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Original Article

Materials for the red book of vascular flora of Montenegro (second contribution)

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***Abstract*:**
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The first contribution to the "Material for the red book of Montenegro" was published in 2008 and it included 30 threatened taxa of vascular flora. In the mean time, new floristic surveys were undertaken and some new chorological data, that helped us to define a conservation status of some rare species, were gathered. In this paper we present 5 taxa categorized as endangered: *Ammophila arenaria* (L.) Link subsp. *arundinacea* H. Lindb., *Haplophyllum patavinum* (L.) G. Don fil., *Hydrocotyle vulgaris* L., *Medicago carstiensis* Jacq. and *Orchis pallens* L., and 4 as vulnerable: *Campanula sparsa* Friv. subsp. *sphaerothrix* (Griseb.) Hayek, *Geranium subcaulescens* L'Hér. ex DC, *Hydrocharis morsus-ranae* L., *Polygonum maritimum* L..

Key words: vascular plants, threatened taxa, red book, Montenegro

Introduction

Up to now, systematic investigations of rare and endangered vascular plants of Montenegro have never been performed. Majority of data about these groups of plants are more than few decades old, not very accurate, and without information about population size, population trend, covered area. Due to the fact it is very difficult to rely on this data and combine them with new findings and give precise proposals for IUCN categorization for threatened species. Especially if we take into consideration the fact that in last few years human impact is rapidly growing. Thus, for some species, which are in old literature sources known for only one locality, is doubtfully if they are still present in our flora. This is particular for localities situated in the southern part of the country, which is under the great pressure of urbanization, known as a major man made threat to biodiversity in Montenegro (Petrović, 2009).

The first contribution to the "Material for the red book of Montenegro" was published in 2008 (Petrović et al., 2008) and it included 30 threatened taxa of vascular flora. In the mean time, new floristic surveys were undertaken and some new chorological data, that helped us to define a conservation status of some rare species, were gathered.

Material and methods

The nomenclature follows Med-Checklist (Greuter et al., 1984-1989), and Flora Europaea (Tutin et al., eds., 1964-1980, 1993). Actual name of the taxon is followed by synonym(s), IUCN category and criteria, regional adjustment of category, estimation of population condition and its trend, causes of threats, description of taxon, habitat type, distribution in Montenegro and Europe. In estimation of level of threat we used 3.1 version of IUCN Red List categories and criteria (IUCN, 2001), as well as Guidelines for using IUCN Red List categories and criteria (IUCN, 2005); while in regional adjustment of categories IUCN Regional guidelines to Red List categories and criteria

(IUCN, 2003.) Population size is assessed by approximate number of individual or approximate area size. Causes of threats are given as descriptive, while types of threats are accorded to IUCN standard classification (Hilton-Taylor, 2000). Conservation measures included information about conservation status of the taxon in Montenegro, and for some species also a recommendation of the author for need of conservation. Description of the taxon comprise of general morphological features, life form and flowering time. Literature sources on which we based descriptions are: Tutin et al., eds., (1964/1980, 1993), Josifović ed. (1970-1977), Pignatti (1982). Due to the fact that Montenegro doesn't have developed habitat classification, descriptive method is used. Distribution range of the taxon on territory of Montenegro is based on literature data and own field observations and it is mapped on a 10 × 10 km^2 UTM grid system. One UTM map presents distribution of 3 taxa. Symbols used are 3 colored spots and asterisk. In citations considering area of distribution in Europe, abbreviations from Flora Europaea were used, with addition of one for ex Yugoslav Republics (BH-Bosnia & Herzegovina; Cro- Croatia; Mc-Macedonia; Mne- Montenegro; Sr- Serbia; Sl-Slovenia). In the case when we reliably know that species is extinct from the locality on which it was in former time recorded, than locality is marked with (†).

Non-published chorological data are marked with asterisk. The collected material is deposited in the Herbarium Collection of Faculty of Natural Sciences and Mathematics, University of Montenegro (TGU).

Results and disscusion

***Ammophila arenaria* (L.) Link subsp. *arundinacea* H. Lindb. (*syn. Ammophila arenaria* (L.) Link var. *australis* (Mabille) Hayek)**

IUCN category: EN **Criteria:** B2ab(iii,v)
Regional adjustment of categories: Introduction is hardly possible because of habitat degradation.
Assessment of population and population trend: Population is decreasing.
Causes of threats: Tourism development and urbanization that result with destruction or habitat fragmentation. According to urban planning, huge hotel complexes will be built up on Long Ulcinj Beach. This might cause a total extinction of this species from the flora of Montenegro.
According to IUCN standard classification: 1. Habitat loss (primarily human induced): 1.3 Development (1.3.3 Tourism).
Conservation measures: Species is protected by national low (Official gazetta of the Republic of Montenegro n°26/06). Due to the fact that Long Ulcinj Beach has status of the Monument of Nature, species is indirectly protected.
Taxon description: Perennial with very long (up to 5m), extensively creeping rhizomes and number of stout stems up to 120 cm. Leaves thick, convolute, with white waxy cuticle, up to 1 m. Inflorescence cylindrical panicle, up to 35 cm; spikelets with 1 flower. Lemma coriaceous, 2-fid at apex, with hairs at base (4-5 mm). Glumes about equaling lemma. Flowering time: IV-V. Life form: G rhiz
Habitat: coastal sandy dunes
Distribution in Montenegro: In arenosis maritimis ad Štoj et Ulcinj distr. Primorje (Rohlena, 1942), Velika ulcinjska plaža (Mijović, 1994) (**Fig. 1**).
Distribution in Europe: Al, Bl, Bu, Co, Cr, †Cro, Ga, Gr, Hs, It, Lu, Rm, Sa, Si, Tu (Nikolić & Topić eds. 2005; Tutin, 1980)

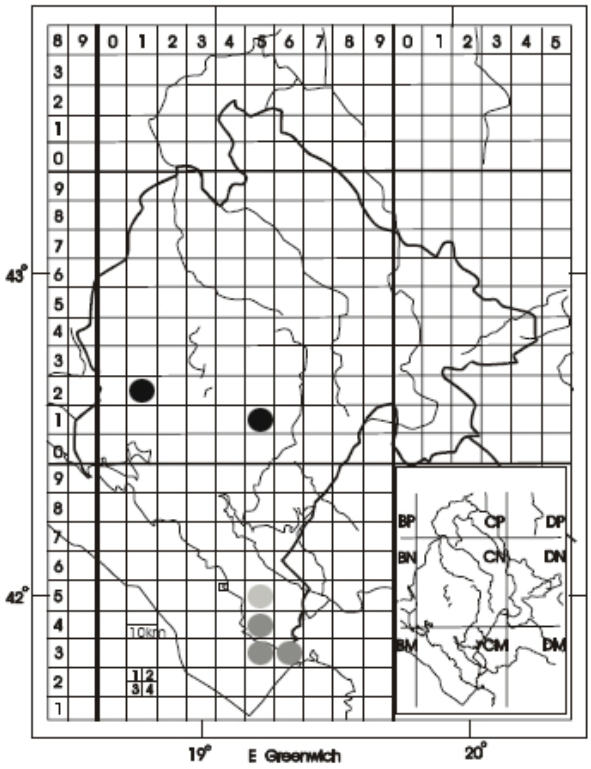

Fig. 1. Distribution map of *Ammophila arenaria* (dark grey spot), *Haplophyllum patavinum* (black spot), *Geranium subcaulescens* (light grey spot).

***Haplophyllum patavinum* (L.) G. Don fil.**

IUCN category: EN **Criteria:** B2ab(iii,v)
Regional adjustment of categories: Possible introduction from neighboring areas, VU.
Assessment of population and population trend: According to Rohlena (1942), this species is recorded only for Nikšićke Rudine, with comment that it is rare. Later, species was found at the locality

Gostilje Martinićko in Piperi, also in a poor population. After a new road construction in the same vicinity of population's habitat, no individuals were recorded. Further investigations are needed in order to investigate if population is completely destroyed. Third locality on which *Haplophyllum patavinum* is recorded is Grahovo polje (Daniel Vincek, pers. comm.), but recent filed survey didn't confirm its presence. Based on these facts we estimate that population of this species in Montenegro is decreasing.

Causes of threats: Population at Gostilje Martinićko is threatened by urbanization. For other localities no precise data are available, but considering the fact that localities are in the vicinity of populated area urbanization tend to be the major threat.

According to IUCN standard classification: 1. Habitat loss (primarily human induced): 1.3 Development (1.3.4 Infrastructure (road, dams, power lines etc.)).

Conservation measures: Species is protected by national low (Official register of the Republic of Montenegro n°26/06).

Taxon description: Perennial, stem 10-30 cm. Leaves alternate, basal entire, middle 3-divided, lanceolate-lineare, uppermost simple or with 3 segments. Inflorescence cymose, dense, with 10-30 flowers, petals yellow, entire. Capsule 5-lobed, with scattered tuberculate glands. Flowering time: V-VI. Life form: Ch suffr.

Habitat: rocky and open habitats.

Distribution in Montenegro: Nikšićke Rudine (Rohlena, 1942), Gostilje Martinićko (Stešević, 2001) (**Fig. 1**).

Distribution in Europe: Al, BH, Cr, Gr, Mne, It, Rm (Beck, 1920, Townsend, 1968, Domac, 1984)

***Hydrocotyle vulgaris* L.**

IUCN category: EN **Criteria:** B2ab(iii,v)

Regional adjustment of categories: Introduction is hardly possible because of habitat degradation.

Assessment of population and population trend: At Long Ulcinj Beach trend of decrease in population size is reported. Populations near the shore of Šasko Lake and Skadarsko Lake are small, but up to now stable.

Causes of threats: Major threat to populations at Long Ulcinj Beach is urbanization, which is intensified in last 5 years. Beach mobiliar, construction of parking places, road infrastructure and temporal buildings is taking more and more space. It distracts very sensitive ecosystems of sandy beaches, as well as Mediterranean wetlands inhabited by *Hydrocotyle vulgaris*. Another potential threat is lake's eutrophication.

According to IUCN standard classification: 1. Habitat loss (primarily human induced): 1.3 Development (1.3.3 Tourism), 6. Land/ Water pollution (6.4 Other)

Conservation measures: Species is protected by national low (Official register of the Republic of Montenegro n°26/06).

Taxon description: Perennial or biennial, stem slender, creeping and rooting at the nodes, up to 30 cm but usually much less. Leaves shiny, glabrous or sparsely pubescent on lower side, suborbicular and slightly crenate, rather fleshy, petioles up to 25 cm, attached in the middle of a leaflet. Flowers in whorls, small, white or reddish. Fruit nearly sessile, with three prominent ridges. Flowering time: V-VII. Life form: G rhiz

Habitat: Damp places, shallow water, often in reed vegetation belt.

Distribution in Montenegro: Ulcinj: Long Beach, brackish water near the see (leg. V. Pulević), Skadarsko lake: village Gostilj, wetlands (Hadžiablahović, 2005), Šasko lake (leg. S. Vuksanović & D. Petrović, 2007)* (**Fig. 2**).

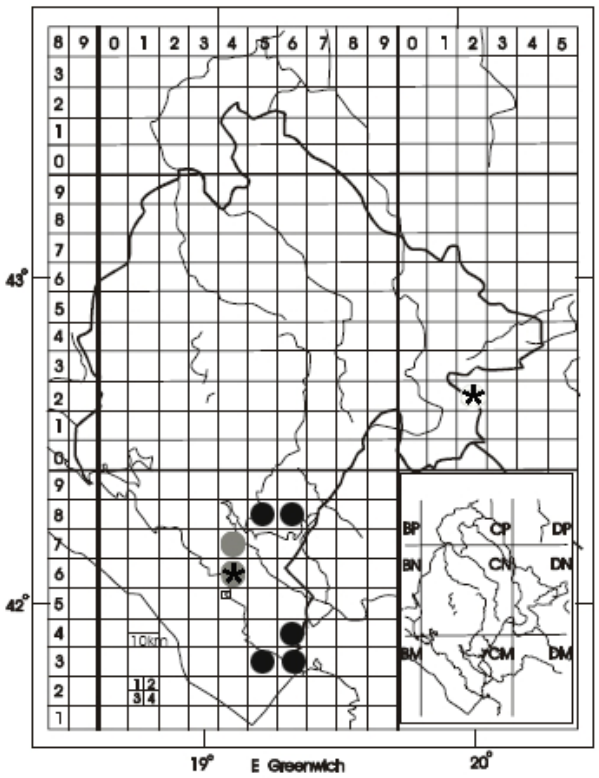

Fig. 2. Distribution map of *Medicago carstiensis* (grey spot), *Hydrocotyle vulgaris* (black spot), *Orchis pallens* (asterisk)

Distribution in Europe: Al, Au, Az, Be, Br, Co, Cr, Cro, Cz, Da, Ga, Ge, Gr, Hb, He, Ho, Hs, Hu, It, Lu, Mc, Mne, No, Po, Rs (B,C), Si, Sl, Su

(Cannon, 1968; Martinčić et al. eds. 1999; Nikolić & Topić, eds., 2005)

***Medicago carstiensis* Jacq.**

IUCN category: EN **Criteria:** B1ab(iv,v); C1
Regional adjustment of categories: Possible introduction from neighboring areas, VU.
Assessment of population and population trend: Species is recorded only at the territory of Rumija massive. Subpopulations are composed of a small number of individuals, and thus, very sensitive to anthropogenic disturbance. In last three years, at the locality Baša not even one individual is recorded, so declining trend of population is noted.
Causes of threats: Major threats are: i) forest cutting that leads to habitat degradation and ii) fires. In last few years in the vicinity of its habitat building constructions is noted. Some minor impact on habitat changes has cattle breeding (bivones grazing).
According to IUCN standard classification: 1. Habitat loss (primarily human induced): 1.1 Agriculture (1.1.5 Grazing), 1.3 Development (1.3.2 Human settlement) 1.4 Unspecified causes (1.4.2 Deforestation); 4. Atmospheric pollution: 4.3 Wildfire
Conservation measures: Species is not protected by national low.
Taxon description: Glabrous perennial, stem single, erect of ascending, up to 65 cm. Leaves long petiolate, leaflets obovate or elliptical, denticulate. Racemes up to 12(-20) flowers, corolla yellow. Legume single or 2-3 together; in a spiral of 5-8 turns, glabrous, with transversal veins, black when ripe. Spines half as long to as long as the diameter of the legume. Flowering time: V-VII. Life form: H scap.
Habitat: In light forests, shrubs, forest edge.
Distribution in Montenegro: Sutorman: Đolaza, 790 mnv Sutorman: Baša, 730 mnv (Petrović, 2004), Virpazar (Hadžiablahović, 2004), Sutorman: Lonac, *Quercus cerris* shrubland edge (leg. D. Petrović, 2009)* (**Fig. 2**).
Distribution in Europe: Al, Au, BH, Bu, Cro, It, Sl, Sr (Beck, 1927, Tutin, 1968; Domac, 1984; Kojić, 1972, Martinčić et al., 1999)

***Orchis pallens* L.**

IUCN category: EN **Criteria:** D
Regional adjustment of categories: Possible introduction from neighboring areas, VU.
Assessment of population and population and population trend: No data are available about population size at locality Planinica. Population recorded at Vrsuta mountain is very small and consists of only few individuals.
Causes of threats: During the last few years illegal and rather intensive forest cutting on Vrsuta is recorded, exactly in the beech-hornbeam forest where this species has been found. If this trend continuous, this habitat might be completely destroyed and lost in near future. In the period April-October this year bovines are grazing there, so grazing and nitrification are considered as additional causes of environmental changes. Other threats are frequent summer fires, which are characteristic for Rumija district. Considering the fact that population consists of only few individuals, and is very vulnerable, it can easily disappear under the pressure of some of the mentioned threats.
According to IUCN standard classification: 1. Habitat loss (primarily human induced): 1.1 Agriculture (1.1.5 Grazing), 1.4 Unspecified causes (1.4.2 Deforestation); 4. Atmospheric pollution: 4.3 Wildfire
Conservation measures: This is one of the few taxa from family *Orchidaceae,* not included in the list of plants protected by national law, although it is very rare. Accordingly, for this species no nature protection measures exist. From that reason, we propose the species to be included in the list of plants protected by national law.
Taxon description: Stem 15-40 cm, with 4-6 oblong or oblong-obovate leaves in the lower part and sheaths above. Flowers pale yellow, spike ovoid or oblong and dens. Outer perianth segments 6-9 mm long, ovate-oblong, lateral spreading; median convergent into a galea with the 2 inner perianth segments. Labelum slightly 3-lobed, wider than long. Spur patent, slightly shorter than ovary. Flowering time: IV-V(-VI). Life form: G (**Fig. 4**).
Habitat: In light forests and shrubs, shrubs, rarely on mountain meadows; on limestone.
Distribution in Montenegro: Planinica u regionu Čakora, cca 1900 m (Šmarda, 1968), Vrsuta (leg. D. Petrović & D. Stešević, 2009)* (**Fig. 2**).
Distribution in Europe: Al, Au, Bu, BH, Cr, Cro, Cz, Ga, Ge, Gr, He, Hu, It, Mc, Mne, Po, Rm, Rs (K), Sr, Sl (Beck, 1903; Stojanov 1921; Soó, 1980; Nikolić & Topić eds. 2005, Martinčić et al., 1999)

***Campanula sparsa* Friv. subsp. *sphaerothrix* (Griseb.) Hayek (*syn. C. expansa* subsp. *sphaerothrix* (Griseb.) Hay, *C. sphaerothrix* Griseb.)**

IUCN category: VU **Criteria:** D
Regional adjustment of categories: Possible introduction from neighboring areas, NT

Assessment of population and population trend: No data are available for population size at locality Balj. Population on Gradišta is rather poor, while one in Boljevići consists of approximate 30 individuals. We estimate that subpopulations at Gradišta and Boljevići are stable.
Causes of threats: Forest cutting and urbanization presents major threat to this taxon. **According to IUCN standard classification:** 1. Habitat loss (primarily human induced): 1.3 Development (1.3.2 Human settlement) 1.4 Unspecified causes (1.4.2 Deforestation);
Conservation measures: Species is not protected by national low (Official register of the Republic of Montenegro n°26/06). Due to the fact that this species is endemic of Balkan Peninsula and its populations are rare and poor, we propose this species to be included in the list of plants protected by national law.
Taxon description: Annual, with taproot, slender stem up to 50 cm, glabrous or sparsely pubescent. Lower leaves pedunculate, obovate, withering at anthesis; upper leaves sessile, linear. Panicles with long branches; flowers are long petiolate; calyx teeth subulate, longer than ovary and violet corolla. Flowering time: V-VII. Life form: T scap.
Habitat: Forests, and scrublands.
Distribution in Montenegro: In silva ad latera montis Balj (reg. subalpina) supra Andrijevica (Rohlena, 1942), Gradište (Vuksanović et al., 2004), Boljevići, chesnut (*Castanea sativa*) forests (leg. D. Petrović, 2009) * (**Fig. 3**).
Distribution in Europe: Al, BH, Bu, Gr, Mc, Mne, Sr (Bornmüller 1928, Fedorov & Kovanda, 1976; Obradović, 1974; Bjelčić, 1983)

***Geranium subcaulescens* L'Hér. ex DC (*syn. Geranium cinereum* Cav. subsp. *subcaulescens* (L'Hér. ex DC.) Hayek)**

IUCN category: VU **Criteria:** D
Regional adjustment of categories: Possible introduction from neighboring areas, NT.
Assessment of population and population and population trend: It is estimated that population consists of 300 individuals and for now it is stable.
Causes of threats: Meadows and rock lands above the timber line on Lisinj mountain are used by local population for cattle grazing (bivones, sheeps, goats). Furthermore, we noticed that in last few years (monitoring of this population dates from 2006) in the period april-october group of 30 horses is also grazing there. At some localities, where species *Geranium subcaulescens* grows nitrifications is noted as well as habitat vulnerability. Considering the fact that locality is approximate 3 km distant from nearest forest, fire doesn't present a serious threat.
According to IUCN standard classification: 1. Habitat loss (primarily human induced): 1.1 Agriculture (1.1.5 Grazing) 4. Atmospheric pollution: 4.3 Wildfire
Conservation measures: Species is not protected by national low (Official gazetta of the Republic of Montenegro n°26/06).
Taxon description: Perennial with stout rhizome, stem up to 25 cm, but usually much shorter. Basal leaves in rosette, with petioles up to 12 cm, deeply-lobed, appresed-pubescent; segments broadly cuneate or obdeltate, 3 lobed at apex. Stem and peduncles patent pubescent. Sepals aristate, appresed-pubescent with some long hairs; petals obovate, reddish-purple. Flowering time: V-VII. Life form: H ros (**Fig. 5**).
Habitat: Alpine rock lands and meadows, between altitudes 1500-2400 m, usually on limestone (Persson, 1986).
Distribution in Montenegro: montis Lisinj supra Bar (Baldacci, 1892); Lisinj (leg. D. Petrović, 2008.) (**Fig. 1**).
Distribution in Europe: Al, An, Cr, Gr, It, Mc, Mne, Sr (Webb & Ferguson, 1968; Hayek, 1925; Persson, 1986; Diklić, 1977; Micevski, 2005)

***Hydrocharis morsus-ranae* L.**

IUCN category: VU **Criteria:** D
Regional adjustment of categories: Possible introduction from neighboring areas, NT
Assessment of population and population trend: Registered subpopulations cover few square meters. Up to now they are stable.
Causes of threats: Lake eutrophication presents a potential threat.
According to IUCN standard classification: 6. Land/ Water pollution (6.4 Other)
Conservation measures: Species is not protected by national law, but taking into account that localities on which it is recorded belong to National Park "Skadarsko lake", it is indirectly protected.
Taxon description: Perennial floating plant, stem 15-30 cm, with long stolons bearing at the end a leaf rosette. Leaves long petiolate, floating, orbicular, cordate at the base. Flowers unisexual, mail flowers in pedunculate, 1-4 flowered spathes, female flowers solitary, sessile. Petals white, much bigger that calyx.
Flowering time: V-VIII. Life form: Hyd
Habitat: Still and slow running water

Distribution in Montenegro: Skadarsko lake, Plavnica (Blaženčić, 2007), Skadarsko lake: Pančeva oka, Crni žar (leg. V. Biberdžić) (**Fig. 3**).
Distribution in Europe: Au, Be, Br, Bu, Cro, Cz, Da, Fe, Ga, Ge, Gr, Hb, He, Ho, Hs, Hu, It, No, Po, Rm, Rs, Sl, Sr, Su, Tu (Stojanov 1921, Janković, 1975 Dandy, 1980; Domac, 1984; Martinčić et al., 1999).

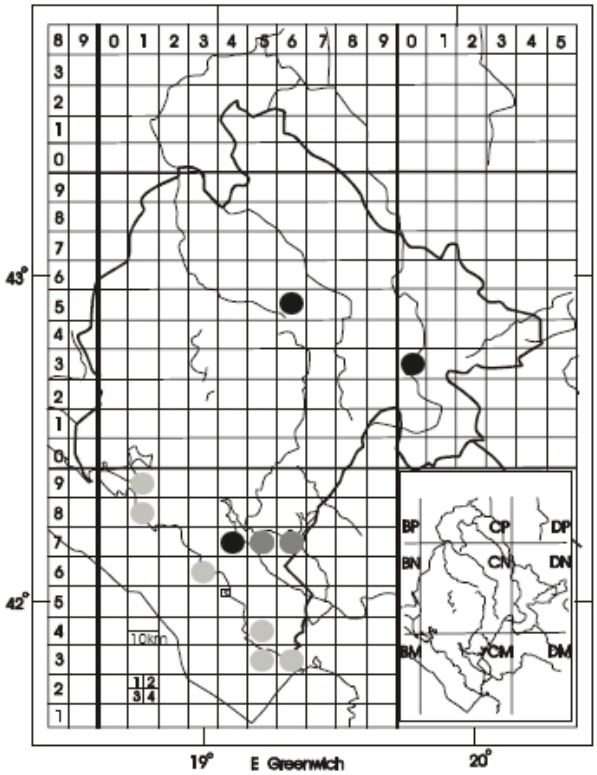

Fig. 3. Distribution map of *Hydrocharis morsus-ranae* (dark grey spot), *Campanula sparsa* subsp. *sphaerothrix* (black spot), *Polygonum maritimum* (light grey spot)

***Polygonum maritimum* L.**

IUCN category: VU **Criteria:** B2ab(iii,v)
Regional adjustment of categories: Introduction is hardly possible because of habitat degradation.
Assessment of population and population trend: Long Ulcinj Beach subpopulation is the most numerous one, but due to habitat degradation tendency of decrease is recorded. In 2002 population at Jaz consists of about 50 individuals, while in the year of 2009 only few of them were noticed. Populations from the other localities are rather poor and consist of a few individuals.
Causes of threats: Tourism development and urbanization, which leads to habitat fragmentation and complete destruction (**Fig. 6**).
According to IUCN standard classification: 1. Habitat loss (primarily human induced): 1.3 Development (1.3.3 Tourism).
Conservation measures: Species is protected by national low (Official register of the Republic of Montenegro n°26/06). Due to the fact that Long Ulcinj Beach has status of the Monument of Nature, species are in addition indirectly protected.
Taxon description: Perennial, with procumbent, much branched stem up to 50 cm. Leaves glabratus, glaucos, narrow elliptical, fleshy and evergreen. Ochrea ferrugineus at the base, hyaline distally. Flowers are small, whit-pinkish, solitary or in clusters 2-3. Flowering time: V-VIII. Life form: H rept
Habitat: sandy beaches
Distribution in Montenegro: ad Bar et Ulcinj, (Rohlena, 1942), Pržno (Karaman, 1997), Jaz, (leg. D. Petrović & D. Stešević, 2002)*, Ada Bojana (leg. D. Stešević & D. Petrović, 2005)*, Buljarica, (leg. S. Vuksanović & D. Petrović, 2007)* (**Fig. 3**).
Distribution in Europe: Al, Az, Bl, Br, Bu, Co, Cr, Cro, Ga, Gr, Hb, Ho, Hs, It, Lu, Mne, Rm, Rs (K), Sa, Si, Sl, Tu (Domac, 1984; Webb, 1993, Martinčić et al., 1999)

Fig. 4. *Orchis pallens*

Conclusion

In our second contribution to the "Materials for the Red Book of Vascular Flora of Montenegro" IUCN categorization for 9 plant taxa was done. Five species are assessed as endangered (EN), and four as vulnerable (VU). Furthermore, two taxa: *Orchis pallens* and *Campanula sparsa* subsp. *sphaerothrix* are proposed to be added on the list of plants protected by national law. So, up to date one species

in flora of Montenegro has status of regionally extinct (RE), 13 are critically endangered (CR), 15 are endangered (EN) and 10 are vulnerable (VU). Rapid urbanization and tourism development (especially in southern part of the country) are recognized as major threats to rare and vulnerable plants. These human actions are directly causing fragmentation or even complete habitat loss. In order to successfully preserve such vulnerable plants and its habitats, intensive and systematic investigation is needed to be done and finally incorporated in the Red Book. Furthermore, results of such investigations will present a good base for implementation of NATURA 2000, which is planed to be done in near future.

Fig. 5. *Geranium subcaulescens*

Fig. 6. Long Ulcinj Beach- habitat degradacion

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