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Calla palustris L. a rare plant in a unique habitat – Bolătău Swamp Reserve, Dorna Arini (Suceava County, Romania) - preliminary study regarding the anthropogenic impact

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Abstract. In this paper we present and confirm the presence of *Calla palustris* L. a rare plant species known in Moldova only from Bolătău Swamp Reserve, Dorna Arini – Suceava country. We also present the preliminary studies regarding the population size and density, the area preferred by *C. palustris*, the species which are associated and grow in that area and the anthropogenic impact over the population of marsh Calla.
Key Words: *Calla palustris*, marsh, conservation, pollution.

Resumen. En este papel se presentan y confirma la presencia de *Calla palustris* L., especia rara de plantas conocidas en Moldova sólo de Bolătău reserva, Dorna Arini - región Suceava. Presentamos los estudios preliminares sobre el tamaño de la población y la densidad, el área preferida por *C. palustris*, las especies que están asociadas y crecen en esa área. Tambien el impacto antropogenico sobre la población de Calla de marisma.
Palabras claves: *Calla palustris*, marisma, conservación, contaminación.

Rezumat. În acest articol confirmăm prezența speciei *Calla palustris* L., o specie vegetală rară menționată în Moldova doar în rezervația mlaștina Bolătău, Dorna Arini, Județul Suceava. Se prezintă un studiu preliminar privind mărimea și densitatea populației, zona unde se găsește, speciile cu care se asociază, cât și impactul antropic asupra populației de *Calla palustris* L..
Cuvinte cheie: *Calla palustris*, mlastină, protecţie, poluare.

Introduction. *Calla* (Bog Arum, Marsh Calla) is a genus of flowering plant in the family Araceae, containing the single species *Calla palustris* L.. *Calla palustris* (Figs 2-3) is a low perennial herb with flowers and fruits from April to August. It is a rhizomatous herbaceous perennial plant growing in bogs and ponds. The leaves are rounded to heart-shaped, 6–12 cm long on a 10–20 cm petiole, and 4–12 cm broad. The greenish-yellow inflorescence is produced on aspadix about 4–6 cm long, enclosed in a white spathe. The fruit is a cluster of red berries, each berry containing several seeds (Dudley 1937).

The genus formerly also included a number of other species, which have now been transferred to the separate genus *Zantedeschia*. These plants, from tropical Africa, are however still often termed "calla lilies", but should not be confused with *C. palustris*.

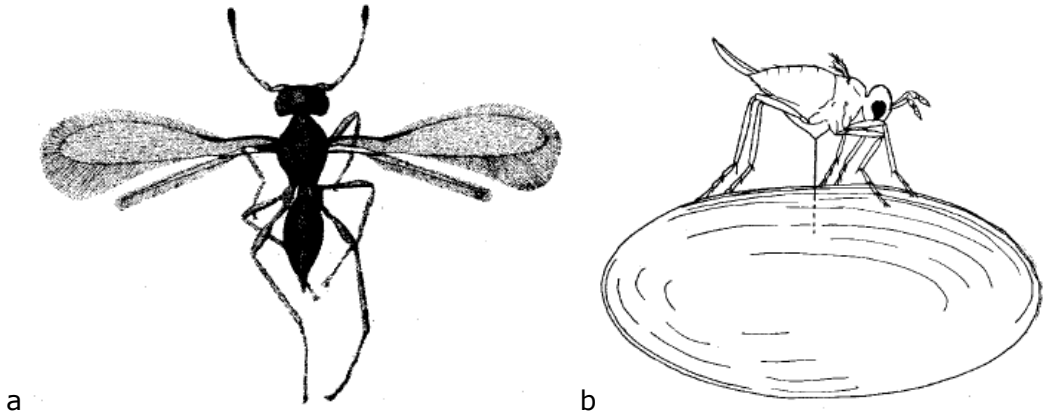
Known Interactions. *Calla palustris* L. is also associated through its biology with the aquatic coleoptera - *Ilybius sp.* (*Col., Dytiscidae*) which lay their eggs in the roots of the plant of Marsh Calla. Also related to this genera and other genera of *Dytiscidae* is also *Dytiscus* L. and *Agabus* Leach. *Ilybius sp.* prefere also to lay their eggs on *Potamogeton* and *Alisma*.

All these three genera of *Dytiscidae* are controled from a biological point of view by the parasitic hymenoptera species: *Caraphractus cinctus* Walker (=*Polynema natans* Lubb.) (Fig. 1.) Other species which prefers to oviposit the eggs of *Dytiscidae* from *C. palustris* is *Prestwichia aquatica* Lubb. (*Trichogrammatidae*) – (Fig. 1) (Rimsky-Korsakov 1917, 1933).

Three families of chalcid wasps (*Trichogrammatidae, Mymaridae, Eulophidae*) are known as egg-parasitoids of many aquatic insects (Rimsky-Korsakov 1917, 1925, 1933; Fursov 1995). The ability to swim under the water is specific for *P. aquatica Lubb.* and *C. cinctus Walk.* (Fursov 1995).

C. palustris is known as one of the most attractive aquatic plants for the hosts' oviposition (Fursov 1995).

Although we try to find the above species, associated with the roots of *C. palustris*, given in the Russian regions, we did not find them yet in the Bolătău Swamp Area. We have cultivated *C. palustris* in the laboratory conditions and tried to obtain the insect species mentioned by Fursov (1995) in his experiments. A further study is necesary.



a b

Fig. 1. Aquatic parasitoids: *Caraphractus cinctus* Walker (from Rimsky-Korsakov 1925); b - *Prestwichia aquatica* Lubb. - oviposition (from Rimsky-Korsakov 1933).

C. palustris is very poisonous when fresh due to its high oxalic acid content, but the rhizome, like that of Caladium, Colocasia and Arum, is edible after drying, grinding, leaching and boiling.

Areal (Range). Circumboreal (Braun 1967). It is native to cool temperate regions of the Northern Hemisphere, in central, eastern and northern as well as central Europe, Northern Asia and northern North America (Alaska, Canada, northeastern contiguous United States). Nowdays is a rare species because of the habitat loss and pollution (Gleason & Cronquist 1991).

In European legislation regarding the protection of the nature habitats with *Calla palustris* are listed as (Doniță et al 2005; European Comission 1992):

- NATURA 2000: 7240 Alpine pioneer formations of *Caricion bicoloris-atrofuscae.*
- PAL.HAB 1999: 54.3 Arctoalpine riverine swards.
- EUNIS: D2.22 *Carex nigra, Carex canescens, Carex echinata* fens.

Conservative value: very important especially when the species *Ligularia sibirica* is present (unconfirmed yet in the investigated area).

Despite the fact that is not the dominant species in any of the listed habitats is one of the characteristic species for these habitats.

Plant Associations Specific for These Habitats. *Sphagno–Caricetum rostratae* Steffen 1931 (Syn.: *Carici rostratae - Sphagnetum* Raţiu O. 1965 non Zólyomi 1931).

Specific Locations in Romania. Oriental Carpathians: Rodnei Mountains (Mountainside of Galaţiului, ridge Galţiul-Gărgălău, near peak Rebra, Rotunda-Preluc, Ştiol), Bistriţei

Mountains, Rarău Mountains, Călimani Mountains, Gurghiu Mountains, Depression of Giurgeu, Mureş River gorge, Lacul Negru (Black Lake) (Country of Vrancea). Meridional Carpathians: Dumbrăviţa, Retezat Mountains, Ţarcu Mountains, Godeanu Mountains. Occidental Carpathians: Bihor Mountains (Stâna de Vale, Valea Ieduţului, Izbuc), Depression of Trascău; in mountain regions and subalpine range (Beldie 1979; Ciocârlan 2000; Doniță et al 2005).

Habitat. Bogs, margins of ponds and openings in swamp forests, buttonbush communities.

Hazards. Overshading by encroaching woody plants; destruction of habitat by draining, filling or peat mining.

Recovery Potential. Probably good, protection of habitat and management of bogs may help this species.

Material and Method. Field investigations have been carried out during summer and autumn of 2009. Visual inspections have been carried out in the area in order to identify the species habitat and the human activity.

The studied area is located in the Bistriței Mountains, in the NN-E part of Vatra-Dornei depression (Fig. 3).

Situated on the right side of the Bistriţa river, Bolătău Swamp Reserve from Dorna Arini is a discontinuous marsh fed by rich springs of ferruginous, bicarbonated, carbonated and hypothermal (10-20°C) water.

Area measures around 10 hectares (100,000 m^2). Average altitude is 800 m.

The soils are aluvionary and hydromorph type formed on sedimentary deposits superposed on the first level of the valley of Bistriţa river, with pH values usually around 4.9-5.6. The main soil is formed by peat and acid hystosoils with a hight amount of organic matter in different states of decay (humification), and a high amount of mobile cations (Ca, K, Na).

In our case, natural organic matter forms a major part of soil.

It consists from organic material in following phases: a)partially degraded, but still identifiable plant parts; b)microbial biomass; c)organic coatings on mineral phases; d)low molecular weight identifiable organic substances; e) refractory part of organic matter - humic substances (humic acid, fulvic acid, and humin).

Historically, the term *humus* has been applied to the dark-colored, organic matter in soils, and the terms humic acid, fulvic acid, and humin have been used to designate different fractions of humus. Natural organic matter is a product of decay of living organic matter formed in following possible types of degradation reactions in environment: a)biotic (enzymatically catalyzed) reactions; b)pyrolytic reactions; c)abiotic reactions exclusive of pyrolytic reactions. In line with these reactions synthetic reactions for low molecular decay products are of definite importance.

In the process of decay of living organic matter, the bulk of the living organic matter is mineralised and not more than only 20% of their mass is transformed into refractory organic substances. Both degradation and synthetic processes of living organic matter are described as humification and in general it describes transformation of numerous groups of substances and individual molecules present in living organic matter into groups of substances with similar properties (humic substances) and finally into mineral carbon compounds (Kononova 1961).

Intramontane depression climate described is specific for this area only (microclimate). Average annual temperature is about 7°C; July average 17°C; January average under -6°C. Precipitations summing about 770 mm (annually).

The climate of the area is moderate continental temperate, on to which superimposes an intra-depression mountain climate.

The closest climatic description of the area is provided by the Vatra-Dornei meteorological station which is at almost the same altitude (around 810 m), but also about ca 10 km to the South-West. According to these data, the average annual

temperature is 5.2°C. Monthly average above-zero maximum/minimum daily temperatures are between end-march – mid-november / end-april – mid-october. Monthly average maximum temperature reaches +14.2 to +16.4°C between mid-July – mid-August. Average minimum temperature reaches -0.1 to -4.4°C between mid-January – mid-February. Extreme temperatures records are: -28.4°C in January, and 29.0°C in July. The annual number of days with frost can go up to 160. The average annual precipitations amount to ca 770 mm, most of it during spring and summer. The month with the highest/lowest number of rainy days, 11.7/0.3, is June/February. The month with the highest/lowest amount of precipitation, 147/39 mm, is June/November-December. Sunny days are most frequent during August-October. The fog is present around 120 days per year. Dominant winds are from south-west (44.8%), with wind speeds between 2.1-2.5 m/s during summer and 3.0-3.1 m/s during winter.

In this preliminary study we confirm that the species *Calla palustris* is present and in well preserved state on this marsh habitat, but there are some problems regarding the future preserving of the area as a natural refuge particularly for this plant species as in general for all species found in this habitat.

Results and Discussions. Legally, the investigated swamp has the status of a Reserve but nobody actually has the custody of the area. We can actually say that nobody wants to assume the responsibility for that area. Sadly this is a common state of facts in nowadays Romania. Despite the fact that the swamp is virtually divided between different landlords (small farmers), provides a refuge to the wild life and wild rare flora. This fact takes place due to the marsh cannot be used in any human activities except hunting.

Bolătău Swamp Reserve from Dorna Arini is the only area from Moldova where the species has been confirmed recently (Chifu et al 2006). The species was mentioned also from Dorna Arini and other locations like: Dorna Candrenilor, Vatra Dornei, Sarul Dornei, Panaci (Suceava county), but not confirmed (Mititelu et al 1988).

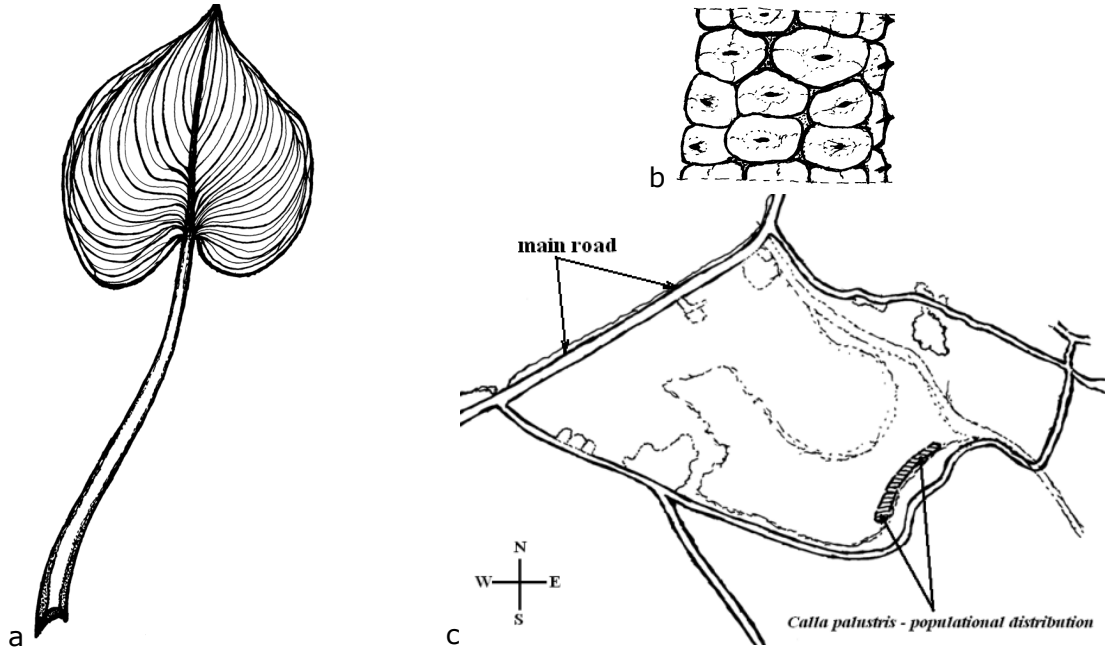


Fig. 2. *Calla palustris* L.: a – leaf detail; b – fruits; c – species distribution from Bolătău Swamp Reserve and the access roads (original)

It was found also by us in small patches in the south-east part of the area where the large amount of water provided by the springs creates shallow ponds with sub thermal water.

The population is small, around 500-600 plants, spread on the total surface of 150 m^2. Average density is 5-6 plants per m^2.

Due the fact of the population it is so small is also very vulnerable.

Small populations, particularly those restricted to a small area, are vulnerable to biotic and abiotic disturbances. If a disturbance is large enough to wipe out the entire area, no population will be left for recovery. Even when several populations are left, any destruction will enhance risks faced by small population species. The risk is amplified by the small total population size of the species, known from this location.

As a general idea, one of the key issues in ecological genetics today is the effect of habitat loss and fragmentation on the biodiversity of a range of ecosystems (Saunders et al 1991). Until recently, indicators of biodiversity have been limited to ecological parameters such as population dynamics and species richness. Recent advances in molecular genetic technology, however, have opened a new chapter in conservation efforts, and results from molecular studies are becoming increasingly important in the conservation and management of a wide range of rare or threatened species (Haig 1998).

Such techniques are of particular relevance to the analysis of plant populations, because plants vary widely in such factors as mode of reproduction (sexual versus asexual; selfing versus outcrossing), relative importance of seed and pollen movement, and the role of dormancy in the re-establishment of populations (Young et al 1996).

Fragmentation of natural plant communities can have deleterious effects on the genetic diversity within a species because there will be a decrease in levels of gene flow, particularly over longer distances. The subsequent effects of genetic drift in small, isolated populations will lead to loss of diversity, leaving plants less able to adapt to changes in their environment and ultimately increasing the risk of extinction (Keller & Waller 2002).

Fragmentation also affects the genetic structure of populations, with isolated fragments tending to be more genetically distinct than would be expected in a continuous population on a similar spatial scale.

This marsh represents a unique ecosystem which is under particular threat from fragmentation and habitat loss.

It is now accepted that fragmentation of natural populations can have deleterious effects on levels of genetic diversity in impacted populations (for reviews see Young et al 1996; Keller & Waller 2002).

The human threat is not to be ignored, given the transitional nature of Romanian society and economy from state-driven to private. This socio-economic situation is already known to be harmful to the environment in various and unexpected ways (Ioraş 2003).

Given the habitat to human and domestic animals, the main risks for the species come from the fast environmental changes, notably climate changes and pollution. If climate changes are too fast or potential pollution too intense (Rusek 1993), the species may not cope.

The damping of sawdust and garbage pollution is serious in the investigated area.

Some sites of illegal dump grounds are located at some distance from the main road (Fig. 4).

Big areas are covered with heaps of household and building rubbish, sawdust and waste from the timber processing plants (aprox. 1,500 m^2). They seriously affect the soil and the water, being a very dangerous threat to the environment.

The sawdust has three major negative effects on soils: it reduces their nitrogen content, it increases their acidity, and it pollutes them with phenol compounds. Each and every one of these effects dramatically reduces soil productivity, which is already low in mountain areas.

Sawdust also affects the waters either by direct contamination of springs and marsh surface (by covering) or by their impurification, which has a negative impact on the living organisms. In addition to the direct effects on soils and water, the sawdust deposits can cause fires by self-induced burning. They also represent dangerous environments, as their simple existence favors big concentration of pathogenic agents, of insect larvae, and phytopathogenic mushrooms. This is why the authorities should control and deliver environmental permits, oblige the sawmills to either deposit in a controlled

way (another than the marsh area) the sawdust, or better, use it in some way or another.

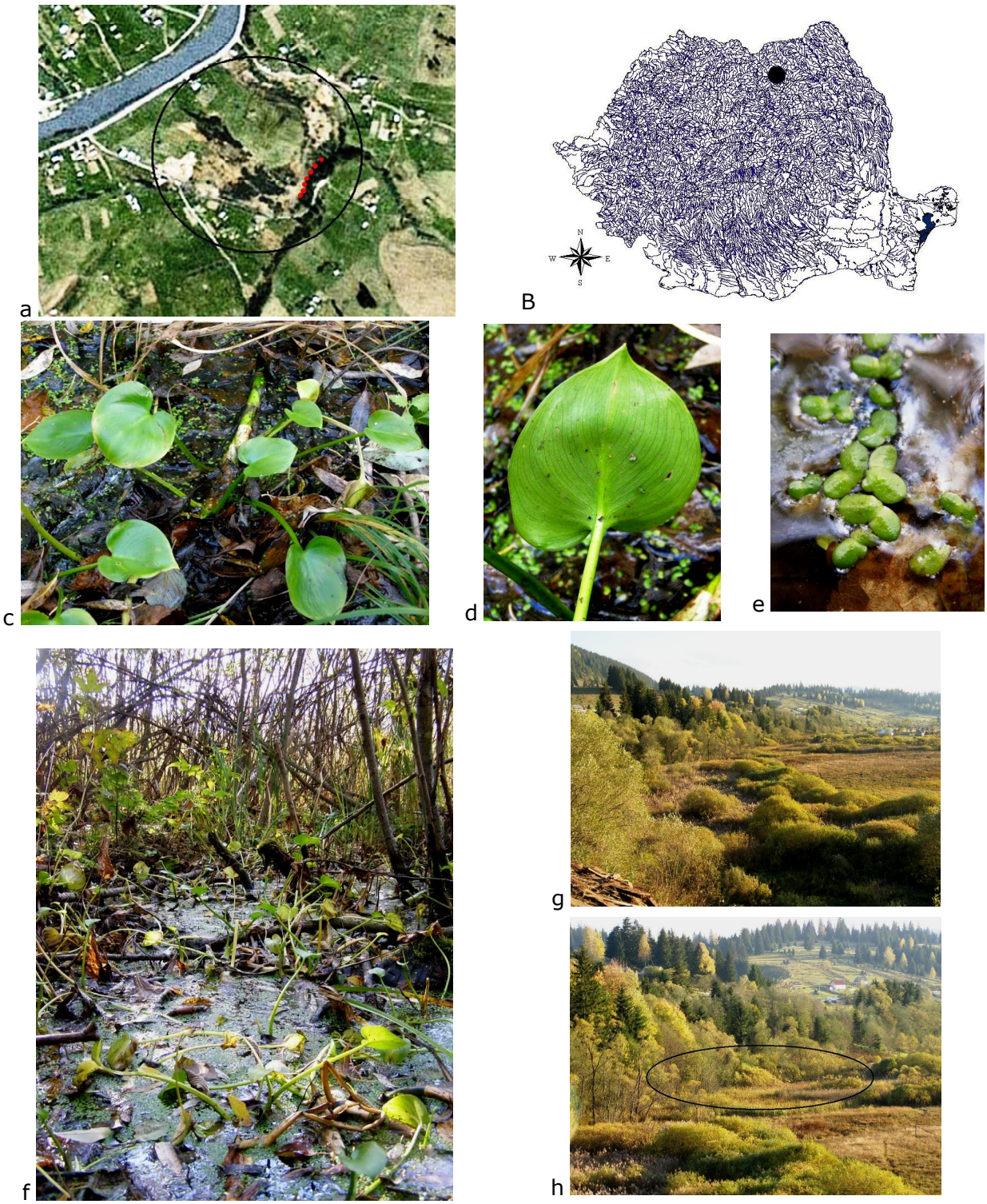


Fig. 3. The habitat of *Calla palustris* L. and the population distribution: a – Bolătău Swamp Reserve from Dorna Arini and the species distribution; b – Romania (rivers) and the only area from Moldova where the species has been confirmed recently; c, d – the plant and a leaf detail; e – *Lemna spp.*; f – the species habitat (*C. palustris* associated with *Lemna spp., Alnus incana* L. and *Salix spp.*); g, h –Bolătău reserve and the natural habitat seen from North-East of the swamp (original)

Fig. 4. The human impact on the Reserve Bolătău (Dorna Arini): a – the main areas of pollution (area "a" - in the southern part, with photos - b, c, e; area "b" in the northern part, with photos – d and f); c, e - garbage disposal on the edge of *Calla palustris* habitat, where the species has disappeared; d, e - storage of sawdust and other materials near the swamp stream (original)

Conclusions. Despite the fact that is virtually divided between different landlords (small farmers), the marsh provides refuge to the wild life and wild rare flora. This fact takes place due to the marsh cannot be used in any human activities except hunting.

Legally the swamp investigated has the status of a Reserve but nobody actually has the custody of the area (Environmental Protection Agency Suceava Country, 2009).

Population of *Calla palustris* is reduced to small patches totally estimated to 500-600 plants. Due the fact of the population it is so small is also very vulnerable. Small populations, particularly those restricted to a small area, are vulnerable to biotic and abiotic disturbances.

Given the habitat to human and domestic animals, the main risks for the species come from the fast environmental changes, notably climate changes and pollution. If climate changes are too fast or potential pollution too intense the species may not cope.

The damping of sawdust and garbage pollution is serious in the investigated area. Both, natural landscape and biodiversity are threatened.

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