel, Ollon (1887); **Valais:** Valère near Sion (1855), Brig–Glis; **Zürich:** Sihlfeld near Zürich (1862), Bülach (1893), Zürich (1919).

Based on data from the specimens in Switzerland's museums and many private collections. There have been no more than 80 specimens collected in Switzerland during the last 150 years.

Turkey

Edirne İli: KeĀan (1994/a).

Ukraine

Chernihiv region: Khlopianyky (year?), Kozlianychi (2003), Novi Mlyny (1987), Yaduty (2001); **Donec'k region:** Donec'k (1935), Slovianohors'k (2003); **Ivano–Frankivs'k region:** Kolomyia (before 1900), Kolomyia (year?), Kosiv (year?); **Kharkiv region:** Merefa (1957); **Khmel'nyts'kyi region:** Kamianec'–Podil's'kyi (1995); **L'viv region:** Hordynia near Sambir (1933), L'viv (before 1914), Mostys'ka (1883), Sambir (before 1900), Zavadivka near Sambir (1933).; **Odesa region:** near Kiliia (2003); **Ternopil' region:** Berezhany (1933), Ivankiv (1907), Kulachkivci (year?), Skala–Podil's'ka (1906), Ternopil' (before 1900), Ustia Zelene (1930's), Zalishchyky; **Zakarpats'ka region:** Kuzij near Dilove (2000).

Based on literature data, specimens in Ukrainian and Polish museums and personal communications.