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CONSERVATION CHALLENGES FOR *LIPARIS LOESELII* (L.) RICH.: A CRITICALLY ENDANGERED ORCHID IN ROMANIA

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Abstract

Liparis loeselii is a rare and highly threatened orchid species in Europe. With a European conservation status of Near Threatened (IUCN), this species is strictly protected under many EU and national regulations. It is present in 475 Natura 2000 sites across Europe, with only 10 sites from Romania. In Romania, L. loeselii is classified as Critically Endangered (CR), marking the southeastern limit of its distribution range. We monitored the species in the context of Article 17 of the Habitats Directive for EU specific reporting of Romania. The species inhabits hygrophilous, eutrophic fens characterized by calcium-rich, neutral to alkaline pH conditions, cold water, and black soil with a humus-turf layer overlaying a silt horizon. These habitats are increasingly threatened by drainage and fragmentation, leading to significant population declines. Historical records indicate that many populations previously cited in literature have not been confirmed in recent surveys, suggesting a critical need for updated assessments and conservation measures. This study underscores the urgency of habitat protection and restoration to prevent further decline and ensure the survival of L. loeselii within its natural range.

Key words*: conservation status, extinction threats, fen orchid, Liparis loeselii, protected species.*

INTRODUCTION

Liparis loeselii (L.) Rich., commonly known as fen orchid, is a rare and highly threatened orchid species in Europe, characterized by its preference for wetland habitats. It is listed as Near Threatened (NT) under the IUCN Red List (Bilz, 2011) and is strictly protected by various EU and national regulations, including the Bern Convention (1979) and the EU Habitats Directive (92/43/EEC). The species serves as an ecological indicator for fen ecosystems due to its strict habitat requirements, making it a subject of conservation interest (Oostermeijer & Hartman, 2014).

According to EUNIS, *L. loeselii* is found in 475 Natura 2000 sites across Europe, yet its presence in Romania is limited to only 10 sites, indicating a highly fragmented and vulnerable population. This orchid predominantly inhabits calcium-rich, neutral to alkaline fens, where cold groundwater maintains stable hydrological conditions. The substrates supporting this species are characterized by humus-turf layers over silt horizons, essential for the development of its seeds, which rely on mycorrhizal associations for germination (Błońska et al., 2016).

Over recent decades, populations of *L. loeselii* have declined significantly due to habitat destruction (Pillon et al., 2007; Błońska et al., 2016; Szatmari, 2022; Andersen et al., 2025). The primary threats include:

- drainage and hydrological alterations, leading to habitat desiccation and seedling mortality;
- habitat fragmentation, reducing genetic flow and increasing local extinction risks;
- expansion of tall perennials such as *Phragmites australis* and *Typha latifolia*, which compete for space and resources;
- climate change impacts, particularly shifts in precipitation patterns and increasing temperatures, which alter fen hydrology and soil conditions.

Given these conservation challenges, this study aims to provide an updated assessment of the

current population status of *L. loeselii* in Romania under the framework of Article 17 of the EU Habitats Directive.

MATERIALS AND METHODS

Analysing the scientific articles, reports, and management plans we developed a database used for all the further specific analysis.

In the *Habitats Directive* (92/43/EEC), monitoring of Annex II and Annex IV species is required in Article 11 and into the Article 17 requires reporting every six years, for each Member State of the EU. Member States shall undertake surveillance of the conservation status of the species with particular regard to priority species. Measures taken pursuant to the *Habitats Directive* shall be designed to maintain or restore, at favourable conservation status for species of wild flora of Community interest.

The Natura 2000 species code for *Liparis loeselii* (L.) Rich. is **1903**. In Romania the species is present in two biogeographical regions: ALP = Alpine and CON = Continental. In the last 12 years, all Member States, including Romania, has reported two times to the Commission: in 2013 (for the evaluation period 2007-2012) and 2019 (for the evaluation period 2013-2018), based on every 6 years of the assessed conservation status for habitats of community interest (S.O.P., 2019; L.I.O.P., 2023). For the next report (deadline 31 July 2025), was approved in 2023 the reporting format on species types (DG Environment, 2023).

Within these framework projects, carried out between 2011-2023, the *L. loeselii* population was inventoried in Romania and the conservation status of this species was evaluated (Mihăilescu et al., 2015).

The species identification was carried out in the field, no specimens were collected.

The concept of favourable reference values is derived from definitions in the *Habitats Directive* (DG Environment, 2023). Overall assessment of conservation status uses four categories: "favourable" (FV), "unfavourable-inadequate" (U1), "unfavourable-bad" (U2) and "unknown" (XX), based on the evaluation matrix for assessing conservation status for a species (Table 1).

Table 1. Overall assessment of the conservation status (CS)

Status of parameters	All favourable or few favourable + one unknown	One or more inadequate, but no bad	One or more bad	Two or more unknown +favourable or all unknown
Overall assessment of CS	Favourable (FV)	unfavourable-inadequate (U1)	unfavourable-bad (U2)	Unknown (XX)

RESULTS AND DISCUSSIONS

Species Occurrence and Distribution

A total of 66 occurrences of *L. loeselii* (Figures 1 and 2) were compiled and documented in a database. These include 12 herbarium records from the collections of Babeș-Bolyai University and Mureș County Museum, 23 occurrences from scientific publications, and 31 records from monitoring efforts under Article 17 of the EU Habitats Directive.

Figure 1. *Liparis loeselii* (L.) Rich. in the Hărman eutrophic fens. The individual is shown in the fruiting stage, with several developing seed capsules visible at the top of the inflorescence. The plant is rooted in a wet, moss-covered substrate, characteristic of alkaline fen habitats, and surrounded by typical fen vegetation such as *Schoenus nigricans*. This stage reflects the species' successful reproductive cycle in situ, despite its known vulnerability (photo by Sorin Ștefănuț, 11.08.2016)

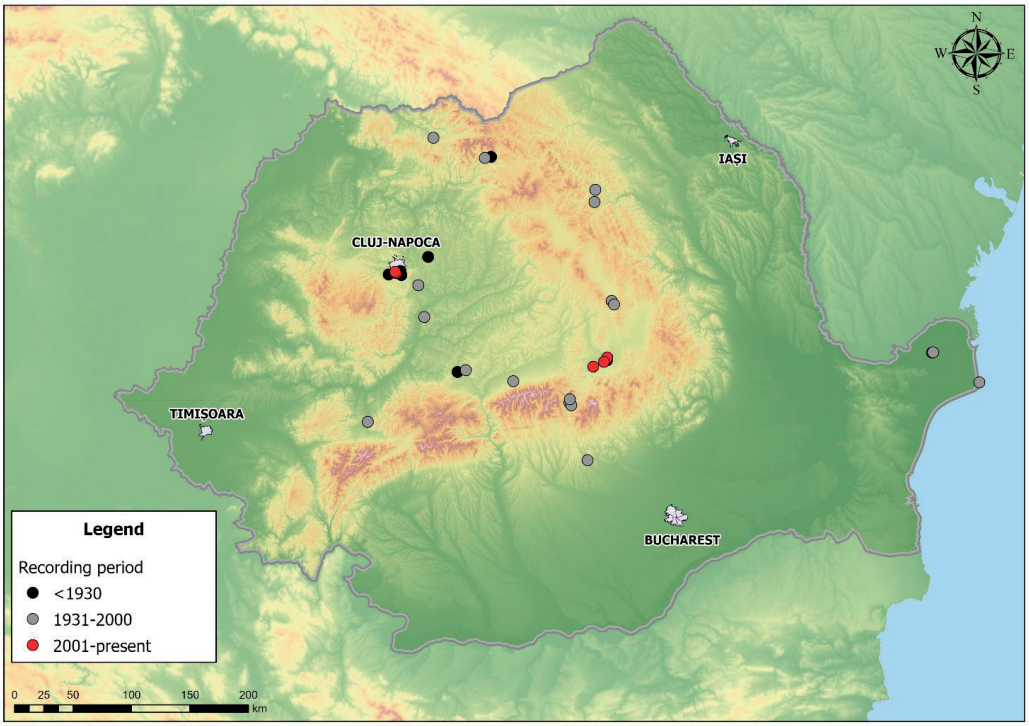

Figure 2. The distribution of *Liparis loeselii* (L.) Rich., a rare and protected orchid species, across various regions. The map highlights the historical and current presence of the species, providing valuable insights into its ecological preferences and conservation status

The historical presence of *L. loeselii* is supported by herbarium specimens dating as far back as 1881 and 1915, while scientific interest peaked in the 1970s with the publication of volumes on Romania's flora. Research has continued at a fluctuating pace, with a steady interest observed from the 1980s to 2016.

According to the EUNIS, the species is currently documented in 10 Natura 2000 sites, including Apuseni, Ceahlău, Dealul Cetății Lempeș-Mlaștina Hărman, Făgetul Clujului-Valea Morii, Munții Făgăraș, Munții Maramureșului, Pădurea și mlaștinile eutrofe de la Prejmer, Piatra Craiului, Sărăturile Ocna Veche, and Vânători-Neamț. Additionally, the Băgău site (AB County) is mentioned in the Romanian Natura 2000 catalog (Brînzan et al., 2013).

According to Witkowski et al. (2003), the species is present in eight divisions of the Carpathians, including Maramureș Mountains, Rodnei Mountains, Ceahlău, Harghita Mountains, Brașov Depression, Poiana Ruscă, Făgăraș Mountains, and the Transylvanian Plateau. These divisions overlap totally or partially with the Natura 2000 sites presented above.

Herbarium records from 1857-1931 document the species in Rodna Nouă (BN County), Hărman (BV County), Ocna Sibiului (SB County), Șuătru, Feleacu, Vîlcele, and Cluj (CJ County), as well as in the Danube Delta (TL Country).

Between 1930 and 2004, *L. loeselii* was reported in scientific publications from multiple locations, including Tăul fără fund de la Băgău (AB County); Pietricica Mountains, Piatra Craiului Mountains and Dâmbovicioarei Valley (AG County); Rodna (BN County); Stupini and Hărman (BV County); Morii Valley, Făgetul Clujului and Băile Sărate de la Turda (CJ County); Tătărani (DB County); between Covragiu and Subcetate (HD County); Puciosul Mountains and Lake Sfânta Ana (HR County); Dragomirești and Dumbrava (MM County); Răpciune and Ceahlău Mountains (NT County); Arpașu de Sus, Ocna Sibiului and Șura Mare (SB County); in the Danube Delta and Sfântu

Gheorghe (TL Country) (Paucă, 1972; Dihoru & Negrean, 2009).
However, since 2000, new records exist for only four locations: Stupini, Hărman, Prejmer (BV County), and Făgetul Clujului, Morii Vally (CJ County) (Figure 2).

Altitudinal range
The altitudinal distribution of *L. loeselii* in Romania (Figure 3) spans a significant range, from 5 m a.s.l. (Danube Delta) to 1260 m a.s.l. (Piatra Craiului Mountains). The mean elevation of occurrences is approximately 606 m, with a median of 640 m, suggesting a preference for mid-altitude habitats. However, the presence of multiple records clustered around 640 m highlights a potential ecological optimum in rich fen environments within this elevation range (Szatmari, 2022; Pop, 1960).

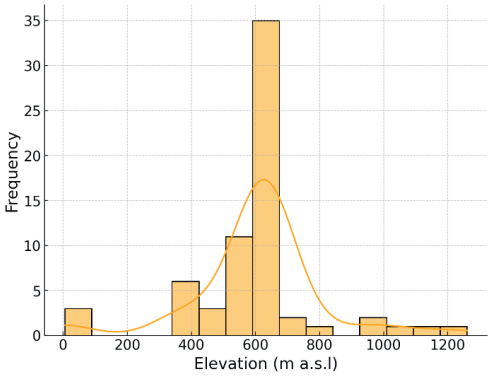

Figure 3. Altitudinal range of *Liparis loeselii* (L.) Rich. in Romania. The horizontal line represents the most frequent elevation range where the species has been recorded

Population Trends
Stupini eutrophic fen was first documented floristically by Diaconeasa in 1957. Subsequent studies by Morariu and Negrus in 1970 highlighted the presence of *Carex lasiocarpa, Drosera anglica*, and *L. loeselii* as well-represented species in the area (Parascan & Danciu, 1976). *L. loeselii* was first identified in Stupini by Pop in 1960, marking its initial recognition in this habitat.
In 2013, the population of *L. loeselii* was estimated at approximately 15 flowering individuals, located within a 9-hectare remnant of the once extensive eutrophic fen. The area has been significantly affected by drainage activities and the conversion of wetlands into agricultural land, leading to habitat degradation and increased vulnerability of the remaining population. However, a reassessment conducted in July 2022 revealed no detectable specimens of the species. This absence it might be a consequence of the assessment activities done after the optimal development of the plant or is likely attributed to a combination of factors, including the severe drought conditions experienced in 2022, ongoing drainage activities, and upstream water abstraction from the Lauterbach tributary.
The species is known to thrive in highly specific ecological conditions, almost exclusively inhabiting highly wet floating mats within the Carpathian-Pannonian region (Illyés, 2006). *L. loeselii* reliance on such specialized habitats makes it particularly vulnerable to changes in hydrology and water availability (Andersen et al., 2025).
Hărman: The flora of the Hărman eutrophic fens was first studied by Moesz in 1905, with subsequent investigations conducted by Pop in 1960.

Figure 4. *Liparis loeselii* (L.) Rich. in the Hărman eutrophic fens (photo by Sorin Ștefănuț, 08.07.2011)

In the summer months of July and August 1965, as well as in 1966, several specimens of *L. loeselii* were observed flowering and fruiting, as documented by Ularu and Danciu (1968).
In 2011 were found eight individual plants with flowers (Figure 4).
In 2014, as part of a research project, *L. loeselii* was once again identified in the Hărman fens, alongside *Ligularia sibirica*. The discovered specimens were protected and monitored to ensure their conservation. Proposed conservation measures included efforts to propagate and preserve *L. loeselii* to enhance its population and ensure its long-term persistence in the area (Miriea et al., 2014).
The eutrophic fens of Hărman are a highly vulnerable wetland habitat, characterized by a mosaic of dry and green vegetation patches, likely influenced by seasonal hydrological fluctuations and anthropogenic pressures.
In recent surveys assessed in 2016, the population counted eleven individuals.
Prejmer: The flora of the Prejmer eutrophic fens was previously studied by Pop (1960), Morariu (1966), and Parascan & Danciu (1976); however, *L. loeselii* was not reported in these early investigations.
The species was rediscovered in 2013, with a single individual identified during the project "Environmental restoration and support of natural processes in the forests and eutrophic marshes from Prejmer and Hărman", implemented by the Carpathian Foundation (BV County). A subsequent reassessment in July 2013 confirmed the species' presence. According to the final report of the project, 15 individuals were observed in 2015, followed by 20 individuals recorded in both 2016 and 2017, indicating a potentially stable but small population.

Făgetul Clujului-Valea Morii: The presence of *L. loeselii* (Figure 5) in the Făgetul Clujului-Valea Morii area has been documented since the early floristic studies conducted by Pop (1960) and Pop et al. (1962). The species was reconfirmed in 1998 by Ruprecht, who reported the rediscovery of both *L. loeselii* and *Bistorta officinalis*, species previously considered extinct from this site. *L. loeselii* was observed in two distinct zones of the fen, particularly near spring sources that maintain the moisture required for the orchid's survival. Individuals were recorded in small clusters of 4-5 plants, suggesting a limited and potentially vulnerable population.
The site holds high ecological value, acting as a refuge for glacial relicts and rare plant species, including *Ligularia sibirica, Tofieldia calyculata*, *Swertia perennis, Carex appropinquata, Ophioglossum vulgatum*, and *Dactylorhiza traunsteineri* (Cristea, 2014; Szatmari, 2022; Bartók et al., 2018).

Figure 5. *Liparis loeselii* (L.) Rich. in the Valea Morii fens, captured during its flowering phase. The plant is shown in close proximity to a human hand, providing a clear scale reference that highlights the delicate and diminutive size of this orchid species. This morphological detail emphasizes the species' vulnerability to habitat disturbance and the difficulty of detection during field surveys (photo by Attila Mátis, 23.06.2017)

More recent monitoring between 2011 and 2018 confirmed that the largest known Romanian population of *L. loeselii* exists in this area, with 184 individuals within the ROSCI0074 Natura 2000 site, and an additional 86 individuals located just outside the protected boundaries.
Population size measured in number of individuals is estimated between 200-800.

Habitat Preferences and Conservation Status
The species thrives in hygrophilous, eutrophic fens with calcium-rich, neutral to alkaline pH soils, cold water sources, and black soil layers over silt horizons (Dihoru and Negrean, 2009; Ciocârlan, 2009; Sârbu et al., 2013). In Romania, *L. loeselii* is associated with *Schoenetum nigricantis* Oberd. 1957, corresponding to two distinct Romanian habitat types: R5413 - Southeastern Carpathian meso-

eutrophic bogs with *Carex davalliana* and R5414 - Southeastern Carpathian eu-mezotrophic fens with *Schoenus nigricans*. These habitats align with the Natura 2000 habitat type 7230 (Alkaline fens) (Figure 6).

Figure 6. The summer vegetation aspect of habitat 7230 (Alkaline fens) within the Hărman Natura 2000 site (photo by Roxana-Georgiana Nicoară, 09.06.2011)

In Ceahlău National Park, the last recorded observation dates back to 1989 (Mititelu), and in Piatra Craiului National Park, *L. loeselii* has not been confirmed despite multiple survey efforts, including those conducted under the POS Mediu project.

Similarly, in the Danube Delta, the species has not been reconfirmed since Kanitz (1879-1881), with Sârbu et al. (2006) failing to locate it in their surveys. Because the optimum conditions for its existence are alkaline fens (Doniță et al., 2005a; Doniță et al., 2005b; Ciocârlan, 2009) and this habitat is distributed only in intramountainous depressions (Gafta & Mountford, 2008; Goriup, 2008; INCDPM, 2014), we argue that it was an identification error for the existence of *L. loeselli* in Danube Delta.

Currently, *L. loeselii* is only confirmed in three Natura 2000 sites: ROSCI0074 Făgetul Clujului - Valea Morii, ROSCI0170 Pădurea și mlaștinile eutrofe de la Prejmer and ROSCI0055 Dealul Cetății Lempeș - Mlaștina Hărman with an estimated population size between 500 and 1000 individuals, although this estimate is based on extrapolated data.
A small population of *L. loeselii* may still persist in the Stupini Mire, which was proposed in 2024 as a new Natura 2000 site, highlighting its ecological importance and the potential need for enhanced protection and monitoring measures.

CONCLUSIONS

Liparis loeselii (L.) Rich., is critically endangered in Romania, with a highly fragmented distribution. Despite being present in 475 Natura 2000 sites across Europe, only three sites in Romania still harbor viable populations, emphasizing the urgent need for conservation and habitat restoration.
Historical records indicate significant population declines, with many previously cited locations failing to confirm the species' presence in recent surveys.
The conservation status is "unfavourable-inadequate" (U1), due to increasing trends in the intensity of different impacts upon the species habitat (Table 2).

Table 2. Overall assessment of the conservation status on each reporting period of *Liparis loeselii* (L.) Rich. in Romania

Species	2013		2019		2025	
	ALP	CON	ALP	CON	ALP	CON
Liparis loeselii (L.) Rich.	U1	U1	U1	U1	U1	U1

List of pressures and threats and conservation measures was updated in 2024 for the period 2019-2024 (EIONET, 2025).

Main conservation measures according with EU code: CA04 - Reinstate appropriate agricultural practices to address abandonment, including mowing, grazing, burning or equivalent measures. Conservation measures are taken inside or outside Natura 2000 sites where species is present.
According to standard Natura 2000 data forms, in Romania the species is listed in ten sites. The potential discrepancy between our results and the Natura 2000 data is the fact that the *L. loeselli* was initially listed in the standard data forms of the sites based on literature data, but subsequent field studies have failed to identify any populations. Due to the small size of the species, its conservation significance and the difficulty of locating individuals, there is a justified reluctance to remove the species from the data forms, therefore contributing to the inconsistency.

The study underscores the importance of long-term monitoring, habitat protection, and the implementation of conservation strategies to prevent further loss of this rare orchid.

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