PRESENT STATE AND CONSERVATION MEASURES FOR *ORCHIDACEAE* SPECIES IN THE NATIONAL PARK NERA GORGES–BEUȘNIȚA (S-W ROMANIA)

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Abstract. *The Family Orchidaceae is represented in Romania by 58 species. Literature describes, in the area of the National Park Nera Gorges – Beuşniţa, 33 species. Orchid species are among the most endangered and are well represented on different Red Lists. The list of threatened species in the Carpathians has 18 orchid species: 12 endangered, 5 vulnerable, and 1 critically threatened (Witkowski et al., 2003). At national level, the Red List developed by Oltean et al. (1994) contains the entire Family Orchidaceae. The Red List described by Dihoru et Dihoru includes 18 orchid species. The Red List described by Boşcaiu et al. (1994) includes 21 orchid species: 12 endangered, 5 vulnerable, 3 rare and 1 with inconclusive information. The Red Book of vascular plants from Romania, developed by Dihoru et Negrean (2009) includes 10 orchid species: 8 critically endangered, 1 endangered and 1 with low risk. The studies concerning the orchids in the area of the National Park Nera Gorges – Beuşniţa are very few and limited to aspects concerning species chorology. Research carried out during 2010-2013 aimed at identifying orchid species, present and/or potential threats a and the establishment of proper conservation measures. The study method consisted in direct observations in the field during species blooming. Thus, we identified 12 orchid species: Himantoglossum caprinum (M.Bieb.) Spreng. (synonymous for Himantoglossum hircinum (L.) Spreng subsp. caprinum (M.Bieb.) K. Richt), a species of community interest, Limodorum abortivum (L.) Sw., Orchis pallens L., Epipactis microphylla (Ehrh.) Swartz, Neottia nidus-avis (L.) L. C. M. Richard, Listera ovata (L.) R. Br., Platanthera bifolia (L.) L. C. Rich, Cephalanthera damasonium (Mill.) Druce, Gymnadenia conopsea (L.) R. Br., Epipactis helleborine (L.) Cr. Stirp., Orchis mascula (L.) L., Anacamptis pyramidalis (L.) Rich. The species were identified in both forest habitats dominated by Fagus sylvatica L. and grassland habitats. The main threats in the case of forest species are the shadow produced by the exaggerated development of the tree layer, uncontrolled tourism, and the destruction of the habitat by accidental forest fires, illegal deforestations, or the disrespect of exploitation technologies. Orchid species in grasslands are threatened mainly by irrational grazing and the lack of mowing or accidental fires. Conservation measures include immediate measures and preventive measures. The species Orchis mascula L. and Himantoglossum caprinum (M.Bieb.) Spreng. need immediate measures. The measures necessary in these species include the diminution of the shadowing through the removal of branches from the tree layer or of branches fallen on the soil to facilitate seed germination. Preventive conservation measures include preventing degradation or destroying habitats through the monitoring of the tree layer, preventing illegal deforestation, monitoring the tourist flows, preventing fires, monitoring grazing, and educating tourists and local population ecologically. The measures advanced should be completed with the monitoring of the population size, of the condition of the individuals, and or the efficiency of the measures applied.*

Keywords: *orchids, the National Park Nera Gorges-Beuşniţa, conservation, present and/or potential threats.*

INTRODUCTION

The Family *Orchidaceae* is one of the most numerous botanical families (Ehler *et* Pedersen, 2000; Cozzolio *et* Widmer, 2005; Kull *et al*., 2006) representing 6-11% of the species of flowering plants (Pillon *et* Chase, 2006). The number of orchid species is

estimated between 24.000 and 30.000 (Tyteca *et* Klein, 2008). In Romania, the Family *Orchidaceae* is represented by 58 species (Ciocârlan, 2009).

The Family Orchidaceae is represented in Romania by 58 species. Literature describes, in the area of the National Park Nera Gorges – Beuşniţa, 33 species. Orchid species are among the most endangered and are well represented on different Red Lists. The list of threatened species in the Carpathians has 18 orchid species: 12 endangered, 5 vulnerable, and 1 critically threatened (Witkowski et al., 2003). At national level, the Red List developed by Oltean et al. (1994) contains the entire Family Orchidaceae. The Red List described by Dihoru et Dihoru includes 18 orchid species. The Red List described by Boşcaiu et al. (1994) includes 21 orchid species: 12 endangered, 5 vulnerable, 3 rare and 1 with inconclusive information. The Red Book of vascular plants from Romania, developed by Dihoru et Negrean (2009) includes 10 orchid species: 8 critically endangered, 1 endangered and 1 with low risk.

In these conditions, conserving orchid species should be seen as a priority. At world and European levels, they make efforts to conserve these species both *in situ* and *ex situ*. Thus, the Washington Convention regulating international trade with flora and fauna threatened species (CITES) includes in its Annexe II the entire Family Orchidaceae.

In Europe, the Bern Convention concerning the conservation of wild life and of natural habitats in Europe and the Directive Habitats (92/43/EEC) attempts at conserving endangered species and their habitats. In Annexe II of these conventions, they have also included orchid species. Thus, the Directive Habitats (92/43/EEC) includes in its Annexe II the species *Cypripedium calceolus* L., *Liparis loeselii* (L.) Rich. and *Himantoglossum hircinum* (L.) Spreng under the name *Himantoglossum caprinum*. In Romania, the protection of the species endangered is done mainly through the adoption of these conventions. National legislation concerning the protection of nature also includes orchid species. Thus, the Emergency Ordinance no. 57/2007 concerning the regime of the protected natural areas, the conservation of natural habitats, of wild flora and fauna in Romania includes the species *Cypripedium calceolus* L. and *Liparis loeselii* (L.).

According to the Interpretation Manual of European Union Habitats, EUR 28, there are 11 types of habitats in Europe where they have identified orchid species. Five of them are a priority (Interpretation Manual of European Union Habitats, Eur 28). The most important habitats present also in the sites Natura 2000 in Romania are dry semi-natural grasslands and facieses covered by shrubbery of lime layer (*Festuco – Brometalia*) and medium-European beech forests of the *Cephalanthero – Fagion* type.

Dry semi-natural grasslands and facieses covered by shrubbery on lime substratum (*Festuco – Brometalia*) were designed priority habitat for orchid protection. This type of habitat is found in 16 of the 273 SCIs in Romania (OM 1964/2007). Studies carried out in Italy in lime grasslands with *Bromus erectus* Huds., a dominant species, show the presence of 7 orchid species in this type of habitat. The most abundant species was *Orchis pauciflora* Ten., followed by *Orchis morio* L. and *Orchis provincialis* Balb. The species *Orchis tridentata* Scop. Was represented by smaller populations, and the species *Orchis simia* Lam. and *Himantoglossum hircinum* (L.) Spreng. *ssp. adriaticum* were sporadic (Landi *et al*., 2009). Xeromesophilous lime grasslands with *Bromus erectus* Huds., dominant species, and discontinuous grass cover are the optimum habitat for all orchids in the Mediterranean area (Barbaro *et al*., 2003).

Medium-European beech forests of the *Cephalanthero – Fagion* type can be found in 20 sites in Romania. In this habitat, they protect mainly orchid species belonging to the genera *Cephalanthera* and *Epipactis.*

The National Park Nera Gorges –Beușnița which is overlapped by the site Natura 2000 ROSCI0031 Nera Gorges-Beușnița includes habitats where there are also orchids and orchid species. Among the habitats there are medium-European beech forests of the *Cephalanthero–Fagion* type (code Natura 2000: 9150) and dry semi-natural grasslands and facieses covered by shrubbery on lime sub-layer (*Festuco–Brometalia*) (code Natura 2000: 6210). In the standard form for which they designated the site ROSCI 0031 Nera Gorges – Beușnița, there is also the species *Himantoglossum caprinum* (code Natura 2000: 2327). In the category "other important flora and fauna species", there are also the species *Dactylorhiza maculata* (L.) Soó, *Gymnadenia conopsea* (L.) R.Br., *Ophrys scolopax* Cav. ssp. *cornuta* (Steven) E.G.Camus, *Orchis morio L.* subsp. *picta* (Loisel.) Arcang., *Orchis tridentata Scop., Orchis coriophora* L. subsp. *fragrans fragrans* (Pollini) Sudre, *Orchis simia* Lam.

Researches carried out so far concerning the orchid flora in the National Park Nera Gorges – Beușnița are few. The paper concerning the orchids in the Aninei Mountains, developed and published by Schrött *et* Faur (1972) refers to their ecology and chorology. They identified, between 1966 and 1968, 33 orchid species. Mentions of the presence of some orchid species from the Park area can also be found in Flora României vol XII edited by Săvulescu (1972), in the papers published by Ciocârlan (2000, 2009) or Goga (2007).

MATERIAL AND METHODS

Research carried out during 2010-2013 aimed at identifying orchid species, present and/or potential threats, and the establishment of proper conservation measures. The study method consisted in direct observations in the field during species blooming. The present state of these species was assessed based on population size and on threats observed. We monitored 3 categories of factors that threaten the species: environmental factors (drought), habitat factors, and species factors (e.g., production or absence of nectar).

RESULTS AND DISCUSSION

We thus identified 12 orchid species: *Himantoglossum caprinum* (M.Bieb.) Spreng. (synonym for *Himantoglossum hircinum* (L.) Spreng subsp. *caprinum* (M.Bieb.) K. Richt) a species of community interest, *Limodorum abortivum* (L.) Sw., *Orchis pallens* L., *Epipactis microphylla* (Ehrh.) Swartz, *Neottia nidus-avis* (L.) L. C. M. Richard, *Listera ovata* (L.) R. Br., *Platanthera bifolia* (L.) L. C. Rich, *Cephalanthera damasonium* (Mill.) Druce, *Gymnadenia conopsea* (L.) R. Br., *Epipactis helleborine* (L.) Cr. Stirp., *Orchis mascula* (L.) L., *Anacamptis pyramidalis* (L.) Rich. Species were identified in forest habitats dominated by *Fagus sylvatica* L. and also in grassland habitats. The species identified, the location, the status, the population size (number of items), the blooming period, present and/or potential threats are presented in Table 1. It shows that the populations are poorly represented numerically. Among species represented by less than 10 individuals were *Himantoglossum caprinum* (M.Bieb.) Spreng., *Limodorum abortivum* (L.) Sw., *Epipactis microphylla* (Ehrh.) Swartz, *Gymnadenia conopsea* (L.) R. Br, *Platanthera bifolia* (L.) L. C. Rich. The species *Anacamptis pyramidalis* (L.) Rich. *Orchis mascula* (L.) L. *Epipactis helleborine* (L.) Cr. Stirp. also had over 100 items.

Among common threats that affect species is drought. Literature shows that drought affects orchid species. Thus, studies carried out in Russia on the effect of climate conditions on

the dynamics of 21 populations belonging to 10 orchid species show that air temperature during vegetation influence particularly species abundance (Blinova, 2008). Drought has a negative effect on the behaviour of some orchid species (Bowles, 1983, Wells *et* Cox, 1991, Bernhardt *et* Retha, 2010). In the case of the species *Epipactis helleborine* (L.) Crantz, drought affects both population survival and blooming process. The effects can be immediate and they consist in flower wilting and shorter plants in the next year; there are also long run effects visible in the second year. In this species, what matters are the amounts of rainfall – particularly in the summer and in the fall – when the plants accumulate for the next season (Light *et* MacConaill, 2006). Climate conditions have a major impact on the species *Himantoglossum caprinum* (M.Bieb.) Spreng. Affecting blooming, flower number, and flower size (Harrap et Harrap, 2009).

The research period was characterised by drought, particularly the year 2011, when there was a maximum temperature of 33.9℃ in June, 36.2℃ in July, and 35.5℃ in August. The mean amount of precipitations was 27 l/m² in June and only 0.2 l/m² in August.

As for habitat factors, we could see that, in the species identified in forest habitats shadowing is a threat. Literature mentions that shadowing and the forest management system influence blooming and the genetic diversity of the species *Orchis mascula* (L.) L. (Jacquemyn *et al.,* 2007, 2009). In the case of the species *Cephalanthera damsonium* (Mill.) Druce also, that tolerated shadow well, we could see that the most robust individuals grow in areas where shadow is not very intense (Harrap *et* Harrap, 2009).

The species *Himantoglossum caprinum* (M.Bieb.) can be affected by shadow when growing in the shrubbery. When it grows in grassland habitats, fertilisation is a threat because it changes particularly soil pH and it can determine the change of the floristic composition. In France and England, they did not identify it on neuter soils or on acid substratum, though the climate conditions seemed favourable. The species does not occur in areas overgrazed by rabbits, sheep, or bovines (Carey *et* Farrel, 2002).

Literature mentions as influence factor in orchids species abundance in grassland habitats. The abundance of the grass cover leads to the competition of more vigorous species with orchid species (Janeckova *et al*., 2006). At the same time, less light also has a negative effect (Maccerini, 2006). Agricultural practices and grazing influence by limiting the competition of the dominant species and by the development of regeneration micro-areas (Grubb, 1986).

Microtopography and the presence or the absence of fungi in the soil is another limiting factor of the development of orchid populations in the grasslands (Rasmussen *et* Whigman, 1998; Brundrett *et al*., 2003). The pressure of grazing and soil heterogeneity has a large influence due to the fact that they act on the concentration of soil nutrients (Shiyomi *et al*., 2001). Besides the environmental factors mentioned above, species features play an important role in the fructification process. The species can influence the pollination process due to its ability of producing or not nectar or of producing self-compatible pollen.

We could see that the species producing nectar, the percentage of fructification is higher than that of the species that do not produce nectar. Nectar production also influences hybridisation and lower orchid density. Orchids that do not produce nectar hybridise more often and are rarer (Neiland *et* Wilcock, 1998; Bernhardt *et* Edens-Meier, 2010). Among the species monitored during 2010-2013, only the species *Gymnadenia conopsea* (L.) R. and *Epipactis helleborine* produce nectar (Neiland *et* Wilcock, 1998, Harrap *et* Harrap, 2009). The species *Cephalantehera damasonium* (Mill.) Druce and *Epipactis helleborine* (L.) Crantz

produce self-compatible pollen. In the species *Epipactis helleborine* (L.) Crantz self-pollination is not a very common phenomenon (Harrap *et* Harrap, 2009).

To these factors, we could also add the threats by uncontrolled tourism, the destruction of the habitat after accidental or intentional fires, the destruction of the habitat through the non-observance of the exploitation technology or illegal deforestation.

Conservation measures suppose immediate measures and preventive measures. We need immediate measures in the case of the species *Orchis mascula* (L.) L. from the Ciclova Valley and *Himantoglossum caprinum* (M.Bieb.) from the Bei Valley. We recommend the diminution of the shadowing through the removal of neighbouring shrubs. In the other species identified in forest habitats, we recommend thorough monitoring and interventions to diminish shadowing if necessary.

In the species *Anacamptis pyramidalis* (L.) Rich. and *Gymnadenia conopsea* (L.) R. Br in the Socolari area, we recommend regular mowing to reduce the abundance of the other grassland species and rational grazing and avoidance of the blooming period in orchids.

Preventive measures aim, in the species identified in forest habitats, careful monitoring and interventions to reduce shadowing if necessary. In the species identified in grassland habitats, we recommend careful monitoring and interventions to reduce the abundance of the other species through regular mowing if necessary.

The measures we recommend should be monitored through careful surveillance of the population and individual condition. Population condition can be monitored by counting the number of plants and that of individuals can be monitored by biometric measurements of the main features (plant height, length of the inflorescence, number of flowers/plant, number of fruits/plant, and percentage of fructification).

CONCLUSIONS

We identified 12 orchid species in both grassland and forest habitats.

The species were poorly represented in number, and the populations were very small. In the species *Himantoglossum caprinum* (M.Bieb.) Spreng., *Limodorum abortivum* (L.) Sw., *Epipactis microphylla* (Ehrh.) Swartz, *Gymnadenia conopsea* (L.) R. Br, *Platanthera bifolia* (L.) L. C. Rich. We identified below 10 individuals. The species *Anacamptis pyramidalis* (L.) Rich. *Orchis mascula* (L.) L. *Epipactis helleborine* (L.) Cr. Stirp. counted over 100 individuals.

Drought is one of the factors that affect all the species we identified. To assess the effects of drought on the studied species, we recommend the monitoring of population size and of morphological features. Thus, the features monitored are related particularly to flowers and fruits, and also to plant size.

In forest species, shadowing is the main factor that affects the species, and in the grassland species the main factor is species abundance caused by irregular mowing.

Conservation measures suppose immediate measures and preventive measures to be taken. Immediate measures in forest species are necessary in the species *Orchis mascula* (L.) L. in the Ciclovei Valley and *Himantoglossum caprinum* (M.Bieb.) in the Bei Valley: they consist in reducing shadowing through the removal of branches from the tree layer.

In the species *Anacamptis pyramidalis* (L.) Rich. and *Gymnadenia conopsea* (L.) R. Br from the Socolari area, we recommend regular mowing to reduce the abundance of the other grassland species and rational grazing avoiding the orchid blooming period.

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Table 1.

Species identified, location, status, population size, blooming period, present and/or potential threats

Species	Location	Status	Population size	Blooming period	Current and/or potential threats
Himantoglossum caprinum (M.Bieb.) Spreng.	Bei Valley, Ciclovei Valley	Endangered (Boşcaiu *et al*. (1994) Rare (Dihoru *et* Dihoru, 1994, Oltean *et al*. (1994) Endangered on the List of threatened species in the Carpathians (Witkowski *et al.*, 2003)	1-9	V-VI indicated in literature (Ciocârlan, 2009) VI-VII noticed in the field	Harvesting by the tourists Degradation or destruction of the habitat by fire Shadowing caused by exaggerated development of the tree layer - needs immediate measures Prolonged drought
Limodorum abortivum (L.) Sw.,	Bei Valley Ilidia Nera Gorges Ciclovei Valley	Rare (Dihoru *et* Dihoru, 1994, Olteanu *et al*. (1994) Endangered on the List of threatened species in the Carpathians (Witkowski *et al.*, 2003)	1-8	V-VI indicated in literature (Ciocârlan, 2009) VI-noticed in the field	Harvesting by the tourists Degradation or destruction of the habitat by fire Deforestation Drought
Orchis pallens L.,	Simion Peak Marilei Valley Poiana Iulii	Rare (Dihoru *et* Dihoru, 1994, Oltean *et al*. (1994) Endangered on the List of threatened species in the Carpathians (Witkowski *et al.*, 2003) Endangered in the Red Book of vascular plants from Romania (Dihoru *et* Negrean, 2009)	2-20	IV-V indicated in literature (Ciocârlan, 2009) IV-noticed in the field	Degradation or destruction of the habitat by fire Shadowing caused by exaggerated development of the tree layer Deforestation Drought
Epipactis microphylla (Ehrh.) Swartz,	Bei Valley	Rare (Dihoru *et* Dihoru, 1994, Oltean *et al*. (1994)	4-5	VI-VII indicated in literature (Ciocârlan, 2009) VI-noticed in the field	Degradation or destruction of the habitat by fire Deforestation Uncontrolled tourism Drought

Neottia nidus – avis (L.) L. C. M. Richard,	Bei Valley Beușnița Basin Ogașul Porcului – Lacul Dracului	Rare (Oltean *et al*. (1994)	2-14	V-VIII indicated in literature (Ciocârlan, 2009) V-noticed in the field	Degradation or destruction of the habitat by fire Deforestation Uncontrolled tourism Drought
Listera ovata (L.) R. Br.,	Bei Valley	Rare (Oltean *et al*. (1994)	2-17	V-VII indicated in literature (Ciocârlan, 2009) V-noticed in the field	Degradation or destruction of the habitat by fire Deforestation Uncontrolled tourism Drought
Platanthera bifolia (L.) L. C. Rich,	Bei Valley Canton Păuleasca – Poiana Florii	Rare (Oltean *et al*. (1994)	2	V-VII indicated in literature (Ciocârlan, 2009) V- VI noticed in the field	Degradation or destruction of the habitat by fire Deforestation Uncontrolled tourism Disrespect of timber exploitation technologies Drought
Cephalanthera damasonium (Mill.) Druce	Bei Valley	Not threatened (Oltean *et al*. (1994)	5-40	V-VI indicated in literature (Ciocârlan, 2009) V-noticed in the field	Degradation or destruction of the habitat by fire Uncontrolled tourism Disrespect of timber exploitation technologies Drought
Gymnadenia conopsea (L.) R. Br	Socolari	Rare (Oltean *et al*. (1994)	2	VI-VII indicated in literature (Ciocârlan, 2009) VI-noticed in the field	Degradation through overgrazing Fire Abandonment of traditional mowing Drought
Epipactis helleborine (L.) Cr. Stirp.,	Bei Valley Ilidia Canton Păuleasca – Poiana Florii Ciclovei Valley Șușara Gorges Poiana Roșchii-Canton Știubei	Rare (Oltean *et al*. (1994)	2-200	VI-VII indicated in literature (Ciocârlan, 2009) VII-noticed in the field	Degradation or destruction of the habitat by fire Uncontrolled tourism Disrespect of timber exploitation technologies Drought

Orchis mascula (L.) L.	Ciclovei Valley Simion Peak	Rare (Oltean *et al*. (1994)	50-100	IV-VI indicated in literature (Ciocârlan, 2009) V-noticed in the field	Shadowing caused by exaggerated development of the tree layer - needs immediate measures Drought
Anacamptis pyramidalis (L.) Rich.	Socolari	Vulnerable/Rare (Oltean *et al*. (1994) Endangered on the List of threatened species in the Carpathians (Witkowski *et al.*, 2003)	14-200	V-VI indicated in literature (Ciocârlan, 2009) V-noticed in the field	Grazing Lack of regular mowing Fire Drought

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Fig.1 Anacamptis pyramidalis (L.) Rich. in Socolari meadows (Photo A. Nicolin)

Fig.2 Orchis mascula (L.) L. în Ciclova Valley (Photo N. Bâtea)

Fig.3 Shrub encroachment have a negative impact *Himantoglossum caprinum* (M.Bieb.) în Bei Valley. (Photo N. Bâtea)