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MONOGRAPH

Conservation significance and habitats variety in the Western Rhodope Mts. as a factor for the diversity of the ground beetles (Coleoptera Carabidae)

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ABSTRACT This study concerns the Western Rhodope Mts. (Southern Bulgaria), their conservationally significant habitats and the carabid beetles occurring in them. The available significant habitats are systematized and the threats to the existence of the important carabid species are assessed. Connections of the carabids with specific habitats and the attachment to particular environmental conditions are discussed. Anthropogenic impact in the area is also assessed. The main threats and problems related to the degradation and destruction of natural habitats and, hence, decreasing the conservation significance of the area, are established.

KEY WORDS Carabids; conservation; natural habitats; Western Rhodopes.

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INTRODUCTION

The Western Rhodope Mountains are a part of the Rila-Rhodope geographic area. They extend between Rila Mts. and Pirin Mts. to the west, the Thracian Lowland to the north, the Eastern Rhodope Mts. to the east and the Aegean Lowland to the south. A small part is in Greece. The Western Rhodopes are the larger and the higher part of the Rhodope Mts., which are one of the faunistically richest areas in Europe.

The relief of the Western Rhodopes is mountainous. For this part of the mountain are characteristic high ridges, flattened hills, steep slopes and deeply cut into the mountain valleys and gorges. Along the river valleys between the gorges are alternating kettles and valley extensions. The highest point of the Rhodope Mountain is Golyam Perelik Peak (2191 m).

Almost the whole of the Western Rhodope Mts., except for the southernmost and southwestern parts, fall within the transitional climatic area. The climate is a mountainous variant of the transitional one with average annual temperatures between 10 °C and 5 °C, which decrease with the increase in altitude. The annual rainfall amounts are between 600 and 800 mm, and only in the highest parts these amounts reach 900 mm.

From the main soil types, the brown forest soils predominate, and in the northern slope foots – the cinnamon forest soils, in the karst regions – the rendzinas. For the lower mountain belt (up to 1000 m a.s.l.) the cinnamon forest soils and deciduous forests in which the oak (*Quercus* spp.) prevails are typical. The other, bigger part is occupied with brown forest soils and dark-coloured mountain-forest soils. They are covered with beech (*Fagus syl-*

vatica L.) and coniferous forests, dominated by the European spruce (*Picea abies* (L.) H. Karst.) and Scots pine (*Pinus sylvestris* L.). In the higher parts are distributed mountain meadow soils, covered with alpine pastures.

This mountainous region enables the coexistence of highly diverse habitats, as well as various types of ecotones and intra- end extrazonal biotopes. Four main vegetation formations can be observed along the altitudinal gradient: xeromesophilous deciduous forests and shrubs of Submediterranean type; mesophilous beech forests of Nemoral type; mesophilous coniferous forest of Boreal type, and open high-mountain pastures of Alpine type (Guéorguiev & Lobo, 2006). The appearance of the area is determined mainly by hygromesophytic to xeromesophytic coniferous forests – spruce, Scots pine, black pine (*Pinus nigra* J. F. Arnold), less often silver fir (*Abies alba* Mill.), dwarf mountain pine (*Pinus mugo* Turra), Balkan pine (*Pinus peuce* Griseb.), yew (*Taxus baccata* L.). The deciduous phytocoenoses are shaped by the beech, sessile oak (*Quercus petraea* Liebl.), European hop hornbeam (*Ostrya carpinifolia* Scop.), Hungarian oak (*Quercus frainetto* Ten.), etc. Due to the strong development of the conifer forests and the relatively active intervention of the anthropogenic factors, the deciduous belt is less pronounced, occupying mainly the peripheral terrains.

The Western Rhodope Mts. occupy an area of 8732.1 km^2. About 11% of that territory is placed under protection. In the territory of the Western Rhodopes fall 58 protected areas under the Protected Areas Act (1999): 8 strict nature reserves ("Beglika", "Dupkata", "Kazanite", "Kastraki", "Kupena", "Mantaritsa", "Soskovcheto", "Chervenata Stena"), 6 managed nature reserves ("Amzovo", "Izgoryaloto Gyune", "Konski Dol", "Momchilovski Dol", "Tamnata Gora", "Shabanitsa"), 40 protected sites and 4 natural monuments.

In 1977, "Mantaritsa" and "Chervenata Stena" are declared Biosphere reserves by UNESCO (Man and Biosphere Programme). In 1998, a large part of the territory is designated for CORINE place, due to its European importance for the conservation of rare and endangered habitats, plants and animals. In 2005, the territory is declared by BirdLife International for Important Bird Area. A large part of the Western Rhodope Mts. is included in the list of the Prime Butterfly Areas in Bulgaria (Abadzhiev & Beshkov, 2007). As a part of the European ecological network Natura 2000, 11 protected areas are declared on the territory of the Western Rhodopes: 6 protected areas for conservation of habitats (SCI) – BG0001033 "Brestovitsa", BG0001030 "Rodopi–Zapadni", BG0001031 "Rodopi–Sredni", BG0000254 "Besaparski Vazvisheniya", BG0000372 "Tsigansko Gradishte", BG0001386 "Yadenitsa", and 5 protected areas for conservation of wild birds (SPA) – BG0002063 "Zapadni Rodopi", BG0002105 "Persenk", BG0002113 "Trigrad–Mursalitsa", BG0002057 "Besaparski Ridove", BG0002073 "Dobrostan".

The Western Rhodopes belong to the UTM grids KG, LG and LF, and it is known that among 10 and 46 protected natural habitats are present in every 10 x 10 km UTM squares (Biserkov et al., 2015).

The aim of the present study is to assess the current state and conservation importance of the habitats in the Western Rhodope Mts. on the basis of the ground beetle communities, as well as to characterise the threats of natural or anthropogenic origin, concerning the existing in the region populations.

MATERIAL AND METHODS

The present study lies on the basis of an extensive literary research on the habitats and carabids diversity and various field observations. Field work was carried out in a 6 years period, from 2014 to 2019, in parallel with the conduction of monitoring research works in some protected territories and other target areas. Ground beetles were collected via: observations *in situ* or collection of material by handpicking, and stationary method with terrestrial „pitfall" traps.

Data about the list of the established ground beetle species and studied localities and methods of research are given in Teofilova (2018) and Teofilova (2019).

RESULTS AND DISCUSSION

Diversity of natural habitats and carabid communities

The investigated territory is extremely heterogeneous and mosaic of habitat types. It provides

historically set conditions for the development of peculiar and typical habitat complexes. They in turn contribute to the formation of characteristic animal communities. Many of them have a high conservation status, as in the Red Data Book of Bulgaria (Biserkov et al., 2015) are included 67 habitat types (Table 1), constituting 40% of all 166 conservationally significant habitats listed there. Three of them are Critically Endangered (CR), 16 – Near Threatened (NT), 19 – Endangered (EN) and 29 are Vulnerable (VU). Under the protection of the Law on the Biological Diversity (2002) and Directive 92/43 fall 56 habitats, and in the Bern Convention list (Bern Convention, 1979) are included 29 natural habitats.

According to the latest complete inventory of the Bulgarian ground beetle fauna (Teofilova & Guéorguiev, in prep.), within the boundaries of the Western Rhodopes 310 species are found. Many of them are attached to particular habitats and that determines their vulnerability to any changes in the natural conditions. A specific complex of ground beetles is attached to each type of habitat and the change in the species composition indicates the relevant changes in the environment.

On the territory of the Western Rhodope Mts. the forest habitats dominate (EUNIS G1 and G3). Characteristic for them are predominantly mesophilic Nemoral species with European or Euro-Siberian origin (genera *Calosoma* Weber, 1801, *Carabus* Linnaeus, 1758, *Cychrus* Fabricius, 1794, *Pterostichus* Bonelli, 1810, *Myas* Sturm, 1826, *Xenion* Tschitscherine, 1902, etc.), and the endemic complex is also very widely presented. Typical for the beech (09G1) and spruce (34G3) forests are *Carabus hortensis* Linnaeus, 1758, *Carabus violaceus* Linnaeus, 1758, *Cychrus semigranosus* Palliardi, 1825 and *Calathus metallicus* Dejean, 1828. *Calosoma inquisitor* (Linnaeus, 1758), *Carabus convexus* Fabricius, 1775, *Carabus hortensis* Linnaeus, 1758 and *Carabus intricatus* Linnaeus, 1760 are common in the *Carpinus-Quercus* forests (27G1), along with *Myas chalybaeus* (Palliardi, 1825) and *Laemostenus terricola* (Herbst, 1784). *Molops dilatatus* Chaudoir, 1868 and *Carabus hortensis* Linnaeus, 1758 have been found dominant in mixed beech and in spruce forests (Kostova, 2009). In different forest habitats are also living the attractive large beetles *Carabus gigas* Creutzer, 1799 and *Carabus scabrosus* Olivier, 1790. Most of all these forest specialists are large, non-flying forms and they also are typical zoophages. Most of them are stenotopic and any impact on the forest habitats where they occur also affects the structure of their communities.

The grasslands and communities of mosses and lichens, which are mostly dry (E1) or of alpine and subalpine type (E4), are also widely covered. Extremely peculiar are the mountain meadows (16E2), which support typical accompanying animal and plant coenoses. From the bush communities prevail alpine and subalpine scrubs (F2). Common in the open biotopes are the representatives of the tribes Amarini and Harpalini, which normally occupy an essential part of the carabid communities in different regions. The alpine and subalpine habitats are characterised by a specific complex of arcto-alpine species, most of which are rare, relict and endemic (*Amara nigricornis* C. Thompson, 1857, *Bembidion rhodopense* Apfelbeck, 1902, *Carabus cavernosus* I. Frivaldszky von Frivald, 1835, some species from the genera *Nebria* Latreille, 1802, *Leistus* Frölich, 1799, *Trechus* Clairville, 1806, etc.).

Relatively less represented are the riparian tallgrass communities (E5), and the least numerous are the seasonally wet and wet habitats (E3). They are characterised by a carabid fauna of a riparian type, including species from the tribes Bembidiini, Clivinini, Platynini, Pterostichini, Callistini, some of which with a limited range of habitation (*Carabus cancellatus* Illiger, 1798, *Dyschiriodes agnatus* Motschulsky, 1844, *Pterostichus vernalis* (Panzer, 1796), *Elaphrus* spp., *Sinechostictus* spp.). Most of the representatives of the genera *Bembidion* Latreille, 1802 and *Agonum* Bonelli, 1810 are strictly attached to habitats with greater humidity, in particular banks of the mountain rivers and small lakes.

Sparsely vegetated ecosystems are represented by screes (05H2, 06H2), inland cliffs, rock pavements and outcrops (07H3, 08H3, 09H3, 10H3, 11H3), and underground caves and cave systems (02H1, 03H1). To the rocky and gravel biotopes are attached many resistant to dry conditions species of the tribes Cicindelini, Amarini, Harpalini, Brachinini, and the cave complex includes species with a high degree of endemism and relicts, and being not sufficiently studied, it enables many future faunistic discoveries. This specific fauna is represented mainly by the small representatives of the genera

Duvalius Delarouzée, 1859 and *Trechus* Clairville, 1806, the Bulgarian endemic genus *Paralovricia* Giachino, Gueorguiev & Vailati, 2011, as well as some trogloxenes, as *Agonum angustatum* Dejean, 1828, *Laemostenus plasoni* (Reitter, 1885), *Laemostenus terricola* (Herbst, 1784), *Trechus crucifer* Piochard de la Brûlerie, 1876.

According to the EUNIS classification, there are only 4 protected habitats from the type Mires, bogs and fens (D2, D4), which are quite valuable from the point of view of the relict vegetation preserved in them over the years thanks mainly to the typical for the region climate and small temperature amplitudes. In the marshes and marsh-like habitats specific natural groupings of hygrophytic, mesohygrophytic and mesophytic species are formed. Their fauna is of a riparian/wetland type and includes hygrophilic and mesohygrophilic species, some of which with a limited range of habitation (*Carabus cancellatus* Illiger, 1798, *Dyschiriodes agnatus* Motschulsky, 1844, *Oodes gracilis* A. Villa et G. B. Villa, 1833, *Elaphrus* Fabricius, 1775 spp.). Many of the smaller carabids are attached to this type of habitat – *Acupalpus* Latreille, 1829 spp., *Anthracus* Motschulsky, 1850 spp., *Bembidion* Latreille, 1802 spp., *Notiophilus* Duméril, 1806 spp., *Stenolophus* Dejean, 1821 spp., *Perileptus areolatus* (Creutzer, 1799), *Tachyura diabrachys* (Kolenati, 1845), and most of them are quite rare.

Habitats richness and mosaics determine the presence of some ecotone species, such as *Amara nitida* Sturm, 1825, *Amara tibialis* (Paykull, 1798), *Badister bullatus* (Schrank, 1798), *Licinus depressus* (Paykull, 1790), *Olisthopus sturmii* (Duftschmid, 1812), *Philorhizus notatus* (Stephens, 1827).

In terms of humidity, the mesophilous species prevail in the Western Rhodopes (Teofilova, 2018), represented mainly by the genera *Leistus* Frölich, 1799, *Calosoma* Weber, 1801, *Carabus* Linnaeus, 1758, *Cychrus* Fabricius, 1794, *Stomis* Clairville, 1806, *Myas* Sturm, 1826, *Molops* Bonelli, 1810, *Aptinus* Bonelli, 1810. The hygrophilous and mesohygrophilous species prevail in the humid grasslands and forests, wetlands, coastal, swamped and marshy biotopes (*Stenolophus* Dejean, 1821, *Bembidion* Latreille, 1802, *Tachys* Dejean, 1821, *Perileptus* Schaum, 1860, *Elaphrus* Fabricius, 1775, *Chlaenius* Bonelli, 1810, *Oodes* Bonelli, 1810). The least represented are the xerophilous species. Xerophilous and mesoxerophilous are the most of the species from the open habitats, including many of the alpine and subalpine beetles, representatives of the genera *Cicindela* Linnaeus, 1758, *Amara* Bonelli, 1810, *Harpalus* Latreille, 1802, *Brachinus* Weber, 1801, many Lebiini.

Species of conservation significance

Many species with conservation significance are established in the studied region. From the protected species, in the Red Data Book of Bulgaria (Golemanski et al., 2015) as Vulnerable (VU) is included *Carabus scabrosus* Olivier, 1790. *Calosoma sycophanta* (Linnaeus, 1758) and *Carabus intricatus* Linnaeus, 1760 are included in the Annexes of CORINE and ESC Red List. *Carabus intricatus* is also included in the IUCN Red List as "Near Threatened". *Carabus gigas* Creutzer, 1799 was protected in 1967 by the Law on protection of nature.

During a study in the region (Teofilova, 2018) 16 endemic species were captured (twelve Balkan endemics, one Bulgarian endemic and three Bulgarian local endemics). According to the latest Bulgarian Carabidae inventory (Teofilova & Guéorguiev, in prep.) in the Western Rhodopes 39 endemic species and subspecies occur: 25 Balkan, 3 Bulgarian and 11 local endemics. In Table 2 are given the endemic and protected species and their most preferred habitats. The established endemic species are primarily typical forest dwellers, representatives of the old European Nemoral complex, and the preservation of their characteristic habitats is a keystone in their protection.

Some relicts (*Amara erratica* (Duftschmid, 1812), *Amara messae* Baliani, 1924, *Amara nigricornis* C. Thompson, 1857, *Amara quenseli* (Schönherr, 1806), *Bembidion bipunctatum* (Linnaeus, 1761), *Carabus hortensis* Linnaeus, 1758, *Myas chalybaeus* (Palliardi, 1825), *Trechus rubens* (Fabricius, 1792), *Xenion ignitum* (Kraatz, 1875)) and rare or stenotopic species (*Abax parallelus* (Duftschmid, 1812), *Agonum piceum* (Linnaeus, 1758), *Amara communis* (Panzer, 1797), *Amara ingenua* (Duftschmid, 1812), *Amara lunicollis* Schiødte, 1837, *Amara messae* Baliani, 1924, *Amara morio* Ménétriés, 1832, *Amara nigricornis* C. Thompson, 1857, *Asaphidion rossii* (Schaum, 1857), *Bembidion balcanicum* Apfelbeck, 1899, *Be-*

mbidion retipenne J. Müller, 1918, *Carabus cancellatus* Illiger, 1798, *Carabus cavernosus* I. Frivaldszky von Frivald, 1835, *Carabus gigas* Creutzer, 1799*, Cicindela transversalis* Dejean, 1822, *Cylindera germanica* (Linnaeus, 1758), *Dyschiriodes agnatus* Motschulsky, 1844, *Leistus magnicollis* Motschulsky, 1865, *Leistus spinibarbis* (Fabricius, 1775), *Masoreus wetterhallii* (Gyllenhal, 1813), *Molops rhodopensis* Apfelbeck, 1904, *Notiophilus aestuans* Dejean, 1826, *Patrobus atrorufus* (Strøm, 1768), *Paussus turcicus* I. Frivaldszky von Frivald, 1835, *Platynus scrobiculatus* (Fabricius, 1801), *Pterostichus quadrifoveolatus* Letzner, 1852, *Pterostichus vecors* Tschitschérine, 1897, *Sinechostictus stomoides* (Dejean, 1831), *Trechus rubens* (Fabricius, 1792), *Duvalius* spp., some *Elaphrus* species) are also known from the Western Rhodopes (Guéorguiev et al., 1998; Gueorguiev & Lobo, 2006; Teofilova, 2018; Teofilova, 2019; Teofilova & Guéorguiev, in prep.).

Specific carabid assemblages and endemic, relict, protected and rare ground beetles were also established by Kostova (2009) in Pannonian-Balkanic turkey oak-sessile oak forests (code 91M0), Asperulo-Fagetum beech forests (9130) and Acidophilous *Picea* forests (9410): *Calosoma sycophanta* (Linnaeus, 1758), *Carabus intricatus* Linnaeus, 1760, *Carabus montivagus* Palliardi, 1825, *Carabus violaceus* Linnaeus, 1758, *Carabus gigas* Creutzer, 1799, *Cychrus semigranosus* Palliardi, 1825, *Laemostenus plasoni* (Reitter, 1885), *Molops alpestris (*Dejean, 1828), *Molops dilatatus* Chaudoir, 1868, *Molops rhodopensis* Apfelbeck, 1904, *Myas chalybaeus* (Palliardi, 1825), *Tapinopterus balcanicus* Ganglbauer, 1891, *Xenion ignitum* (Kraatz, 1875). Gueorguiev & Lobo (2006) found thirty-three ground beetle species of conservation importance. The main criterion for their classification was the low frequency with which we can find them (rarity), or the limited distributional range of the taxon. The populations of all or most of these species were probably either sparse or represented by a low number of individuals. Nevertheless, these were species with low ecological valence. Eighteen of the taxa of conservation importance were classified as rare and at the same time thirteen of them were put in another category too. There were also eight local endemics, seven of them belonging to the tribe Trechini, with five of them being eyeless hypogean species.

Some of the species are rare throughout their areal and the preservation of their habitats has a priority importance. These are, for example, *Carabus scabriusculus* Olivier, 1795 and *Carabus scabrosus* Olivier, 1790. Other species (e.g. *Carabus intricatus* Linnaeus, 1760 and *Carabus gigas* Creutzer, 1799) have become rare under the influence of anthropogenic pressures and changes in their primary habitats. Species such as *Carabus intricatus* Linnaeus, 1760 and *Leistus ferrugineus* (Linnaeus, 1758), which are typical mesophilic forest elements, restrain their distribution under the effect of deforestation and introduction of foreign edificatory species.

Calosoma inquisitor (Linnaeus, 1758), *Calosoma sycophanta* (Linnaeus, 1758) and some of the *Carabus* species are usually highly sensitive to chemical agents, which affects their ranges and numbers (Kryzhanovskij, 1983). In most cases these species are attached to a limited type of biotope (deciduous forests) and require specific abiotic and biotic conditions, making them vulnerable to destruction of their habitats. A major factor in the preservation of the stenotopic species is the conservation of their primary habitats.

Some of the rare species are poorly studied in terms of their way of life, which complements the scientific interest in them and the need for their protection. Such are, for example, *Amara lucida* (Duftschmid, 1812) and *Ophonus gammeli* (Schauberger, 1932).

The stenotopic species are those found only in a particular type of habitat. Typical stenotopic species are the intrazonal psamobionts, halobionts and the inhabitants of the coastal habitats (28E5, 29E5, 03G1). Such are *Asaphidion rossii* (Schaum, 1857), *Demetrias monostigma* Samouelle, 1819, *Dyschiriodes agnatus* Motschulsky, 1844, *Elaphrus aureus* P. W. J. Müller, 1821, *Elaphrus riparius* (Linnaeus, 1758), *Elaphrus uliginosus* Fabricius, 1792, *Elaphrus ullrichi* W. Redtenbacher, 1842, *Omophron limbatum* (Fabricius, 1777), *Perileptus areolatus* (Creutzer, 1799), *Scarites terricola* Bonelli, 1813, some *Agonum* Bonelli, 1810, most of the *Bembidion* Latreille, 1802 species.

Typical inhabitants of mesophilic forests (08G1, 10G1, 32G3, 34G3) are *Leistus ferrugineus* (Linnaeus, 1758), *Leistus magnicollis* Motschulsky, 1865, *Calosoma sycophanta* (Linnaeus, 1758),

Carabus gigas Creutzer, 1799, *Carabus intricatus* Linnaeus, 1760, *Carabus scabrosus* Olivier, 1790, *Cychrus semigranosus* Palliardi, 1825, *Pterostichus vecors* Tschitschérine, 1897, *Stomis pumicatus* (Panzer, 1796), *Tapinopterus balcanicus* Ganglbauer, 1891, *Trechus rhodopeius* Jeannel, 1921, *Trechus subnotatus* Dejean, 1831, *Abax* Bonelli, 1810 spp. and *Molops* Bonelli, 1810 spp. Typical for the xerophilic forests (25G1, 27G1, 28G1, 35G3) are *Calosoma inquisitor* (Linnaeus, 1758), *Carabus montivagus* Palliardi, 1825, *Carabus wiedemanni* Ménétriés, 1836, *Myas chalybaeus* (Palliardi, 1825), *Notiophilus rufipes* Curtis, 1829, *Ophonus gammeli* (Schauberger, 1932). Particularly specific is the carabid complex in the humid and coastal forests (03G1, 04G1, 40G3), including species such as *Acupalpus luteatus* (Duftschmid, 1812), *Anisodactylus nemorivagus* (Duftschmidt, 1812), *Bembidion guttula* (Fabricius, 1792), *Bembidion mannerheimii* C. R. Sahlberg, 1827, *Callistus lunatus* (Fabricius, 1775), *Carabus cancellatus* Illiger, 1798, *Harpalus laevipes* Zetterstedt, 1828, *Loricera pilicornis* (Fabricius, 1775), *Notiophilus palustris* (Duftschmid, 1812), *Oxypselaphus obscurus* (Herbst, 1784), *Patrobus atrorufus* (Strøm, 1768), *Pterostichus leonisi* Apfelbeck, 1904, *Pterostichus minor* (Gyllenhal, 1827), *Tachyura diabrachys* (Kolenati, 1845), *Trechus rubens* (Fabricius, 1792), some *Agonum* Bonelli, 1810 species.

Characteristic for the open biotopes, including alpine and subalpine pastures, are *Amara anthobia* A. Villa et G. B. Villa, 1833, *Amara erratica* (Duftschmid, 1812), *Amara messae* Baliani, 1924, *Amara morio* Ménétriés, 1832, *Bembidion balcanicum* Apfelbeck, 1899, *Bembidion bipunctatum* (Linnaeus, 1761), *Carabus cavernosus* I. Frivaldszky von Frivald, 1838, *Cicindela sylvicola* Dejean, 1822, *Cymindis humeralis* (Geoffroy in Fourcroy, 1785), *Cymindis miliaris* (Fabricius, 1801), *Cymindis vaporariorum* (Linnaeus, 1758), *Harpalus honestus* (Duftschmid, 1812), *Harpalus hospes* Sturm, 1818.

Extremely sensitive and vulnerable are the representatives of the cave (02H1, 03H1) endemic complex: *Duvalius karelhurkai* Farkač, 1990, *Duvalius nedelkovi* B. V. Guéorguiev, 2006, *Duvalius bureschi* Jeannel, 1928, *Duvalius rajtchevi* (Genest et Juberthie, 1983), *Paralovricia beroni* Giachino, Guéorguiev et Vailati, 2011.

In a particular category of danger, the attractive species, which often fall into private collections, can be separated. These are mainly the large representatives of the tribe Carabini. In many European countries, various restrictive and punitive measures have been applied for their collection and trade for years. Some of the species need their conservation status to be revised. Particular attention should be paid to, for example: *Calosoma sycophanta* (Linnaeus, 1758) (Kryzhanovskij, 1983), *Carabus gigas* Creutzer, 1799 and *Carabus scabrosus* Olivier, 1790, as well as the representatives of the genus *Cicindela* Linnaeus, 1758, inhabiting threatened by human activity habitats (Jaskula, 2011).

It should be noted the importance of the surveyed territory for the preservation of a number of faunistic elements with limited distribution in Europe and Bulgaria. Particularly important is the role of the protected areas as refugiums of some mesophilous and hygrophilous mountain elements.

Threats to invertebrates, in particular ground beetles, and negative factors and problems of the nature conservation in the Western Rhodope Mts.

Along with the naturally occurring processes and the global environmental changes, there is also a range of anthropogenic activities that threaten the normal functioning of the ecosystems, quality of the habitats and, as a result, the existence of the studied group of animals.

Conducting of fellings, destroying of old and hollow trees can lead to deterioration of the habitats qualities, disturbance of the natural water balance in the whole region and may cause erosion and landslides processes, narrowing or destruction of forest habitats, and as a result – deterioration of the structure of communities or destruction of populations of different species. The main problems for the woodlands in the area and in other regions of Bulgaria are the poacher's fellings and the deliberate arsons, with the purpose of "regularisation" the extraction and sale of timber. A particularly pressing problem is the uncontrolled removal of timber from the reserve "Kupena". The relevant authorities are repeatedly approached, but their actions are still inadequate and ineffective.

The systematic removal of the dead wood from the forests is a serious threat to the biodiversity of

the forest dwelling beetles. A large number of these species are directly related to the presence of dead wood, as their larvae develop in it. Their populations would be severely diminished if not at least one third of the fallen trees are left in the forest.

Along with the conducting of fellings, the existing dams and reservoirs also contribute to serious water balance disturbances. The realisation of investment projects for the construction of numerous small hydro power plants on the riverbanks further increases the negative impact on the water balance in the Western Rhodopes. The change in the hydrologic regime of the territory would result in a successive replacement of the hygrophilic animal complexes with mesophilic.

The felling of the coastal vegetation leads to destruction of the banks of the rivers and lakes, deterioration of water quality and reduction of the diversity of microhabitats for the hygrophilous species.

Despite the small percentage of arable lands, the intensification of the agriculture has a strong negative impact, as it is associated mainly with treatment with chemicals and use of artificial fertilizers, which have a particularly strong impact on the populations of the large predatory species.

The construction actions connected with the development of tourism infrastructure, as well as the movement of motor vehicles of the "off road" type, cause disruption and destruction of valuable habitats in easily accessible areas. The development of ski tourism is the most serious threat for both forests and subalpine habitats. Such a process is already seen in the area of the dam Dospat (Abadzhiev & Beshkov, 2007).

The depopulation of many regions, as well as the reduced number of farm animals, are the reason part of the meadows and the pastures are abandoned, which leads to the change of plant communities and deterioration of the qualities for most of the open habitat beetles biotopes.

Socio-economic constraints are expressed primarily in: low level of socio-economic development in the region, inadequate protection, irrational management and lack of control of the human activities within the boundaries of the protected zones and protected areas, lack of extensive commitment and support in the conservation actions.

Necessary measures and recommendations

Further studies are needed in more habitats, on a larger area, with sufficient regularity and longer duration, focusing on the application of different methods for collection of biological material in order to ensure a more qualitative coverage of the local biodiversity and a traceability of the phenology of the species. It would be appropriate to analyse the preimaginal stages of the ground beetles. Some concrete measures may be proposed to mitigate the effect of the mentioned negative factors:

- Control over the uncontrolled removal of dead wood from the forest territories and purposefully leaving of large dead trees (fallen and standing), maintaining the populations of the species associated with deadwood. This activity could and should be regulated within the boundaries of the adjacent protected areas;
- Control over the uncontrolled and unregulated fellings;
- Preservation of the natural habitats in unaltered state;
- Observance of all restrictions and prohibitions, currently in force within the territory of the protected areas, more rigorous protection and control over all activities;
- Control and synchronisation of the actions of the different institutions;
- Accomplishment of long-term and in-depth studies and monitoring and introducing a system of measures to protect and restore the populations of priority species;
- Abadzhiev & Beshkov (2007) suggest the prohibition of the bivouacking of gipsy camps with the purpose of collecting mushrooms and herbs, as well as the announcement of a cross-border natural park of the Western Rhodopes and adoption of a strategy for sustainable development of the region.

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Level 2	Level 3	EUNIS code/HD code	Habitat types (name)	Conservation status*
C. Inland surface waters	C1. Surface standing waters	03C1/3140	Charophyte communities in stagnant waters	RDB (EN); LBD, HD
		06C1/3160	Dystrophic lakes	RDB (EN); LBD, HD
	C2. Surface running waters	02C1	Charophytic vegetation in oligotrophic lime-rich running water	RDB (EN); LBD, HD
		08C2/7220	Karst springs and streams with travertine formations	RDB (EN); LBD, BC, HD
		09C2	Thermal springs	RDB (NT)
		11C2/3260	Mountain streams and fast flowing rivers	RDB (VU); LBD, HD
		12C2	Waterfalls	RDB (VU)
		13C2/3260	Vegetation of oligotrophic, fast flowing mountain streams and rivers	RDB (VU); LBD, HD
D. Mires, bogs and fens	D2. Valley mires, poor fens and transition mires	01D2/7140	Peat bogs dominated by sedges and grasses	RDB (EN); BC
		02D2/7140	Bogs with mosses near soft water springs	RDB (EN)
		03D2/7140	Transitional mires and quaking bogs	RDB (EN); LBD, BC, HD
	D4. Base-rich fens and calcareous spring mires	04D4/7230	Alkaline swamps and mires	RDB (EN); LBD, BC, HD
E. Grasslands and lands dominated by forbs, mosses or lichens	E1. Dry	01E1/6110	Pioneer thermophilic herbaceous communities in calcareous rocky and stony places	RDB (NT); LBD, BC, HD
		03E1/62A0	Sub-Mediterranean petrophytic steppes	RDB (VU); LBD, HD
		11E1/6210	Xerothermic meadows and pastures of *Chrysopogon gryllus*, *Bothriochloa ischaemum* and *Festuca valesiaca*	RDB (NT); LBD, BC, HD
		12E1/6520	Mountain pastures	RDB (EN); LBD, BC, HD
	E2. Mesic	16E2/6520	Mountain hay meadows	RDB (VU); LBD, HD
	E3. Seasonally wet and wet	19E3/6410	Mountain purple moorgrass (*Molinia caerulea*) meadows	RDB (VU); LBD, BC, HD
	E4. Alpine and subalpine	22E4/6150	Alpine acidophilic grasslands	RDB (VU); LBD, HD
		25E4/6170	Alpine and sub-alpine open calcareous grasslands	RDB (EN); LBD, HD
		26E4/6230	Sub-alpine acidophilic mesophytic grasslands mainly with mat-grass swards of *Nardus stricta*	RDB (VU); LBD, HD
		27E4/62D0	Subalpine acidophilic xerophytic grasslands	RDB (VU); LBD, HD
	E5. Moist or wet tall-herb and fern fringes and meadows	28E5/6430	Lowland riverside tall-herb communities	RDB (EN); LBD, HD
		29E5/6430	Riverside tall-herb communities in the mountains	RDB (VU); LBD, HD
F. Heathland, scrub	F2. Arctic, alpine and subalpine scrub	05F2/4060	Mountain scrub of Siberian juniper (*Juniperus sibirica*)	RDB (NT); LBD, HD
		08F2/4060	Spiky heath (*Bruckenthalia spiculifolia*) heaths	RDB (NT); LBD, BC, HD
		09F2/4060	High-mountain communities of Bearberry (*Arctostaphylos uva-ursi*)	RDB (EN); LBD, HD
		11F2/4060	Mountain communities of *Vaccinium* spp.	RDB (NT), LBD, HD
		12F2/4060	Mountain heaths of *Chamaecytisus absinthioides*	RDB (NT), LBD, HD
		14F2/4080	Sub-alpine willow (*Salix* spp.) communities	RDB (EN), LBD, HD
		15F2/40B0	Rhodope thickets of Shrubby cinquefoil (*Potentilla fruticose*)	RDB (CR), LBD, HD
		16F2/4070	Dwarf pine (*Pinus mugo*) mountain scrub	RDB (VU), LBD, HD

F. Heathland, scrub	F3. Temperate and mediterranean-montane scrub	17F3/5130	Common juniper (*Juniperus communis*) scrub	RDB (NT), LBD, HD
		21F3	Mediterranean fields of Rumelian green weed (*Genista rumelica*) and Lydian green weed (*Genista lydia*)	RDB (VU)
	F5. Thermo-Mediterranean brushes	25F5	Balkan pseudomaquis	RDB (NT)
	F7. Spiny Mediterranean heaths	29F7/4090	Communities of Milk vetch (*Astragalus angustifolius*)	RDB (EN); LBD, BC, HD
	F9: Riverine and fen scrubs	32F9	Rhodope thickets of Willow-leaf meadow sweet (*Spiraea salicifolia*)	RDB (CR)
G. Forests	G1. Broadleaved deciduous	03G1/91E0	Mountain Grey alder (*Alnus incana*) galleries	RDB (VU); LBD, BC, HD
		04G1/91E0	Riverside woodlands of Ader (*Alnus* spp.) and Common ash (*Fraxinus excelsior*)	RDB (VU); LBD, BC, HD
		07G1/92C0	Forests of Oriental plantain (*Platanus orientalis*)	RDB (EN); LBD, BC, HD
		08G1/9110	Acidophilic common beech (*Fagus sylvatica*) forests	RDB (VU); LBD, BC, HD
		09G1/9130	Neutrophilic common beech forests	RDB (NT); LBD, BC, HD
		10G1/91W0	Moesian beech forests	RDB (NT); LBD, BC, HD
		11G1/9150	Limestone forests of Common beech (*Fagus sylvatica*)	RDB (NT); LBD, BC, HD
		21G1	Hop-hornbeam (*Ostrya carpinifolia*) woods	RDB (VU); BC
		25G1	Birch (*Betula pendula*) forests	RDB (NT)
		27G1/9170	Mountain forests of *Carpinus betulus* and *Quercus dalechampii*	RDB (NT); LBD, HD
		28G1/9180	Mixed forests on screes, steep slopes and mountain ravines	RDB (EN); LBD, BC, HD
		31G1	Forests of Grey alder (*Alnus incana*)	RDB (EN)
	G3. Coniferous	32G3/91BA	Silver fir (*Abies alba* subsp. *Alba*) forests	RDB (EN); LBD, BC, HD
		33G3/9270	King Boris's fir (*Abies alba* subsp.*borisii-regis*) forests	RDB (EN); LBD, BC, HD
		34G3/9410	Norway spruce (*Picea abies*) forests	RDB (NT); LBD, BC, HD
		35G3/91CA	Scots pine (*Pinus sylvestris*) forests	RDB (NT); LBD, BC, HD
		36G3/9530	Forests of Black pine (*Pinus nigra* subsp. *pallasiana*)	RDB (VU); LBD, BC, HD
		39G3/9560	Forests of Grecian juniper (*Juniperus excelsa*)	RDB (CR); LBD, BC, HD
		40G3/91D0	Bog conifer forests and shrubs	RDB (VU); LBD, BC, HD
H. Inland unvegetated or sparsely vegetated habitats	H1. Terrestrial underground caves, cave systems, passages and waterbodies	01H1/8310	Cave entrances	RDB (VU); LBD, BC, HD
		02H1/8310	Continental caves	RDB (VU); LBD, BC, HD
		03H1/8310	Volcanic caves	RDB (VU); LBD, BC, HD
		04H1	Artificial galleries	RDB (VU)
	H2. Screes	05H2/8110	Mountain siliceous screes	RDB (VU); LBD, HD
		06H2/8120	Mountain calcareous screes	RDB (VU); LBD, HD
	H3. Inland cliffs, rock pavements and outcrops	07H3/8220	Silicate rocks with chasmophytic vegetation	RDB (VU); LBD, HD
		08H3/8210	Calcareous rocks with chasmophytic vegetation	RDB (VU); LBD, HD
		09H3/8230	Silicate rocks with pioneer herbaceous vegetation	RDB (VU); LBD, HD
		10H3/8220	Siliceous steep rocks with lichens	RDB (VU); LBD, HD
		11H3/8210	Calcareous steep rocks with lichens	RDB (VU); LBD, HD

Table 1. Types of EUNIS Level 1 ecosystems (Terrestrial ecosystems) and habitats included in the Red Book of Bulgaria and occurring on the territory of the Western Rhodope Mts. HD = Habitats Directive 92/42/EEC; RDB = Red Book of Bulgaria (2011); LBD = Law on the Biological Diversity (2002); BC = Bern Convention.

Species	Status/Level	Habitat
Protected		
Calosoma (Calosoma) sycophanta (Linnaeus, 1758)	CORINE, ESC Red List	08G1 09G1 10G1 27G1 28G1
Carabus (Chaetocarabus) intricatus Linnaeus, 1760	IUCN (NT), CORINE, ESC Red List	04G1 08G1 11G1 27G1 28G1 34G3 40G3
Carabus (Procerus) scabrosus Olivier, 1790	RDB (VU)	08G1 11G1 28G1 34G3
Carabus (Procerus) gigas Creutzer, 1799	1967	09G1 11G1 28G1 35G3
Endemic		
Duvalius (Paraduvalius) bureschi Jeannel, 1928	local	02H1 03H1
Duvalius (Paraduvalius) karelhurkai Farkač, 1990	local	02H1 03H1
Duvalius (Paraduvalius) nedelkovi B. V. Guéorguiev, 2006	local	02H1 03H1
Duvalius (Paraduvalius) rajtchevi (Genest et Juberthie, 1983)	local	02H1 03H1
Molops (Molops) alpestris rhilensis Apfelbeck, 1904	local	27G1 09G1 10G1 34G3
Molops (Molops) rhodopensis rhodopensis Apfelbeck, 1904	local	08G1 09G1 10G1 32G3 34G3
Nebria (Alpaeonebria) rhilensis J. Frivaldszky, 1879	local	25E4 11F2 16F2 08G1 34G3
Paralovricia beroni Giachino, Guéorguiev et Vailati, 2011	local	02H1 03H1
Pterostichus (Pterostichus) rhilensis rhilensis Rottenberg, 1874	local	08G1 09G1 10G1 34G3
Trechus (Trechus) matrismeae Pawłowski, 1972	local	05F2 11F2
Trechus (Trechus) szujeckii Pawłowski, 1972	local	09G1 34G3
Pterostichus (Morphnosoma) melanarius bulgaricus (Lutshnik, 1915)	Bulgarian	various habitats
Tapinopterus (Tapinopterus) balcanicus balcanicus Ganglbauer, 1891	Bulgarian	04G1 08G1 09G1 10G1 27G1 34G3
Zabrus (Pelor) balcanicus Heyden, 1883	Bulgarian	07H3 08H3 12E1 12F2
Asaphidion nebulosum balcanicum Netolitzky, 1918	Balkan	01D2 19E3
Bembidion (Bembidionetolitzkya) rhodopense Apfelbeck, 1902	Balkan	04G1 22E4 25E4 26E4
Carabus (Archicarabus) montivagus montivagus Palliardi, 1825	Balkan	01E1 10G1 09G1 11E1 27E4 27G1 35G3 36G3
Carabus (Archicarabus) wiedemanni wiedemanni Ménétriés, 1836	Balkan	27G1 35G3 36G3
Carabus (Megodontus) violaceus azuresens Dejean, 1826	Balkan	26E4 09G1 27G1 28E5 29E5 10G1 21G1 40G3
Carabus (Pachystus) cavernosus cavernosus Frivaldszky von Frivald, 1838	Balkan	12E1 25E4 27E4
Carabus (Procerus) scabrosus bureschianus Breuning, 1928	Balkan	08G1 09G1 10G1 34G3

Carabus (Tachypus) cancellatus intermedius Dejean, 1826	Balkan	19E3 04G1 08G1 21G1 31G1 34G3
Carabus (Trachycarabus) scabriusculus bulgarus Lapouge, 1908	Balkan	01E1 11E1 12E1 25F5
Cychrus semigranosus balcanicus Hopffgarten, 1881	Balkan	04G1 08G1 09G1 10G1 27G1 34G3
Laemostenus (Actenipus) plasoni plasoni (Reitter, 1885)	Balkan	34G3 01H1
Laemostenus (Pristonychus) cimmerius weiratheri J. Müller, 1932	Balkan	29F7 36G3 01H1
Leistus (Pogonophorus) magnicollis Motschulsky, 1865	Balkan	08G1 09G1 10G1 34G3
Microlestes apterus Holdhaus, 1904	Balkan	01E1 03E1 11E1
Molops (Molops) dilatatus dilatatus Chaudoir, 1868	Balkan	08G1 09G1 10G1 27G1 34G3
Molops (Molops) piceus bulgaricus Mařan, 1938	Balkan	08G1 09G1 10G1 27G1 34G3
Pterostichus (Feronidius) melas depressus (Dejean, 1828)	Balkan	various habitats
Pterostichus (Parahaptoderus) vecors Tschitschérine, 1897	Balkan	07G1 08G1 09G1 10G1 27G1 34G3
Trechus (Trechus) irenis Csiki, 1912	Balkan	05F2 12F2 04G1 34G3 01H1 04H1
Trechus (Trechus) priapus priapus K. Daniel, 1902	Balkan	09F2 12F2 34G3 01H1
Trechus (Trechus) rhodopeius Jeannel, 1921	Balkan	09F2 12F2 34G3 01H1
Trechus (Trechus) subnotatus subnotatus Dejean, 1831	Balkan	27G1 01H1 04H1 07H3 08H3 10H3
Xenion ignitum (Kraatz, 1875)	Balkan	05F2 16F2 04G1 08G1 09G1 10G1 27G1 34G3
Zabrus (Pelor) incrassatus Germar, 1814	Balkan	03E1 12E1 27G1 28G1 21F3
Zabrus (Pelor) rhodopensis Apfelbeck, 1904	Balkan	03E1 12E1 12F2 28G1

Table 2. List of the protected and endemic ground beetles in Western Rhodope Mts.

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