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FORUM

When a threatened species becomes a threat: a key to reading the Habitats Directive based on occurrence and distribution of *Cerambyx cerdo* L. in Mediterranean urban and peri-urban areas

ROBERTO MANNU,[1] LUIS M. TORRES-VILA,[2] MAURIZIO OLIVIERI[1] and ANDREA LENTINI[1] [1]Università degli Studi di Sassari, Sassari and [2]Servicio de Sanidad Vegetal, Consejería de Agricultura DRPyT, Junta de Extremadura, Badajoz, Spain

Abstract. 1. *Cerambyx cerdo* is a large saproxylic species included in the Annex IV of the European Habitats Directive as a 'priority species'.

2. Although *C. cerdo* populations have shown a significant decline in size and distribution in central and northern European forests, in the Mediterranean basin it is often considered as a pest in urban and peri-urban areas.

3. Based on European legislations currently in use, we propose a simplified decision-making flowchart that should be followed regarding the adoption of different control measures against severe *C. cerdo* infestations.

Key words. Conservation biology, EU Habitats Directive, Great Capricorn beetle, IPM.

Introduction

Cerambyx cerdo L. (Coleoptera Cerambycidae), commonly known as the great capricorn beetle (GCB), is a large and emblematic saproxylic longhorn species, generally associated, but not exclusively, with decaying oaks and other forest trees (Torres-Vila, 2017; De Zan *et al*., 2017). GCB larvae need living and fresh wood to feed on and properly develop. Mated females wander over the host tree probing the bark with the ovipositor and lay up to more than 300 eggs individually into suitable bark crevices and pruning wounds. After hatching, larvae initiate feeding under the bark and then move towards the inner wood from about the second year. Larvae growth during 2–3 (4) years and when complete their development, mature larvae tunnel outwards, build a pupal cell closed by a calcareous plug and pupate inside. About 1 month after pupation, in late summer or early autumn, adults emerge, but they remain inside the pupal cells throughout the winter in a reproductive stage until the following season. Adults leave the host tree from May to August depending on local climatic conditions, altitude and latitude. Adults emerge from the host trees through 15–20 mm ellipsoid-shaped exit holes on the bark, often producing abundant frass (Neumann, 1985; Bense, 1995; Horák *et al*., 2010; Torres-Vila, 2017; De Zan *et al*., 2017).

Correspondence: Roberto Mannu, Università degli Studi di Sassari, Sassari. E-mail: rmannu@uniss.it

GCB populations have shown a significant decline and fragmentation in population size and distribution throughout central and northern European forest habitats, mainly due to a continuous loss of old trees, which are the main resource for GCB development (Buse *et al*., 2008, De Zan *et al*., 2017). This is of particular interest especially in open and semi-open woodlands, where GCB populations are strongly connected with other highly endangered saproxylic species, given its important role as ecosystem engineer (Buse *et al*., 2008; Casula *et al*., 2021). In fact, trees colonised by GCB generally survive over long periods, still leading to an increase of dead wood where other secondary saproxylic insects take advantage. Moreover, larval galleries and subsequent tree hollows, which extend outward, represent a crucial niche for other endangered insect species such as *Osmoderma eremita* (Coleoptera, Scarabaeidae) (Ranius & Nilsson 1997, Buse *et al*., 2007), and are also important shelters for many other larger animals, including reptile, birds and mammals (Grove, 2002; Buse *et al*., 2008; Gottfried *et al*., 2019).

In order to limit its decline, GCB was early included in the appendix II of the Bern Convention (Council of Europe, 1979) as a strictly protected species, and then in the Annexes II and IV of the European Union's Council Directive 92/43/EEC (1992) (the so-called Habitats Directive). According to the Red List of Threatened Species made by the International Union for Conservation of Nature (IUCN) (IUCN, 2020), GCB is currently recognised as 'Vulnerable' worldwide and 'Near threatened' in Europe (Horák *et al*., 2010), so that several national and regional

regulations were issued as well (Torres-Vila, 2017). The Habitats Directive represents the core strategy of conservation in Europe: it indicates guidelines to ensure biodiversity through specific measures with the aim of maintaining and restoring natural habitats, including wild fauna and flora populations. For this reason, the Natura 2000 network was implemented throughout European countries to develop '*a coherent European ecological network of special areas of conservation*'. Following the Habitats Directive, specific measures of conservation should be applied in natural habitats recognised as '*terrestrial or aquatic areas distinguished by geographical*, *abiotic and biotic features*, *whether entirely natural or semi-natural*'. However, the Habitats Directive contains no explicit information concerning conservation measures or management of threatened species in artificial habitats like urban areas. This is a critical issue because parks, gardens, avenues, roadsides and other 'unnatural' places can have old and sun-exposed trees, which are important hosts for saproxylic species (Carpaneto *et al*., 2010).

Holm oak (*Quercus ilex* L.), which is one of the main host species for GCB (Buse *et al*., 2008; Casula, 2017; De Zan *et al*., 2017), is an evergreen broadleaf species widely distributed over the Mediterranean basin. It grows naturally in pure and mixed woodlands, but it is sometimes also used as urban tree in Mediterranean cities. In such locations, where the anthropic conditions may modify the natural insect–tree interactions, wood boring beetles can strongly compromise both tree health and stability. When GCB populations are large, initial tunnelling activity of small larvae into the cambium and xylem can alter sap flow and trigger wilting, die-back, leaf fall, vigor loss and tree decay. As the larvae grow, they bore increasingly wider and longer galleries into the inner wood and may cause huge physiological, mechanical and structural damage (Torres-Vila, 2017). Emergence holes made by GCB adults can act also as entryways for several fungal and bacterial oak pathogens, further complicating the survival of affected trees (Soria *et al*., 1996; Martín *et al*., 2005).

A list of reported cases of damage caused by *Cerambyx* spp., especially *C. cerdo*, to various species of oak trees in urban and peri-urban contexts is given in Table 1. In addition to tree deterioration and, often, loss of valuable ornamental oaks, trees damaged by GCB can endanger the safety of citizens, as main branches or trunks can fall suddenly with the wind. Although GCB is subject to strict protection also outside Natura 2000 network, being included in the Annex IV of the European Habitats Directive as a 'priority species', actions aimed to reduce the risk GCB can cause to human health and public safety could be conducted (article 6 of the Habitats Directive). It is important to consider that GCB could become a major threat to trees in urban and peri-urban environments where potential hosts occur, including roadsides, gardens and parks. The same could happen to monumental trees protected by their age, morphology, beauty, botanical, historical, cultural, folkloric or religious values, even though these trees are not found in urban spaces. In general, standard insecticide applications against GBC are not carried out in urban areas for logistic, practical or safety reasons. In fact, pruning of attacked branches together with closure of public spaces in windy or snow weather are the methods normally used to reduce the risks derived from falling of damaged tree parts.

The situation described so far is the cause of a number of conflicts between people and public administrations and very often between different administrations (Table 1), as there is an underlying legislative and ethical dilemma: to protect the tree or to protect the beetle. Therefore, public administrations often wonder whether certain control and management measures against GCB can be applied in compliance with the principles of both the Habitats Directive and the indications of the IUCN Red List of Threatened Species. In order to respond readily to this question, we propose a simplified decision-making flowchart (Fig. 1) representing a key to reading the European legislation and other indications that should be followed regarding the adoption of different control measures against severe GCB infestations.

Decision-making approach to manage GCB infestations in urban and peri-urban areas

Activities made by a public administration must always consider whether the area to be controlled covers the Natura 2000 network or not (Fig. 1). Based on the Habitats Directive, if an area or site is included in the Natura 2000 network, intervention measures negatively affecting conservation and biodiversity cannot be adopted. Differently, if an area or site is not included in this network, the adoption of intervention measures can be considered, depending the evaluation of the presence of threatened and endangered species and on the risk to public safety. Therefore, outside the Natura 2000 network, after a preliminary assessment of the species present, no intervention measures can be applied in case of occurrence of organisms included in both the Habitats Directive and the IUCN Red List as threatened or endangered species with limited distribution areas and decreasing populations. To date, the IUCN Red List of Threatened species represents the most effective conservation proposal listing and ranking system throughout European countries, especially because species are listed considering quantitative criteria rather than qualitative ones. This issue is of primary interest because GCB can have a different conservation status, depending on the geographical area, being considered as 'Near threatened' species in central-northern Europe and 'Least concern' species in Mediterranean areas (Horák *et al*., 2010). However, whatever the conservation status, GCB damages could be controlled with methods based on integrated pest management (IPM) when a high risk for human safety occurs (article 6 of the Habitats Directive). The latter statement allows public administrations to consider control measures against GCB infestations occurring in urban and peri-urban areas, where colonised trees might represent a significant threat to citizens. Recognition of GCB colonised trees is relatively simple by detecting the presence of the typical oval exit holes on the trunk and main branches. These holes can persist over many years or even decades, but typical signs of GCB recent activity are wood frass and fresh holes with red-colored interior sides (Buse *et al*., 2007; Torres-Vila *et al*., 2017). However, if the occurrence of another large wood-boring beetle is suspected, GCB identity must be confirmed because exit holes are not species specific (Torres-Vila *et al*., 2017). This scenario is usual, for instance, in those

Table 1. A non-exhaustive list of cases of *Cerambyx* spp. damages reported in urban and peri-urban areas (including monumental trees) from 2008 to 2020 in southern Europe, in which conflicts between individuals and/or public administrations derived from the Habitats Directive application were detected or suspected.

Year	Site	Municipality	Province	Country	Host species	Tree number	Species*	Source
2008	San Martín (Cajigal del Carmen)	Santiurde de Toranzo	Santander	Spain	*Quercus faginea*	Several	Cc	https://www.eldiariomontanes.es/20081014/region/santiurde-toranzo/gobierno-saneara-robledal-pero-20081014.html
2010	Santa Maria	Civitanova Marche	Macerata	Italy	*Quercus Ilex*	Several	[Cc]	https://m.cronachemaceratesi.it/2010/08/23/albero-crollato-sopra-un-ragazzo-ora-a-civitanova-si-iniziano-ad-abbattere-le-piante-malate/40613/
2011	La Herguijuela de doña Blanca (Alcornoque El Abuelo)	Toril	Cáceres	Spain	*Quercus suber*	Single	Cw Cc	https://www.elperiodicoextremadura.com/noticias/extremadura/el-abuelo-muere-quinientos-anos_625188.html
2012	Ca n'Oriol (Roure de Ca n'Oriol)	Rubí	Barcelona	Spain	*Quercus pubescens*	Single	Cc	https://www.rubi.cat/es/ayuntamiento/comunicacion/sala-de-prensa/notas/el-ayuntamiento-de-rubi-y-la-generalitat
2012	Valcorchero	Plasencia	Cáceres	Spain	*Quercus suber*	Several	Cc Cw	https://www.hoy.es/v/20121029/plasencia/seca-avanza-amenaza-alcornocal-20121029.html
2014	A Carballeira	Caldas de Reis	Pontevedra	Spain	*Quercus robur*	Several	Cc	https://www.diariodepontevedra.es/articulo/noticias/priorizaran-la-carballeira-ante-la-plaga-de-insectos-de-una-especie-protegida/20140111214500243312.html
2014	Villa Fondi	Piano di Sorrento	Naples	Italy	*Quercus Ilex*	Several	Cc	http://www.comune.pianodisorrento.na.it/it/news/alberi-di-villa-fondi-e-riorganizzazione-degli-spazi-verde
2014	Viale Colombo, Viale Marconi	Quartu Sant' Elena	Cagliari (Sardinia)	Italy	*Quercus ilex*, *Quercus sp.*	Several	[Cc]	https://www.castedduonline.it/il-coleottero-che-uccide-gli-alberi-di-quartu-striscia-la-notizia-ce/
2015	Santa Mariña de Augas Santas (Carballo de Santa Mariña)	Allariz	Ourense	Spain	*Quercus robur*	Single	[Cc]	https://www.laregion.es/articulo/provincia/propuesta-proteger-carballo-santa-marina/20150227122412527127.html
2015	Constanza	Maside	Ourense	Spain	*Quercus robur?*	Single	Cw [Cc]	https://www.laregion.es/articulo/o-carballinho/escarabajo-antes-arbol/20151230084703590466.html
2015	Somogil	Moratalla	Murcia	Spain	*Quercus faginea*	Single	Cc	https://arbolesmonumentalestudmiria.blogspot.com/2015/11/roble-de-somogil-moratalla.html?m=1
2016	Mourente (Carballo de Santa Margarida)	Mourente	Pontevedra	Spain	*Quercus robur*	Single	Cc	https://www.lavozdegalicia.es/noticia/pontevedra/pontevedra/2016/07/15/carballo-santa-margarita-pasando-bien/0003_201607P15C4991.htm
2016	Serra de Tramuntana	several	Mallorca (Illes Balears)	Spain	*Quercus Ilex*	Several	Cc	https://www.mallorcadiario.com/lucha-contra-el-escarabajo-banyarriquer-en-mallorca
2016	San Pietro in Cerro (Quercia de San Pietro in Cerro)	San Pietro in Cerro	Piacenza	Italy	*Quercus robur*	Single	Cc	http://www.baronerampante.it/intervento-quercia-pietro/
2016	Marais de Bruges	Bruges	Gironde	France	*Quercus robur*	Several	Cc	https://www.google.com/url?q=http://www.gironde.gouv.fr/content/download/29724/213455/file/RNN-Marais-Bruges_Gd-Capricorne.pdf&usg=AFQjCNFiPb-YbhupPi-6tVd0TNCKyLgWgw

(continued)

Table 1. (continued)

Year	Site	Municipality	Province	Country	Host species	Tree number	Species*	Source
2018	Parco La Mandria	Venaria Reale	Torino	Italy	*Quercus robur*	Several	Cc	http://www.alcedonatura.it/il-cerambice-della-quercia/
2020	Villa Borghese	Roma	Roma	Italy	*Quercus ilex*, *Quercus sp.*	Several	Cc	https://amp.romatoday.it/green/villa-borghese-lecci-malati-tronchi-scavati-.html
2020	Landes de Breslon (Chêne de Breslond)	Pléchâtel	Ille-et-Vilaine	France	*Quercus petraea*	Single	Cc	https://www.ouest-france.fr/bretagne/plechatel-35470/pres-de-rennes-un-chene-vieux-de-400-ans-perd-une-branche-de-23-metres-6929189
2020	Via Mameli	Pistoia	Pistoia	Italy	*Quercus robur*	Several	Cc	http://www.valdinievoleoggi.it/a87197-via-mameli-inizia-la-riqualificazione-con-nuove-alberature-prevista-anche-un-area-sgambatura-cani.html

Reported cases are listed following chronological occurrence.
*Cc: Cerambyx cerdo, Cw: Cerambyx welensii. Species membership suspected or inferred, but not specified in the source, is given in brackets.

ecosystems where *C. cerdo* coexists sympatrically with its congeneric *Cerambyx welensii* Küster (Torres-Vila & Bonal, 2019).

After having ascertained the presence of the target insect and the possibility of adopting control measures, a visual tree assessment (VTA) procedure or other risk assessment methods (i.e. sonic tomography) should be implemented to evaluate the risk for public safety due to tree infestation. Following Mattheck and Breloer (1994) and Carpaneto *et al.* (2010), risk assessment might lead to the classification of different levels of falling risk category (FRC), indicating a status of an infested tree that ranges from 'no risk' to 'high risk'. No maintenance procedures are needed when a low or absent risk to public health is revealed, and interventions should be done exclusively when the risk exceeds the preset threshold. Measures to be performed must firstly consider low-impact control actions such as pruning and removing part of the trees highly attacked by GCB. Management of natural enemies such as the egg parasitoid *Oobius rudnevi* (Nowicki) could also be potentially effective in some situations (Torres-Vila & Fusu, 2020; Torres-Vila *et al*., 2021). These interventions normally lead to a significant decrease in GCB infestations and reduce drastically the risk of potential damage to citizens by falling branches. The use of traps baited with a mixture of vinegar, wine, beer and/or fruit during the GCB flight period is often recommended for monitoring purposes (De Zan *et al*., 2017) and can be taken into account to collect adults alive in order to transfer them onto other areas as well. This approach, although difficult to be implemented in some urban areas, could allow to estimate GCB population density and reduce at the same time the adult population size (Torres-Vila *et al*., 2012). The use of food-baited traps, which is the only effective method for trapping GCB adults due to the lack of species-specific long-range sex pheromones, could be considered mainly in some restricted areas (e.g. private parks and gardens) for some general, as well as technical, limitations. In fact, non-lethal trapping of GCB involves a daily check to avoid any injury or death of the individuals collected (De Zan *et al*., 2017), being particularly time and cost consuming for public administrations. Moreover, in roadsides and other public areas commonly frequented by citizens, traps placed on trunks and branches are easily visible and approachable by visitors, causing potential interferences even when they are located as hidden as possible within the canopy. Basically, all these potential control/management methods could be insufficient at high densities of GCB and, in the most critical situations, the use of low-impact insecticides might be necessary. On the basis of GCB biology and larval development, insecticide application could be carried out by endotherapic treatments, which should be applied in an IPM approach together with appropriate cultural techniques (e.g., optimal tree growing conditions, smart pruning, and insecticide application immediately after GCB egg laying) to maximise benefits. Endotherapic treatments (i.e., injection of systemic insecticides into the trunks) have been suggested as an effective, environment-friendly and environmentally safe method against pests, with a significant reduction in pesticide losses to the environment. Although no species-specific data are

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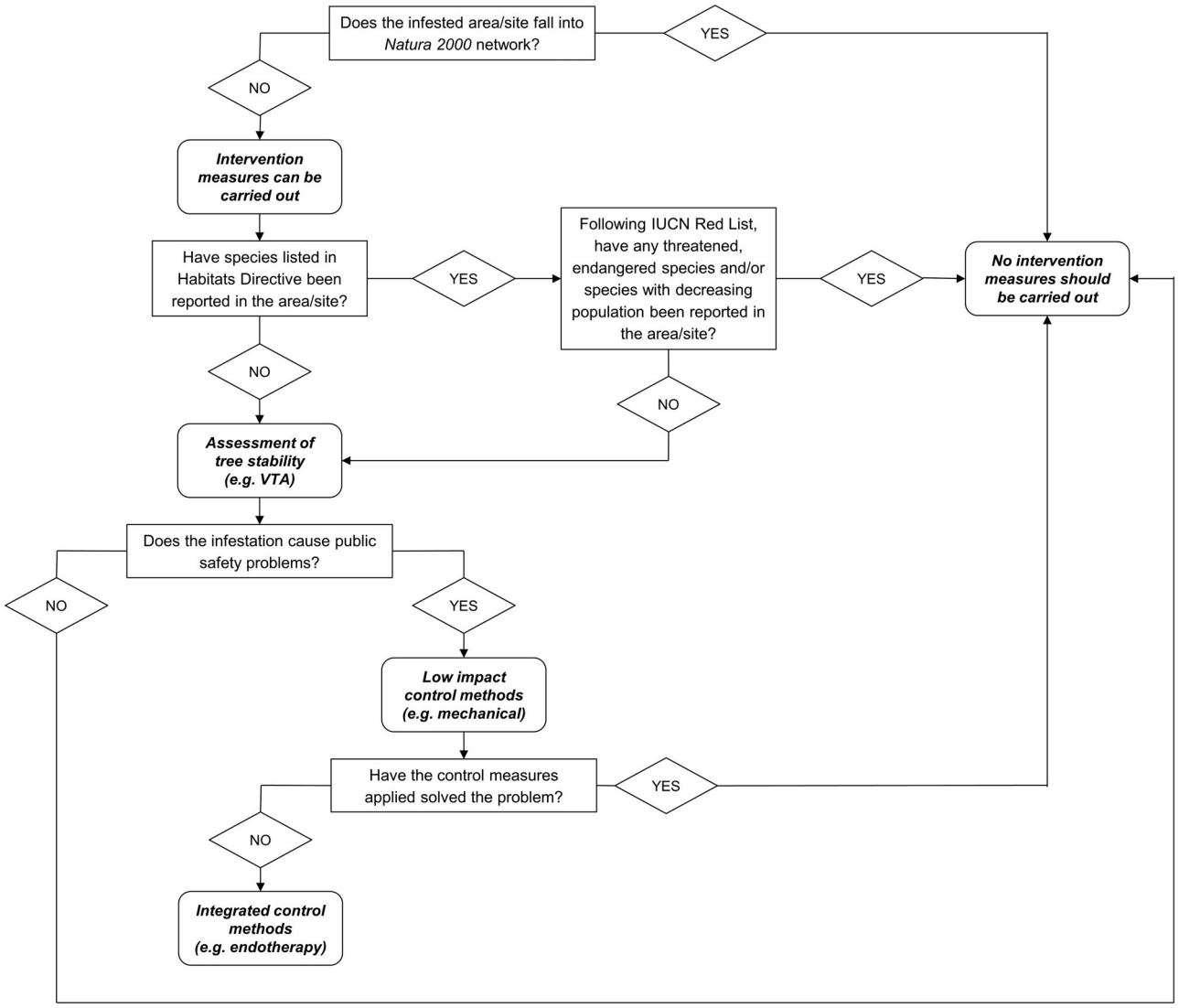

Fig 1. Simplified decision-making flowchart based on European legislation (e.g. European Habitats Directive) and IUCN Red List of threatened species for the application of control measures against *Cerambyx cerdo* in urban and peri-urban areas (including monumental trees)

available, endotherapy might be useful to control GCB larvae feeding under the bark, as already reported for other longhorn beetles infesting trees in urban areas (Maspero *et al*., 2006; Sarto i Monteys & Torras i Tutusaus, 2018).

Conclusions

Our key to reading the European Habitats Directive and, possibly, other European legislations must not neglect that conservation of vulnerable and endangered species must be of primary interest in all areas, including urban and peri-urban ones, where limited populations are recognised. However, attention to species like GCB must always consider its potential role as a pest in Mediterranean ecosystems. In areas where a risk for conservation of a threatened species does not occur, selected measures against GCB could be considered to manage damaging populations, preserving the trees and reducing the potential risk for citizens. Additionally, our indications evidence the urgent necessity to revise and update the regulations currently in use, mainly because they do not take into account the different needs for species conservation in geographically and ecologically different European regions and countries.

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Conflict of interest

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study

References

Bense, U. (1995) Longhorn Beetles: Illustrated Key to the Cerambycidae and Vesperidae of Europe. Margraf Publishers GmbH, Weikersheim.

Buse, J., Ranius, T. & Assmann, T. (2008) An endangered longhorn beetle associated with old oaks and its possible role as an ecosystem engineer. *Conservation Biology*, **22**, 329–337. https://doi.org/10.1111/j.1523-1739.2007.00880.x.

Buse, J., Schröder, B. & Assmann, T. (2007) Modelling habitat and spatial distribution of an endangered longhorn beetle - a case study for saproxylic insect conservation. *Biological Conservation*, **137**, 372–381. https://doi.org/10.1016/j.biocon.2007.02.025.

Carpaneto, G.M., Mazziotta, A., Coletti, G., Luiselli, L. & Audisio, P. (2010) Conflict between insect conservation and public safety: the case study of a saproxylic beetle (*Osmoderma eremita*) in urban parks. *Journal of Insect Conservation*, **14**, 555–565.

Casula, P. (2017) Monitoring and management of *Cerambyx cerdo* in the Mediterranean region – a review and the potential role of citizen science. *Nature Conservation*, **19**, 97–110. https://doi.org/10.3897/natureconservation.19.12637.

Casula, P., Fantini, S., Fenu, G., Fois, M., Calvia, G. & Bacchetta, G. (2021) Positive interactions between great longhorn beetles and forest structure. *Forest Ecology and Management*, **486**, 118981. https://doi.org/10.1016/j.foreco.2021.118981.

Council of Europe. (1979) Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979). <https://rm.coe.int/1680078aff> 1st June 2021.

De Zan, L.R., Bardiani, M., Antonini, G., Campanaro, A., Chiari, S., Mancini, E., Maura, M., Sabatelli, S., Solano, E., Zauli, A., Sabbatini Peverieri, G. & Roversi, P.F. (2017) Guidelines for the monitoring of *Cerambyx cerdo*. *Nature Conservation*, **20**, 129–164. https://doi.org/10.3897/natureconservation.20.12703.

Gottfried, I., Gottfried, T. & Zając, K. (2019) Bats use larval galleries of the endangered beetle *Cerambyx cerdo* as hibernation sites. *Mammalian Biology*, **95**, 31–34. https://doi.org/10.1016/j.mambio.2019.01.002.

Grove, S.J. (2002) Saproxylic insect ecology and the sustainable management of forests. *Annual Review of Ecology and Systematics*, **33**, 1–23. https://doi.org/10.1146/annurev.ecolsys.33.010802.150507.

Horák, J., Büche, B., Dodelin, B., Alexander, K., Schlaghamersky, J., Mason, F., Istrate, P. & Méndez, M. (2010) *Cerambyx cerdo*. The IUCN Red List of Threatened Species 2010: e.T4166A10502932 (21st April 2021)

IUCN. (2020) The IUCN Red List of Threatened Species. Version 2020-2. <https://www.iucnredlist.org> 21st April 2021

Martín, J., Cabezas, J., Buyolo, T. & Patón, D. (2005) The relationship between *Cerambyx* spp. damage and subsequent *Biscogniauxia mediterranum* infection on *Quercus suber* forests. *Forest Ecology and Management*, **216**, 166–174. https://doi.org/10.1016/j.foreco.2005.05.027.

Maspero, M., Jucker, C., Valentini, M., Hérard, F., Lopez, J., Cocquempot, C., Delvare, G., Cavalieri, G., Panariello, R., D'Angelo, G. & Colombo, M. (2006) Note biologiche di *Anoplophora chinensis* in Lombardia e suo contenimento. *Giornate Fitopatologiche*, **I**, 197–204.

Mattheck, C. & Breloer, H. (1994) *The Body Language of Trees: A Handbook for Failure Analysis*. Research for amenity trees series 4. The British Department of the Environment, London, UK.

Neumann, V. (1985) *Der Heldbock (*Cerambyx cerdo*)*. Neue Brehm Bücherei Ziemsen, Wittenberg, Germany.

Ranius, T. & Nilsson, S.G. (1997) Habitat of *Osmoderma eremita* Scop (Coleoptera: Scarabaeidae), a beetle living in hollow trees. *Journal of Insect Conservation*, **1**, 193–204. https://doi.org/10.1023/A:1018416000766.

Sarto i Monteys, V. & Torras i Tutusaus, G. (2018) A new alien invasive longhorn beetle, *Xylotrechus chinensis* (Cerambycidae), is infesting mulberries in Catalonia (Spain). *Insects*, **9**, 52. https://doi.org/10.3390/insects9020052.

Soria, F.J., Villagran, M. & Cárdenas, A.M. (1996) Distribution and incidence of the most important holm oak borers in Sierras Subbéticas Natural Park (Córdoba, Spain). *Zoologica Baetica*, **7**, 33–43.

Torres-Vila, L.M. (2017) Reproductive biology of the great capricorn beetle, *Cerambyx cerdo* (Coleoptera: Cerambycidae): a protected but occasionally harmful species. *Bulletin of Entomological Research*, **107**, 799–811. https://doi.org/10.1017/S0007485317000323.

Torres-Vila, L.M. & Bonal, R. (2019) DNA barcoding of large oak-living cerambycids: diagnostic tool, phylogenetic insights and natural hybridization between *Cerambyx cerdo* and *Cerambyx welensii* (Coleoptera: Cerambycidae). *Bulletin of Entomological Research*, **109**, 583–594. https://doi.org/10.1017/S0007485318000925.

Torres-Vila, L.M. & Fusu, L. (2020) First record in Iberia of *Oobius rudnevi* (Nowicki, 1928) (Hymenoptera: Encyrtidae), a poorly-known egg parasitoid of *Cerambyx* species (Coleoptera: Cerambycidae). *Graellsia*, **76**, e106.

Torres-Vila, L.M., López-Calvo, R., Sánchez-González, Á. & Mendiola-Díaz, F.J. (2021) Ecology of *Oobius rudnevi*, egg parasitoid of *Cerambyx cerdo* and *Cerambyx welensii* in oak forests. *Entomologia Experimentalis et Applicata.*, **169**, 646–656. https://doi.org/10.1111/eea.13059.

Torres-Vila, L.M., Sánchez-González, Á., Ponce-Escudero, F., Martín-Vertedor, D. & Ferrero-Garcia, J.J. (2012) Assessing mass trapping efficiency and population density of *Cerambyx welensii* Küster by mark-recapture in dehesa open woodlands. *European Journal of Forest Research*, **13**, 1103–1116. https://doi.org/10.1007/s10342-011-0579-0.

Torres-Vila, L.M., Zugasti-Martínez, C., Mendiola-Díaz, F.J., De-Juan-Murillo, J.M., Sánchez-González, Á., Conejo-Rodríguez, Y., Ponce-Escudero, F. & Fernández-Moreno, F. (2017) Larval assemblages of large saproxylic cerambycids in Iberian oak forests: wood quality and host preference shape resource partitioning. *Population Ecology*, **59**, 315–328. https://doi.org/10.1007/s10144-017-0592-3.

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