EVALUATION OF THE DISTRIBUTION OF *CARABUS HUNGARICUS* (*COLEOPTERA: CARABIDAE*) POPULATIONS IN ROMANIA

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Abstract. *Carabus hungaricus, a species protected by Council Directive 92/43 / EEC and the Berne Convention, is very localized in Romania and has a distribution that seems to have changed compared to the last century and for which recent discoveries show that there are still gaps in knowledge. Over time, there have been reports of the presence of the species in localities where the species is no longer confirmed but the paper presents new locations and reconfirmations of the present species. In Romania, being a species with isolated populations on small areas, there is a real danger of extinction by natural and anthropogenic causes. Carabus hungaricus is a Natura 2000 species present in only 6 of the Community European countries. In each country it has a very limited distribution and an unfavourable state of conservation except for Hungary where it has a wide spread and favourable state of conservation. If it is unanimously accepted that the declining of the distribution area is due to the development of agriculture, the distribution in the field and the limiting factors that determine the isolation of the species in islands at the geographical level are insufficiently known and was never explained by the verifiable indices of the limiting factors. The paper proposes updating the distribution data of the species in Romania, the spatial analysis of the areas where the species was identified and the characterization of the habitats but also the identification of the main pressures and threats. In 2019 we rediscovered the species in South-West of Romania and in July 2020 we discovered two new places in North-West. The discovery of new locations and the absence in others known from historical data show that knowledge of distribution at the national level may have gaps and further detailed studies are needed to know the conservation status of each population.*

Keywords*: Carabus hungaricus, Natura 2000, GIS spatial analysis*

INTRODUCTION

Despite being a Natura 2000 species, of community importance, *Carabus hungaricus* still has hidden aspects regarding its populations in Romania. Over time has been mentioned or studied various authors. BREUNING (1933) mentions Timișoara and Mașloc-Remetea for the two specimens of his collection with Romanian provenance, which he considers to be a distinct form (ab. in CSIKI 1946) named *frivalskianus* as well as those from the Serbian Deliblat. (BREUNING 1933, CSIKI 1946, BARLOY&PRUNAR 2006, 2012a, 2012b). Both in the area of Timișoara and in Mașloc Remetea the presence of the species was not confirmed after this mention neither by the present study nor by other authors. In 1993-1994, the human doctor Lie, passionate entomologist from Lugoj, discovered a new location near the Romanian-Serbian border between the localities of Lățunaș and Jamu Mare located in south-western Romania (LIE 1995, 1996). In south part of Romania the first observation of the species was in 2014 near Murta village (Dolj County) by POPESCU&IORGU (2016). At that time, only two locations of presence of the species, far apart, were considered valid. During studies undertaken in 2016 of wildlife road mortality between Horia and Sanislău (Satu Mare County) in the protected area ROSCI0020 Câmpia Careiului, Alfred C.L. identifies the first individual in 26 May, three others in 8 June and one more in 23 June. (ALFRED 2020). Being a species protected by

European legislation within the Natura 2000 network, in 2007 when Sites of Community Importance were declared in Romania, *Carabus hungaricus* was included on the standard forms of four protected areas, from western Romania ROSCI0115 Mlaștina Satchinez and from the south of Romania ROSCI0039 Ciuperceni – Desa, ROSCI0045 Coridorul Jiului, ROSCI0202 Silvostepa Olteniei. In 2019, after reviewing the standard forms of Natura 2000 protected areas, *Carbus hungaricus* is mentioned in the protected areas in Oltenia (ROSCI0039 Ciuperceni – Desa, ROSCI0045 Coridorul Jiului, ROSCI0202 Silvostepa Olteniei) and in ROSCI0425 Pădurea Șemița which include the area discovered by LIE (1995, 1996). The history of the knowledge about the distribution of *Carabus hungaricus* in Romania shows that the changes in what we know about the distribution of the species is due not only to anthropogenic impacts, the main cause of the negative changes. The presence of the species in Romania was known at the beginning of the last century in two nearby resorts where it is now extinct. In the last 25 years it has been confirmed in Jamu Mare (1995), Murta (2016), Sanislău-Horia (2020). Future surveys are needed for detailed knowledge of habitats in areas where the presence of the species has been confirmed but also for the identification of new areas.

MATERIAL AND METHODS

Investigations have been carried out in Natura 2000 protected areas on whose standard form the species is mentioned, in the localities mentioned in the bibliography but also in new areas considered by us as favourable for the presence of the species. Specific methods were applied according to the species monitoring guide in Romania, being mainly used pitfall traps. The studies were conducted in 2019-2020 but we also refer to our previous observations made in all the locations studied. The aim was to analyse the conservation status of the *Carabus hungaricus* species in protected areas from Romania, identify impacts on the species and analyse of the factors and pressures that may limit the distribution of the species.

RESULTS AND DISCUSSIONS

The study records new distribution points of the species in southern and north-western Romania. We confirm the presence of the species in ROSCI0039 Ciuperceni – Desa as well as the presence of one located population in ROSCI0045 Coridorul Jiului where only one specimen was found. Also, we found a large area in Romania with characteristic habitat of the species in ROSCI0020 Câmpia Careiului, for which there was no indication of the species at the time we found the species on this zone. Through the investigations in the first's locations where *C. hungaricus* it was reported in Romania at the beginning of the last century we did not find the species.

ROSCI0039 Ciuperceni – Desa

The protected area *ROSCI0039 Ciuperceni – Desa* has a surface of 105 km2 and is located in the Oltenia Plain, the continental bioregion with altitudes between 2 and 65 m from the Danube meadow. The first searches to identify the species using pitfall traps that we did in 2015 in the meadows and the edge of the forest near Piscu Vechi were unsuccessful. In June 2019 we found the first individuals near Desa and in October 2019 we resumed the investigations that confirmed the first data. In both searches we focused on a several areas with different appearance and vegetation type, located south of Desa. In the identified area, the abundance of individuals was on average 10 specimens per pitfall trap. Using the combination 4-3-2 Sentinel 2 satellite bands from 31 August 2020, we highlighted and vectorized the species-specific habitats in ROSCI Ciuperceni Desa. Based on the observations of presence / absence collected in different habitats of the site and the knowledge about the ecology of the

species, we identified an area of 2520 ha. (6,37%), potentially favourable for the species. We did not find the species in the forest habitats, even in clearings or in those with grassy vegetation, nor in the meadows with short vegetation without trees or shrubs. Wavy areas of sand dunes with diverse high grassy vegetation are preferred. They have shades of colour specific to the habitat identified in the analysed image.

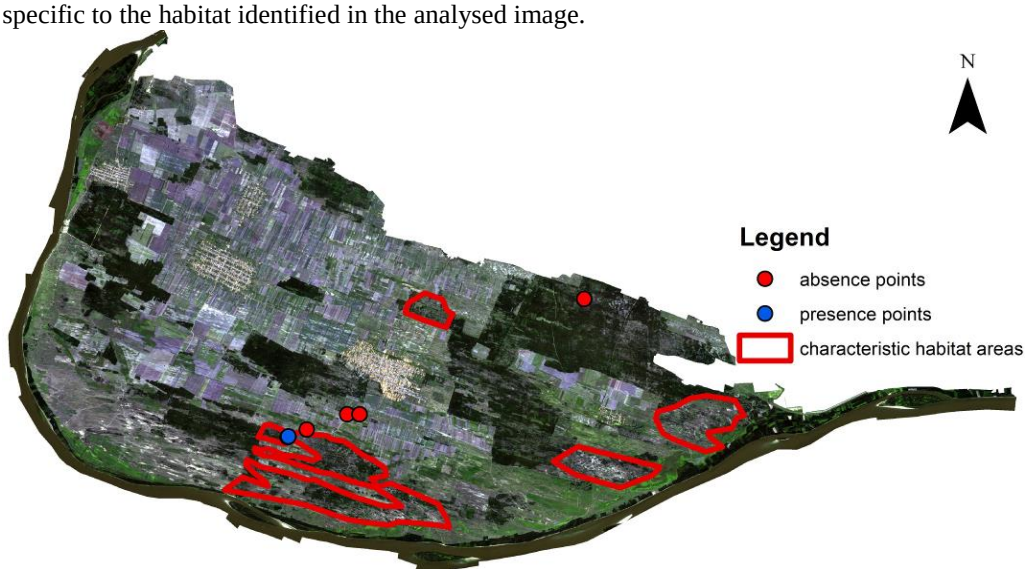

Figure 1. Characteristic habitat analysis on Sentinel images in ROSCI0039 Ciuperceni-Desa

Figure 2. Specific habitat with sand dunes at Desa

Figure 3. *C. hungaricus* in ROSCI0039 Ciuperceni-Desa

According to the 2019 edition of Natura 2000 Standard Data Form of the protected area, most of the site is occupied by forests (28.07%) and crops (arable land) (23.96%). We consider that the expansion of the areas occupied by these two categories of habitats is the most important threat to the species. Land cultivation and afforestation of grasslands lead to fragmentation or loss of habitat. The conservation of the species in the protected area requires first of all the prohibition of the installation of crops of any kind in the identified habitats; monitoring the conservation status of the habitat and, if necessary, active interventions to prevent afforestation.

ROSCI0045 Coridorul Jiului

The first report of the species in the protected area is for the vicinity of Murta locality and was made for a female of *C. hungaricus* found in 2014 by Popescu I.E. & Iorgu I.Ș in an area with sandy grasslands POPESCU&IORGU (2016).

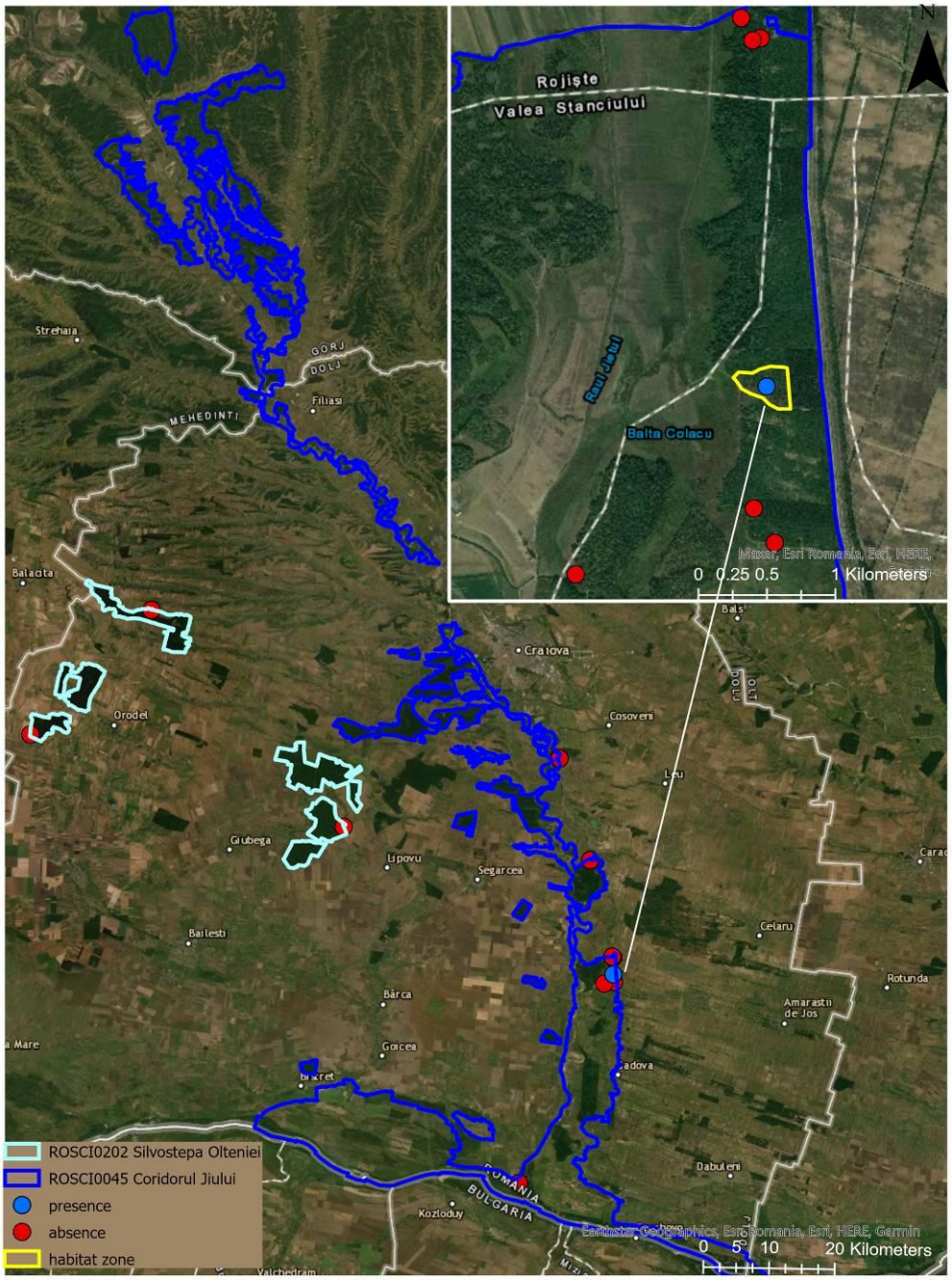

Figure 4. *Carabus hungaricus* in ROSCI0045 Coridorul Jiului

Prior to identifying the location of the *C. hungaricus* habitat in the site in 2019, we unsuccessfully conducted investigations in areas with sandy soils in 2015 between Secui and Malu Mare, in forest edge at Bratovoești and Zăval Forests but also in several places at Murta. The first specimens were found on a sandy slope under *Crataegus monogyna* in June 2019. The place was also verified in September 2019 when the data showed that the species is present also in the *Robinia pseudoacacia* L. forest where the grassy vegetation is high and achieves a good soil cover but also where the trees are far enough apart from each other and the soil is sunny. The maximum area on which we could identify the same habitat model covers only approx. 80 hectares. This surface tends to shrink because the invasive *Robinia pseudoacacia* L. through the development of the canopy evolves towards the total shading of the ground below. In order to maintain the reporting of the *C. hungaricus* in the ROSCI0202 Silvostepa Olteniei protected area, we did not find data to confirm its presence. Through field searches conducted in 2019 at various points in the site and in the vicinity, we did not identify favourable habitats or points of presence. The surface of the site is covered by deciduous forests in proportion of 96.25% and by arable lands of 3.37%. Using open habitats, in case the species exist in the site, she has only 0.37% (34,4 ha) of the entire site available which is used as pastures, vineyards and orchards.

ROSCI0020 Câmpia Careiului

Given the presence of the species *C. hungaricus* in HUHN20036 Bátorligeti Nagy-legelő, HUHN20038 Újtanyai lápok, HUHN20058 Teremi-erdő, which are Hungarian protected areas locates at the state border of Romania and adjacent to the ROSCI0020 Câmpia Careiului, we suspected the presence of the species on the sandy areas of the site. We made observations in previous years but focused on the forest area so we did not identify the species.

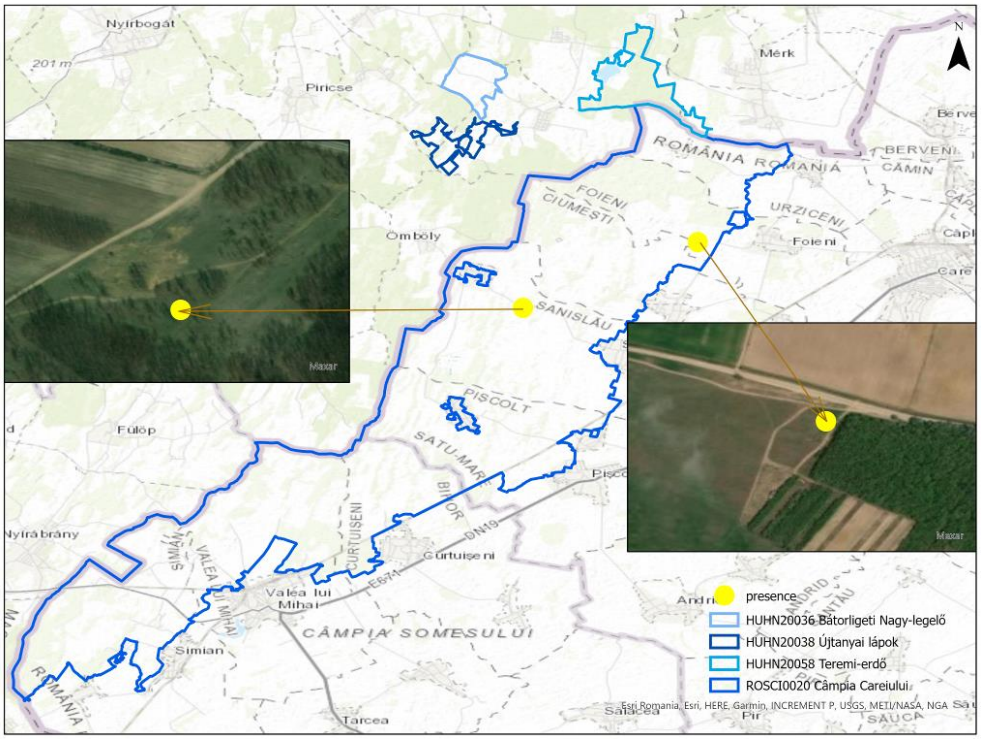

Figure 5. *Carabus hungaricus* reports in ROSCI0020 Câmpia Careiului

In July 2020 we searched in three locations where we identified characteristic habitat. We found the species only in two of them near Foieni and between Sanislău and Horea. In both locations we identified on average 2 specimens / pitfall trap. The first identification of the species in the area was made by Alfred Ș. Cicort-Lucaciu who found 5 specimens in 2016 in May-June road-killed between Sanislau-Horia, about which we found out after our report (ALFRED 2020). Considering the large size of the protected area (23641 ha) and the wide distribution of sandy soils with pastures or forests in transition, the availability of the characteristic habitat is sufficient to ensure the favourable conservation of the species in the ROSCI0020 Câmpia Careiului. The most important threats to the species' habitat are the transformation of natural areas into arable land, the expansion of acacia forests and overgrazing. Sampling of all apparently characteristic areas is required to establish the conservation status and propose appropriate measures for the species.

ROSCI0425 Pădurea Șemița

The Jamu Mare-Lățunaș is the most known and best studied location (LIE 1995, 1996, BARLOY et al. 2002, 2004, 2012a, 2012b, 2007, PRUNAR 2007, PRUNAR et al. 2007) which also is different by its characteristics from all other locations in Romania. This location, discovered by Lie in 1994, was until 2016 the only place where the presence of the beetle was proven. The reports on the presence of species made by Breuning and summarized by Csiki 1946, for Timișoara and Masloc-Remetea Mică were not subsequently confirmed. Thus, the only place known and proved for *Carabus hungaricus* remained for a long time only the one discovered by Lie. The protection of species in this area was started in 2016, when it was declared the ROSCI0425 Pădurea Șemița, Natura 2000 site.

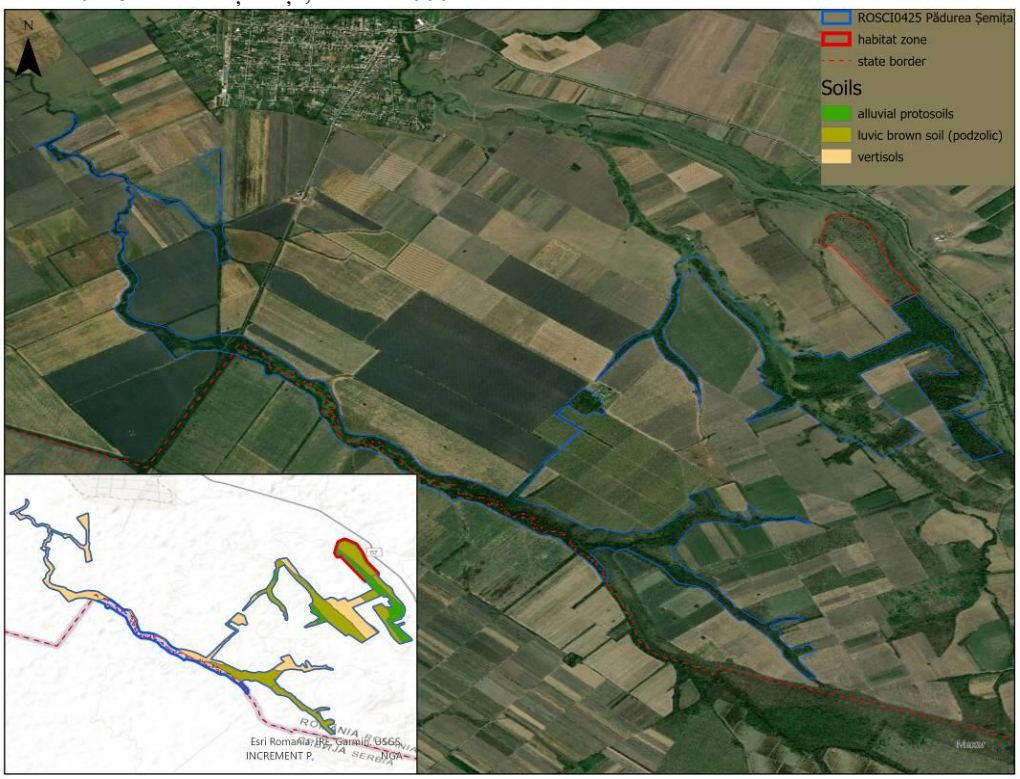

Figure 6. The distribution of *C. hungaricus* in relation to the ROSCI0245 Pădurea Șemița particularities

In all the locations where we found the beetle in Romania the soils are sandy, excepting Jamu Mare-Lățunaș location. The studied area in the vicinity of the *Robinia pseudoacacia* forest located outside the site and in which we identified the species is located on a slope with alluvial protosoils and luvic brown. The surface of the habitat in which the species was identified outside the site has 23 ha. In the observations from 2019 we did not find it on the valley at the Romania-Serbia border or on other meadows near Lățunaș, but the number and distribution of the samples are not enough to conclude the absence in outside of the known area. Of the habitat classes mentioned in the Standard Data Form of the protected area, the class vineyards and orchards, in which the beetle can be found, occupy only 6.26%. For the protection of the species, it is necessary to extend the site to include the meadows and orchards from the vicinity.

In Hungary, prior to the designation of Natura 2000 areas, knowledge about the distribution of the species and population size has been relatively low (BÉRCES et al. 2007) and in 2021 the species is protected in 37 Natura 2000 sites in Hungary. In the Republic of Moldova the species is known only from the publications of Kryžanovskij, 1983, 1995 (NECULISEANU 2003-2004). Only one Natura 2000 protected area has been designated for the protection of the species in Bulgaria, but new locations have also been identified through recent observations (BEKCHIEV et al 2018).

Given the small area of existing habitat, the pressures and threats on habitats and the national distribution, *Carbus hungaricus* require special attention and urgent measures to conserve existing habitats.

CONCLUSIONS

In Romania, the species *Carabus hungaricus* is located and has a distribution scattered in 4 areas far from each other. It was identified during the observations from 2019-2020 in four Natura 2000 sites. We made the first report of the species in ROSCI0039 Ciuperceni – Desa and we identified two areas where the species is present in ROSCI0020 Câmpia Careiului. Based on the sampling of presence / absence and field experience, we delineated the specific habitat area of ROSCI0039 Ciuperceni – Desa using Sentinel-2, 4-3-2 satellite bands. At ROSCI0045 Coridorul Jiului where there was only one signaling of an individual, we identified a favorable area occupied by the species. In locations where the species is present, the main pressure is habitat loss through the expansion of *Robinia pseudoacacia* forests and arable land. With the exception of Desa and Carei in all other locations, the habitat of the species has a small and affected surface. In ROSCI0425 Pădurea Șemița we propose the inclusion in the site of the meadows and orchards in the vicinity, respectively of the area where the species was identified. Sampling in the characteristic habitats is necessary to identify new distribution locations in which to apply measures for the conservation of the species.

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