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MONOCOTYLEDONS WITH ECONOMIC AND ECOLOGICAL VALUE IN ROMANIA (II)

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ABSTRACT

The analyzed plant groups include numerous species with various economic and ecological roles. The Asparagaceae family includes 25 useful species, predominantly ornamental, but also with cosmetic, medicinal, culinary, or honey-producing uses. Seven species are toxic, many of which have been studied for medicinal purposes. The Asphodelaceae family is represented by a single rare species. The Juncaceae family includes 14 species with few economic uses but important for ecology (phytoremediation, restoration, bioindicators, soil protection). The Juncaginaceae family has two toxic species, used ecologically for soil cover and phytoremediation. The Lemnaceae family includes 5 species with important roles in the ecological and rural economy, one of which is vulnerable. The Liliaceae family includes 14 ornamental species, most of which are endangered in their natural habitat. The Melanthyaceae family contains three highly toxic species. The Najadaceae family has two aquatic species that are not used by Romanians. The Orchidaceae family is relatively diverse, but most species are endangered. The Potamogetonaceae family includes 11 species, important for phytoremediation and bioindication of environmental quality. The families Ruppiaceae, Sparganiaceae, Zannichelliaceae, and Zosteraceae each include 1–2 species used mainly for ecological restoration or phytoremediation. Scheuchzeriaceae has only one toxic species. The family Tofieldiaceae includes one species with ornamental value. The Typhaceae family includes 5 species whose uses have been partially abandoned. Overall, the families presented include species with a wide variety of uses—ornamental, medicinal, culinary, ecological—but also with varying degrees of vulnerability, many of which are already threatened and require conservation measures.

INTRODUCTION

This summary lists the uses of vascular plant species belonging to several families of monocotyledons, initially selected in alphabetical order, with the aim of completing the lists started by Kovacs A. (1979), Pop I. (1982), and other authors. During this time, numerous studies have been accumulated and they create new possibilities for using plants from each genus. For example, the Juncaceae family includes 38 species, of which we have found reliable uses for 14 species. Four to five decades ago, only four species were used.
Modern classifications have undergone many changes, with some species being removed from the Liliaceae family and integrated into other families. Information has been gathered on the uses of these plants and their status.
In Romania, the Orchidaceae family has 51 species, of which 47 have been studied in detail and validated for their economic importance, but most are on the red lists. In past centuries, only 9 species were frequently used, and these plants were abundant.
Aquatic plants from the families *Potamogetonaceae*, *Zannichelliaceae*, *Zosteraceae*, *Najadaceae*, *Ruppiaceae*, *Scheuchzeriaceae*, as well as some marsh species, were not used by Romanians in the past. We do not have an explanation for this, but it is likely that other, more widespread and valuable species served as substitutes. Today, these plants are the subject of numerous studies on phytoremediation, ecological restoration, and distribution, as their potential utilities have been rediscovered. Aquatic plants from the family *Lemnaceae* were historically used

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as bird fodder. Although this practice is now abandoned, the prospects for these tiny plants in water remediation and pollutant removal are much greater today. Many other examples could be cited, end we can focus on the restoration and sustainable use of our natural heritage.

MATERIALS AND METHODS

The purpose of this synthesis is to identify and classify species in these families according to their economic value. This is useful for phytosociology, pratology, ecological reconstruction, phytoremediation, and other related fields. In Romania, two other summaries have been published: Kovacs A., 1979 (pratology) and Pop I., 1982 (phytocenology). Recent works on the uses of species in these families were consulted to complete the list started by these two authors.
Economic assessments are provided for all categories of use. We used a 5-point scale; for example, for edible plants we have the following assessments: 1/5 – very poor (slightly edible, unpleasant taste, complex preparation), 2/5 – poor (edible, but with limited taste), 3/5 – average (edible and useful), 4/5 – very good (nutritious, tasty, easy to use), 5/5 – excellent (tasty, versatile, valuable).
Assessments of plants used for decontamination of heavy metals and other toxins are available for a limited number of species, but offer promising prospects for phytoremediation and ecological restoration, areas for which long-term predictions are difficult.
Variability studies for spontaneous species with economic value will highlight qualitative differences.
The distribution of species, degree of habitat disturbance, ecology, medicinal importance, and possibility of introduction into cultivation were analyzed.

RESULTS AND DISCUSSION

In the **Asparagaceae family**, we have identified 25 species with economic value, which are grouped into the following categories of use (Table 1).
Cosmetic uses: *Polygonatum multiflorum* (L.) All., *P. odoratum* (Mill.) Druce, *Ruscus aculeatus* L., *R. hypoglossum* L.
Culinary: *Nectaroscordium siculum* (Ucria) Lindl. ssp. *bulgaricum* (Janka) Stearn
Dye plants: *Muscari neglectum* Guss. ex Ten., *Polygonatum odoratum* (Mill.) Druce, *Scilla bifolia* L.
Edible: *Muscari comosum* (L.) Mill., *M. neglectum* Guss. ex Ten., *Ornithogalum pyrenaicum* L., *O. sigmoideum* Freyn & Sint., *Polygonatum odoratum* (Mill.) Druce, *P. verticillatum* (L.) All., *Streptopus amplexifolius* (L.) DC
Fodder: *Muscari tenuifolium* (Tausch.) Heldr., *Ornithogalum pyrenaicum* L.
Medicinal: *Convallaria majalis* L., *Muscari comosum* (L.) Mill., *M. neglectum* Guss. ex Ten., *M. tenuifolium* (Tausch.) Heldr., *Nectaroscordium siculum* (Ucria) Lindl. ssp. *bulgaricum* (Janka) Stearn, *Ornithogalum boucheanum* Aschers., *O. orthophyllum* Ten. subsp. *kochii* (Parl.) Zaharia, *Polygonatum multiflorum* (L.) All., *P. odoratum* (Mill.) Druce, *P. verticillatum* (L.) All., *Ruscus aculeatus* L., *Scilla bifolia* L., *Streptopus amplexifolius* (L.) DC
Medium melliferous: *Muscari botryoides* (L.) Mill., *M. neglectum* Guss. ex Ten., *Ornithogalum pyramidale* L., *Scilla bifolia* L.
Poor melliferous: *Ornithogalum amphibolum* Zahar., *O. sigmoideum* Freyn & Sint.
Weakly melliferous: *Convallaria majalis* L.
Ornamental: *Anthericum liliago* L., *A. ramosum* L., *Convallaria majalis* L., *Hyacinthella leucophaea* (K. Koch) Schur, *Maianthemum bifolium* (L.) F.W. Schmidt, *Muscari botryoides* (L.) Mill., *M. comosum* (L.) Mill., *M. neglectum* Guss. ex Ten., *Ornithogalum fimbriatum* Willd., *O. pyramidale* L., *Polygonatum latifolium* (Jacq.) Desf., *P. multiflorum* (L.) All., *P. odoratum* (Mill.) Druce, *Ruscus aculeatus* L., *R. hypoglossum* L., *Scilla bifolia* L., *Streptopus amplexifolius* (L.) DC
Perfumery: *Convallaria majalis* L.
Spice: *Muscari comosum* (L.) Mill.
Toxic: *Convallaria majalis* L., *Maianthemum bifolium* (L.) F.W. Schmidt, *Polygonatum latifolium* (Jacq.) Desf., *P. multiflorum* (L.) All., *P. odoratum* (Mill.) Druce, *Ruscus aculeatus* L., *Scilla bifolia* L.
Veterinary uses: *Convallaria majalis* L.
Bioindicator: *Maianthemum bifolium* (L.) F.W. Schmidt
The genus *Anthericum* includes two perennial species of ornamental value: *Anthericum ramosum* L., which is common, and *A. liliago* L., which is sporadic and threatened.
Convallaria majalis L. (Lily of the Valley) is a perennial, frequent species, but harvesting is recommended only in small quantities (Dihoru G., Boruz V., 2014). As a medicinal plant it is used for dizziness, migraines, and neuralgia (Crăciun F. et al., 1977; Pârvu C., 2013). The aerial parts are used as a tea for cough (Papp N. et al.,

2011). The flowers contain glycosides with cardiotonic properties (Romm A., 2010). The berries are toxic but also medicinal. In veterinary practice it is used for cardiac rhythm disorders. The species is widely employed in the perfume industry, frequently cultivated, capable of naturalizing, and valued as a cut flower source (Pop I., 1982; Preda M., 1989; Oakes A.J., 1990). It has low melliferous value, producing small amounts of nectar (1/3) and very little pollen (Dihoru G., 2023).

Hyacinthella leucophaea (K. Koch) Schur is of ornamental value, rare, and threatened. Lilies from the spontaneous flora are highly attractive as ornamental plants; their collection is prohibited.

Maianthemum bifolium (L.) F. W. Schmidt is common on acidic soils under spruce forests. Owing to its abundance, it forms attractive landscapes and can be used as a bioindicator of pollution; the underground parts accumulate Ni, Cu, and Cd (Bierza K., 2022). The species is toxic.

Muscari botryoides (L.) Mill. is a perennial with sporadic distribution, ornamental value, and medium melliferous potential, characterized by low nectar (1/3) and abundant pollen (3/3) production (Dihoru G., 2023).

Muscari comosum (L.) Mill. (Tassel hyacinth) is ornamental (Kayiran S., Özkan E.E., 2016), edible (3/5), used as a spice and medicinal plant. It requires re-evaluation for potential cultivation (Loizo M.R. et al., 2010).

Muscari neglectum Guss. ex Ten. (syn. *Muscari racemosum* L.) is a medicinal and edible plant in traditional Turkish medicine; its leaves and flowers can be used as dyes for eggs and hair (Kayiran S., Özkan E.E., 2016). It has medium melliferous value with low nectar (1/3) and high pollen production (2/3) (Dihoru G., 2023). In Romania it is a sporadic, threatened Red List species, and harvesting is strictly prohibited (Dihoru G., Boruz V., 2014). It can be cultivated in rock gardens and ornamental horticultural settings (Pârvu C., 2002; Kayiran S., Özkan E.E., 2016).

Muscari tenuifolium (Tausch.) Heldr. occurs sporadically in lowland and hilly areas. Its uses are not documented in Romania; in Turkish traditional medicine the bulbs are used for their antibiotic, antirheumatic, and antitumor properties. It has poor fodder value (Kayiran S., Özkan E.E., 2016).

Nectaroscordium siculum (Ucria) Lindl. ssp. *bulgaricum* (Janka) Stearn is a Ponto-Balkan species, sporadically distributed in lowland and hilly regions, and considered threatened. It has significant medicinal and culinary value, comparable to *Allium ursinum*, but with particular distinguishing traits.

Species of *Ornithogalum* are highly toxic and not consumed in Romania; however, in other regions—especially Turkey—they are better known. Their biochemistry and uses can be comparatively assessed through a dendrogram.

Ornithogalum amphibolum Zahar. is a perennial, rare species found in lowland and hilly areas. It has low melliferous value regarding both nectar (1/3) and pollen (1/3) (Dihoru G., 2023).

Ornithogalum boucheanum Aschers. occurs sporadically in lowland and hilly regions and contains secondary metabolites of therapeutic importance (Plancic M. et al., 2014).

Ornithogalum pyramidale L. is sporadically distributed in lowland and hilly areas, with ornamental and medium melliferous value.

Ornithogalum pyrenaicum L. occurs sporadically in lowland and hilly regions. In Romania it has not been economically or conservationally evaluated. Elsewhere it is edible (2/5) (pfaf.org) and used as fodder (Kayiran S., Özkan E.E., 2016).

Ornithogalum sigmoideum Freyn & Sint. is a rare species of lowland and hilly regions. It has low melliferous value (nectar 1/3, pollen 1/3) (Dihoru G., 2023) and is edible (Kayiran S., Özkan E.E., 2016).

Ornithogalum umbellatum L. is sporadic in ruderal habitats from the forest-steppe to oak forests. It has cardiotonic properties similar to digitalis. Romanian empirical medicine cites it in cases of leucorrhoea (Pârvu C., 2013). It produces secondary metabolites influenced by light and nitrogen availability (Plancic M. et al., 2014; Rat M.M. et al., 2016).

The plant is entirely toxic and medicinal; Turkish traditional medicine uses it for fever and acne. Ground and boiled bulbs lose toxicity and contain cardiotonic glycosides used for dyspepsia and indigestion (Montgomerie K., 2001). Flowers and roots are edible (3/5) and have antimicrobial properties (pfaf.org; Kayiran S., Özkan E.E., 2016; Kenç, 2019; Semerci A. et al., 2019). It is used in homeopathy (Clarke J.H., 1909).

The species can be cultivated in ornamental horticulture (Preda M., 1989; Pârvu C., 2002), and is of medium melliferous value with low nectar and pollen production (1/3 each) (Dihoru G., 2023).

The genus *Polygonatum* comprises four shade-loving species in Romania, all ornamental, medicinal, and slightly toxic. They contain similar bioactive compounds and uses that can be assessed through a dendrogram.

Polygonatum latifolium (Jacq.) Desf. (Solomon's Seal) is common in forests and shrubs from steppe to beech zones. It is toxic (Pop I., 1982) and may be cultivated in ornamental horticulture (Pârvu C., 2002).

Polygonatum multiflorum (L.) All. is common in forests and shrubs from lowland to beech forests. The rhizome is used in China and India for lung diseases, as an expectorant, and for gout, rheumatism, diabetes, and anti-HIV activity (Khare C.P., 2007; Wu L., Bao J.K., 2013; Zhao P. et al., 2017). In Romania it has similar uses to *P. odoratum*. It is medicinal, toxic, ornamental, and cosmetically valuable. Harvesting is recommended only in small quantities every 2–3 years.

Polygonatum odoratum (Mill.) Druce is used in Romania for rheumatism, skin diseases, bruises, and contusions (Crăciun F. et al., 1977; Pop I., 1982). In cosmetics it is used for skin irritations and acne, and to prevent photoaging (Ionescu-Călinești L., 2009).
In China the leaves are gathered before flowering as a green vegetable and for soups; edible value 2/5 (pfaf.org). The rhizome is used as a tea substitute (Wujishguleng et al., 2012).
The fruits are toxic; steamed rhizomes have low toxicity. Combined with *Morus alba* leaves, it has anti-osteoporotic effects in menopause, strong antioxidant activity, strengthens immunity, supports lung and stomach health, and helps in diabetes, indigestion, and cardiovascular disorders (Zhao P. et al., 2017). It is ornamental and pigment-producing, and can be cultivated in horticultural settings (Pop I., 1982; Pop M., Pop O., 2007; Pârvu C., 2002). Though common in Romania, it should be harvested only sparingly or at 2–3-year intervals (Dihoru Gh. & Boruz V., 2014).
Polygonatum verticillatum (L.) All. is widely used in India, Tibet, and China as a tonic, edible (2/5), and medicinal species, especially beneficial in old age for fatigue, weakness, emaciation, headaches, and respiratory, renal, genital, and digestive disorders. The species is globally threatened. In Romania it is relatively common but should be harvested with caution.
Ruscus aculeatus L. (Butcher's Broom) is an important medicinal species, used since the Middle Ages in France and Germany. Young shoots were consumed as food, and the plant was used for heavy legs, urinary disorders, and abdominal pain. The rhizomes contain up to 6% steroids with decongestant, anti-inflammatory, and hemostatic properties. It is effective in treating venous insufficiency, varicose veins, hemorrhoids, and arthritis (Balica G. et al., 2013; Crăciun F. et al., 1977; Pârvu C., 2003; Scarlat M.A., 2019; Vanscheldt W. et al., 2002).
It protects microcirculation (Mari A. et al., 2012), prevents postmenopausal osteoporosis (Chakulska L. et al., 2019), and is used in premenstrual syndrome (Rodrigues J.P.R. et al., 2021). Roots and stems are used for fungal skin infections (Ali-Shatayeh M.S., Ghdeib S.I.A., 1998).
Cases of internal toxicity have been reported, especially from fruits; therefore the plant must be used under medical supervision (Colombo M.L. et al., 2009; pfaf.org).
In cosmetics, the rhizome extract is used for venous insufficiency, bruises, cellulite, and eyelid edema (Ionescu-Călinești L., 2009). It has also been used as a dye plant.
In Romania's spontaneous flora it is rare, vulnerable, and protected as a natural monument; harvesting is prohibited. It is globally and Europeanly threatened (Oprea A., 2005). It may be cultivated on rocky soils as an ornamental and medicinal plant (Pârvu C., 2002; Pop I., 1982; Preda M., 1989).
In the Spontaneous Flora of Romania it is a rare, vulnerable plant, protected as a natural monument, harvesting is prohibited, it is threatened globally and in Europe (Oprea Ad. 2005). It can be cultivated as a medicinal and decorative plant on stony soil, rocks (Pârvu C., 2002; Pop I., 1982, Preda M., 1989).
Ruscus hypoglossum L. is sporadic in forests and thickets from oak to beech zones. It has ornamental value (Preda M., 1989) and is vulnerable; harvesting is prohibited (Dihoru G., Boruz V., 2014).
Scilla bifolia L. (Alpine Squill) is among the most attractive spring plants, traditionally collected by children in rural areas. Historically it was used as a dye plant and provides nectar and pollen to bees. It may be harvested only with caution, at 2–3-year intervals (Dihoru G., Boruz V., 2014).
Streptopus amplexifolius (L.) DC. is sporadic and threatened.

Table 1. Plants with economic value from the Asparagaceae Family

No.	Species	Categories of Use	Observations
1	*Anthericum liliago* L.	ornamental	under-threatened
2	*Anthericum ramosum* L.	ornamental	–
3	*Convallaria majalis* L.	weakly melliferous; medicinal; veterinary uses; perfumery; ornamental; toxic	harvesting in small quantities is recommended
4	*Hyacinthella leucophaea* (K. Koch) Schur	ornamental	rare and under-threatened
5	*Maianthemum bifolium* (L.) F.W. Schmidt	bioindicator; toxic; ornamental	–
6	*Muscari botryoides* (L.) Mill.	medium melliferous; ornamental	–
7	*Muscari comosum* (L.) Mill.	edible (3/5); spice; medicinal; ornamental	–
8	*Muscari neglectum* Guss. ex Ten.	edible; medicinal; ornamental; dye plant; medium melliferous	under-threatened; harvesting is prohibited
9	*Muscari tenuifolium* (Tausch.) Heldr.	medicinal; fodder	–
10	*Nectaroscordium siculum* (Ucria) Lindl. ssp. *bulgaricum* (Janka) Stearn	culinary; medicinal	sporadic and under-threatened

No.	Species	Categories of Use	Observations
11	*Ornithogalum amphibolum* Zahar.	poor melliferous	rare
12	*Ornithogalum boucheanum* Aschers.	medicinal	–
13	*Ornithogalum fimbriatum* Willd.	ornamental	rare and under-threatened
14	*Ornithogalum orthophyllum* Ten. subsp. *kochii* (Parl.) Zaharia	medicinal	globally threatened in Europe
15	*Ornithogalum pyramidale* L.	medium melliferous; ornamental	–
16	*Ornithogalum pyrenaicum* L.	edible (2/5); fodder	–
17	*Ornithogalum sigmoideum* Freyn & Sint.	edible; poor melliferous	rare
18	*Polygonatum latifolium* (Jacq.) Desf.	toxic; ornamental	–
19	*Polygonatum multiflorum* (L.) All.	medicinal; toxic; cosmetic uses; ornamental	harvesting should be done in small quantities or every 2–3 years
20	*Polygonatum odoratum* (Mill.) Druce	edible; medicinal; toxic; dye plant; cosmetic uses; ornamental	harvesting should be done in small quantities or every 2–3 years
21	*Polygonatum verticillatum* (L.) All.	medicinal; edible	threatened worldwide
22	*Ruscus aculeatus* L.	ornamental; medicinal; toxic; cosmetic uses	harvesting is prohibited; rare and vulnerable; protected as a natural monument; globally threatened and threatened in Europe
23	*Ruscus hypoglossum* L.	ornamental	vulnerable; harvesting is prohibited
24	*Scilla bifolia* L.	medicinal; dye plant; ornamental; medium melliferous; toxic	harvesting from the same location should occur only every 2–3 years
25	*Streptopus amplexifolius* (L.) DC.	edible (4/5); medicinal; ornamental	under-threatened

Asphodelaceae Family

Asphodeline lutea (L.) Rchb. is used in Greek cuisine, but in Romania it is rare and under threat. It must be protected. The species grows only in steppe and forest-steppe areas and has both ornamental and medicinal value. It is of interest for potential cultivation (Table 2).

Table 2. Plants with economic value from the Asphodelaceae Family

No	Species	Categories of use	Observations
1	*Asphodeline lutea* (L.) Rchb.	ornamental; edible; medicinal	rare, under-threatened, protected

Juncaceae Family

Juncus species have historically been used for various handicrafts, including braiding, and in ancient times as a substitute for twine for tying sprouts in gardens. The seeds of some species can be used to treat diarrhea and exhibit mild effects against colds (Hammouti et al., 2023), dysuria, agitation, irritability, insomnia, and inflammation (Gainche et al., 2020).

These plants are halotolerant and can be employed to vegetate wet habitats alongside hydrophytes (Rodrigo, 2021). They are also suitable for the decontamination of polluted waters containing heavy metals (Syranidon et al., 2016) and residues of pharmaceutical compounds (Syranidon et al., 2016). However, some species can be detrimental in meadows. Additionally, they possess ornamental value (see Table 3).

The most widespread species are *Juncus inflexus* L. and *Juncus effusus* L. Numerous studies have focused on *J. effusus*, *J. littoralis*, *J. maritimus*, and related species.

Juncus effusus L. serves as a bioindicator for arsenic (As), accumulating significant amounts of As and antimony (Sb) in the roots, and it is capable of removing pesticides and insecticides (Syranidon et al., 2016). It also accumulates low concentrations of zinc (Zn), copper (Cu), cadmium (Cd), and lead (Pb) (Friioff et al., 2005).

Juncus littoralis C.A. Mey. is rare, covering and stabilizing saline sands along the seaside and the Danube Delta. It is ornamental, of medicinal interest, and tolerates high concentrations of Zn.

Juncus maritimus Lam. is rare on seaside sands but locally abundant. It contributes to the stabilization of mobile sands in the Danube Delta, aids in salinity reduction, and absorbs various metals including Hg, Al, Cr, Fe, Mn, Ni, Pb, Zn, Cd, Cu, and accumulates organochlorine compounds such as DDT, DDE, and DDD (Syranidon et al., 2016). Due to pollution, Romanian populations are unsuitable for medicinal use or biomass production, which can be substituted with *Phragmites* and *Typha* species.

Juncus articulatus L. is moderately halotolerant, accumulating residues in the roots, including As (Craw et al., 2007; Bergqvist, Greger, 2013, 2016).
Juncus gerardii Loisel. has poor forage value (4/9) with very limited usable phytomass (2/9) (Maruşcă, 2019). It is important for the ecological restoration of saline soils (Khan, Qaiser, 2006) and effective for Cd decontamination (Vamek et al., 2016).
Juncus bufonius L. indicates wet habitats, tolerates saline soils, and has ornamental potential (Khanbabyeva et al., 2021).
Juncus conglomeratus L. and *J. thomasii* Ten. are detrimental to meadow swards, lacking useful phytomass, although their stems can be used for weaving baskets, mats, and straw fabrics (https://pfaf.org/user).
Juncus tenuis Willd. has therapeutic applications, including herbal baths for children's fortification (https://pfaf.org/user) and uses in cancer treatment (Bús et al., 2020).
Juncus trifidus L. is widespread in alpine and subalpine zones, with poor forage value (4/9) and minimal usable phytomass (1/9) (Maruşcă, 2019).
The genus *Luzula* contains species with ecological value, protecting soil on forest slopes and mountain meadows. *Luzula luzuloides* (Lam.) Dandy & Wilmott is common in the herbaceous layer of mountain forests, indifferent to soil pH. During growth, it has poor forage value; when mature, its stems turn light brown, making it suitable for decorative use and dried flower arrangements (Pop, 1982; Oakes, 1990; Pârvu, 2003).
Luzula sylvatica (Huds.) Gaud. prevents soil erosion and serves as ground cover in decorative mountain spaces, forming dense herbaceous layers under shrubs and shaded edges (Preda, 1989; Oakes, 1990; Davidson & Gobin, 1998). Medicinally, it exhibits anti-inflammatory and moderate cytotoxic properties (Gainche et al., 2020).
Luzula campestris (L.) DC. is common in nitrogen-poor meadows from hilly areas to spruce forest levels. It has low forage value (4/9) and limited usable phytomass (2/9) (Maruşcă, 2019). As a decorative species, it covers the ground among shrubs and can occasionally be cultivated in pots (Oakes, 1990; Pârvu, 2003).
Luzula pilosa (L.) Willd. is sporadically distributed and shares similar decorative characteristics with *L. campestris*.

Table 3. Plants with economic value from the Juncaceae Family

No.	Species	Categories of Use	Observations
1	*Juncus articulatus* L.	low phytoremediation potential	–
2	*Juncus bufonius* L.	ornamental	–
3	*Juncus conglomeratus* L.	handicraft / domestic uses	–
4	*Juncus effusus* L.	handicraft / domestic uses; medicinal; ecological restoration; bioindicator; medium phytoremediation; ornamental	–
5	*Juncus gerardii* Loisel.	low fodder value; ground cover	–
6	*Juncus inflexus* L.	handicraft / domestic uses; phytoremediation	–
7	*Juncus littoralis* C.A.Mey.	phytoremediation; medicinal; ornamental; ground cover	rare
8	*Juncus maritimus* Lam.	handicraft / domestic uses; high biomass potential; medicinal; ground cover; phytoremediation	–
9	*Juncus tenuis* Willd.	medicinal	–
10	*Juncus thomasianus* Ten.	ornamental; handicraft / domestic uses	–
11	*Juncus trifidus* L.	low fodder value	–
12	*Luzula campestris* (L.) DC.	low fodder value; ornamental	–
13	*Luzula luzuloides* (Lam.) Dandy & Wilmott	low fodder value; ornamental; dye plant	–
14	*Luzula pilosa* (L.) Willd.	ornamental	–
15	*Luzula sylvatica* (Huds.) Gaud.	ornamental	–

Juncaginaceae Family

This family is represented by two species that tolerate highly saline soils: *Triglochin maritima* L. and *T. palustris* L. (Table 4). They are highly toxic to ruminant animals (Zanoschi V. et al., 1981; Pop I., 1982; https://pfaf.org/user).
Triglochin maritima L. accumulates cadmium (Cd) and copper (Cu) in the aerial parts, chromium (Cr) and lead (Pb) in the underground parts (Syranidon Ev. et al., 2016), and large amounts of iron (Fe) from saltwater (Terebova E.N. et al., 2022).

Table 4. Juncaginaceae Family

No.	Species	Categories of Use	Observations
1	*Triglochin maritima* L.	highly toxic; phytoremediation potential; ground cover / soil stabilization	–
2	*Triglochin palustris* L.	toxic; ground cover / soil stabilization	–

Lemnaceae Family (Duckweeds)

The family Lemnaceae is represented by six species across three genera. Among these, *Lemna minor* L. is the most widespread, *L. trisulca* L. is common, and *L. gibba* L. is sporadic. *Spirodela polyrhiza* (L.) Schleid. is also commonly found. These species are fast-growing, produce substantial biomass, and are tolerant to cold, heat, and environmental stress (Khellaf, 2009). These species have multiple applications. They can be used as green fertilizers, poultry feed, and are highly suitable for water quality monitoring due to their phytoremediation capabilities (Bergqvist, Greger, 2016). They are capable of removing up to 80% of heavy metals such as Cd, Cu, Pb, and Ni from contaminated waters, while moderately accumulating Cu and Pb (Qayoon, Jaies, 2022). Proper application requires thorough knowledge of water quality.

Lemna gibba has thicker and more consistent fronds compared to *L. minor*. It is considered edible (3/5; https://pfaf.org/user). This species is highly effective in phytoremediation, accumulating significant quantities of heavy metals including Cd, Cr, Cu, Zn, Ni, and As, with Zn and As accumulated in particularly high amounts (Boros-Lajszner et al., 2020; Borisova et al., 2016; Khellaf, Zeradaoni, 2009; Mkandawire et al., 2009; Megateli et al., 2009; Rahman, Hasegawa, 2011; Sood et al., 2012). Mkandawire et al. (2004) reported that a biomass yield of 73.6 $t \cdot ha^{-1} \cdot year^{-1}$ can reduce 752 kg $As \cdot ha^{-1} \cdot year^{-1}$, accumulating 1022 mg $As \cdot kg^{-1}$ dry weight over 21 days (Srivastava et al., 2021). *L. gibba* also accumulates radioactive isotopes such as uranium (U) and thorium (Th) (Boros-Lajszner et al., 2020; Mkandawire et al., 2009; Sood et al., 2012; Krems et al., 2013).

Historically, *Lemna minor* was used in rural environments for feeding poultry, although it has low fodder value (Pop, 1982). While no medicinal use is reported in Romania, it has been used in other countries to treat colds, edema, and urinary difficulties (https://pfaf.org/user).

L. minor is an excellent bioindicator for monitoring heavy metal contamination, accumulating Cd, Zn, As, Cr, Cu, Pb, Ni, Fe, Hg, and Ti. It effectively reduces metal concentrations in contaminated waters (Deng et al., 2004; Friioff et al., 2005; Kara, 2005; Olette et al., 2008; Babic et al., 2009; Usal & Taner, 2009; Rahman, Hasegawa, 2011; Parra et al., 2012; Sood et al., 2012; Krems et al., 2014; Török et al., 2018; Galczyńska et al., 2019; Qayoon, Jaies, 2022; Sitarska et al., 2022; Enache et al., 2023). Furthermore, it removes fungicides, herbicides, and pesticides. The presence of *Spirulina* and *Scenedesmus* enhances its decontamination capacity (Danson-Olette et al., 2009, 2011). It also bioaccumulates DDT and radioactive ions such as Cs-137 (Cecal et al., 2001) and U and Th (Sasmaz et al., 2016).

Lemna trisulca has low fodder value (Pop, 1982) and is effective in purifying water polluted with Cd and Zn (Ergönül et al., 2022; Rahman, Hasegawa, 2011; Huebert, Shay, 1993; Qayoon, Jaies, 2022).

Spirodela polyrhiza has edible fronds and is used to treat colds, edema, and urinary difficulties (https://pfaf.org/user). It contains antioxidant compounds (Sen, Chakraborty, 2011). This species efficiently removes pollutants from wastewater, including antibiotics, and serves as a bioindicator of anthropogenic impact (Singh et al., 2019). It is suitable for phytofiltration (Bergqvist, Greger, 2016), accumulates Zn (Zhang et al., 2006; Roli et al., 2007), hyperaccumulates Cd (Chaudhuri et al., 2013), and removes DDT, fungicides, Hg, Pb, and Ni (Gao et al., 2000; Rahman & Hasegawa, 2011; Goswami et al., 2014). The biomass can also be used as compost in agriculture.

Wolffia arrhiza has sporadic distribution in lowland areas and is considered vulnerable. It is highly edible (4/5) when harvested from clean waters. Its presence in metal-contaminated water demonstrates its phytoremediation potential (Bergqvist & Greger, 2016). It is the smallest Lemnaceae species, producing limited biomass, and typically coexists with *Lemna* species and other aquatic macrophytes.

Puddles and water bodies dominated by Lemnaceae species indicate mineral-rich waters. In lakes, dense Lemnaceae mats are indicative of advanced eutrophication. Their rapid growth, biomass production, and bioaccumulation capacity make them key species for phytoremediation, ecological monitoring, and sustainable agriculture (Table 5).

Table 5. Lemnaceae Family

No.	Species	Categories of Use	Observations
1	*Lemna minor* L.	low fodder; bioindicator; phytoremediation; green fertilizer; poultry feed	most widespread; useful in water quality monitoring
2	*Lemna trisulca* L.	low fodder; phytoremediation; bioindicator	common; purifies water contaminated with Cd and Zn
3	*Lemna gibba* L.	edible (3/5); phytoremediation; green fertilizer	sporadic; accumulates heavy metals; edible fronds
4	*Spirodela polyrhiza* (L.) Schleid.	edible; medicinal; bioindicator; phytoremediation; antioxidant	common; removes heavy metals, antibiotics, pesticides

No.	Species	Categories of Use	Observations
5	*Wolffia arrhiza* (L.) Horkel ex Wimm.	edible (4/5); phytoremediation; bioindicator	sporadic; vulnerable; grows with *Lemna* spp.; limited biomass

Liliaceae Family

The Liliaceae family includes perennial, geophytic plants whose habitats have been increasingly restricted over time due to the conversion of many land areas for economic use. Many useful species have entered the Red Lists. When analyzing them numerically, we find that more than two-thirds have known uses.

All species in this family are ornamental. We identified uses for 14 species, but the following 10 species are listed: *Erythronium dens-canis* L., *Gagea bohemica* (Zauschn.) Schult. & Schul. fil., *Fritillaria meleagroides* Patrin ex Schult. & Schult.f., *Lilium bulbiferum* L., *Tulipa hungarica* Borbás ssp. *undulatifolia* Roman & Beldie, *Fritillaria montana* Hoppe ex W. D. J. Koch, *F. meleagris* L., *Lilium carniolicum* Bernh. ssp. *jankae* (A. Kern.) A. & G., *L. martagon* L., *Tulipa sylvestris* L. (Table 6).

The melliferous value is very low, with only four species showing medium melliferous potential: *Gagea lutea* (L.) Ker Gawl., *G. minima* (L.) Ker Gawl., *G. pratensis* (Pers.) Dumort., and *Lilium carniolicum* Bernh. ssp. *jankae* (A. Kern.) A. & G.

These species have no significant value for human nutrition. Only occasionally were the following species consumed as snacks: *Erythronium dens-canis* L., *Gagea lutea* (L.) Ker Gawl., *Lilium bulbiferum* L., and *L. martagon* L.

For human and veterinary medicine, only *Lilium martagon* L. has been of interest in the past. Harvesting of this species is prohibited, but it can be cultivated.

The following species are listed as toxic: *Fritillaria meleagris* L., *F. montana* Hoppe ex W.D.J. Koch, and *Lilium martagon* L.

Erythronium dens-canis L. var. *dens-canis* is common, and var. *niveum* Baumg., a Romanian endemic, is also common but faces a low risk of threat due to harvesting for ornamental purposes. It is not known whether its leaves or underground organs were traditionally consumed in Romania.

The genus *Fritillaria* includes three very attractive species—*F. meleagris* L., *F. meleagroides* Patrin ex Schult.f., and *F. montana* Hoppe ex W.D.J. Koch—that have been severely affected by collectors; currently, they are considered vulnerable in their natural habitats.

Fritillaria meleagris L., popularized in recent decades as a natural monument, is toxic and has poor melliferous value. Its seeds are cultivated in ornamental gardens.

Species of the genus *Gagea* are ornamental and moderately melliferous, and their populations are generally not endangered.

Lilium bulbiferum L. ssp. *bulbiferum* and ssp. *croceum* (Chaix) Arc., commonly known as Lily or Emperor's Crown, are rare.

Lilium carniolicum Bernh. ssp. *jankae* (A. Kern) A. & G. is rare, vulnerable, protected, and considered globally and regionally threatened in Europe (Oprea, 2005).

Lilium martagon L., the Forest Lily, is sometimes common in semi-shaded habitats. Harvesting its bulbs is prohibited, although they are eaten in other regions of the world.

Tulipa hungarica Borbás ssp. *undulatifolia* Roman & Beldie, the Yellow Tulip, is rare and restricted to hilly limestone cliffs in Mehedinți County. It has ornamental value (Pop, 1982) and is a very poor melliferous species, with low nectar production (0/3) and low pollen output (1/3) (Dihoru, 2023). It is on the verge of extinction in Romania and is globally and regionally threatened in Europe (Oprea, 2025).

Tulipa sylvestris L. ssp. *sylvestris* and ssp. *australis* (Link) Pamp. have a sporadic distribution in Mureș, Sibiu, Hunedoara, and Vaslui counties. They are considered rare and vulnerable. They have ornamental value (Pop, 1982) but are very poor honey producers, providing a small amount of pollen (1/3) and very little nectar (0/3) (Dihoru, 2023).

Table 6. Species with economic value in the Liliaceae family

No.	Species	Categories of use	Observations
1	*Erythronium dens-canis* L.	very weak melliferous; decorative; edible	var. *niveum* Baumg. is a Romanian endemic with a low risk of threat
2	*Fritillaria meleagris* L.	poor melliferous; decorative; toxic	vulnerable; protected as a natural monument
3	*Fritillaria meleagroides* Patrin ex Schult. & Schult.f.	decorative	rare; Cotu Morii – Popricani commune (Iași County)
4	*Fritillaria montana* Hoppe ex W.D.J.Koch	decorative; very poor melliferous; toxic	vulnerable in Romania; globally threatened also in Europe
5	*Gagea bohemica* (Zauschn.) Schult. & Schult.f.	decorative	rare; not used in Romania

No.	Species	Categories of use	Observations
6	*Gagea lutea* (L.) Ker Gawl.	decorative; medium melliferous; edible (1/5)	–
7	*Gagea minima* (L.) Ker Gawl.	medium melliferous	–
8	*Gagea pratensis* (Pers.) Dumort.	decorative; medium melliferous	–
9	*Gagea villosa* (M.Bieb.) Sweet	decorative	–
10	*Lilium bulbiferum* L.	decorative; edible bulbs (3/5)	rare
11	*Lilium carniolicum* Bernh. subsp. *jankae* (A.Kern.) A.& G.	medium melliferous; decorative	in Romania it is rare, vulnerable and protected; globally threatened also in Europe
12	*Lilium martagon* L.	decorative; edible bulbs (2/5); medicinal; veterinary uses; poor melliferous; dye plant	harvesting is prohibited
13	*Tulipa hungarica* Borbás subsp. *undulatifolia* Roman & Beldie	decorative; very poor melliferous	rare; at risk of extinction in Romania; globally threatened in Europe
14	*Tulipa sylvestris* L.	decorative; very poor melliferous	rare; vulnerable

Melanthyaceae Family

The Melanthyaceae family comprises perennial, geophytic plants, some of which have significant economic and medicinal value. Their habitats have been partially restricted over time due to the conversion of land for agricultural and urban use. Several species are included in red lists due to overharvesting and habitat loss (Table 7).

Paris quadrifolia L. is widespread in forests, thickets, and glades, from plains to the spruce forest level. It has applications in traditional veterinary medicine, which is reflected in its common Romanian name, "Dalac" (Anthrax). The plant is toxic, particularly affecting the heart (Kovacs A., 1979; Zanoschi V. et al., 1981; Jenet-Siems K. et al., 2012). Its fruits are poisonous and potentially fatal to children, hence the alternative name "Fox fruit"; however, in very small doses, they have therapeutic applications for adults under medical supervision. The plant also has ornamental value, with yellow leaves and red fruits (https://pfaf.org/user). Harvesting of isolated specimens is prohibited to preserve wild populations (Dihoru G., Boruz V., 2014).

Veratrum album L. is a toxic weed affecting horses, cattle, and sheep and is harmful to meadows. It is widespread from the beech forest to the lower alpine level. In humans, it causes nausea, vomiting, and increased sweating (Vončina M. et al., 2014). Historically, it was used as a psychic protector and has applications in the treatment of epilepsy. Externally, it is used for eczema, wounds, pruritus, herpes, scabies, and rheumatism. Internally, rhizome tinctures are used under medical supervision for hypertension, hypertensive crises, and toxicosis in pregnant women (Kong I.M. et al., 2003; Heinrich, 2019; Pârvu C., 2013; Scarlat M.A., 2019; Zanoschi V. et al., 1981). In traditional veterinary medicine, it was applied externally for deworming (Marian S. Fl., 1870–1906; Crăciun F. et al., 1977). Its rhizome extracts have insecticidal activity and can protect crops from pests such as the Colorado potato beetle (*Leptinotarsa decemlineata*) and can kill caterpillars, mice, and rats (Aydin T. et al., 2014; https://pfaf.org/user). The plant is notable for its large size and decorative appearance, and in controlled contexts, it can be harvested extensively (Dihoru G., Boruz V., 2014; Preda M., 1989).

Veratrum nigrum L. is sporadically distributed at lower altitudes. It is toxic (Zanoschi V. et al., 1981; Pop I., 1982), decorative (Preda, 1989), and considered vulnerable.

Table 7. Species with Economic Value in the Melanthyaceae Family

No.	Species	Categories of use	Observations
1	*Paris quadrifolia* L.	toxic; medicinal; veterinary uses; dye plant; ornamental	harvesting of isolated specimens is prohibited
2	*Veratrum album* L.	toxic; medicinal; veterinary uses; insecticide; ornamental; cultural uses	–
3	*Veratrum nigrum* L.	toxic; ornamental	vulnerable

Najadaceae Family

Najas marina L. is a common aquatic plant found in plains and hilly areas, and it is also adapted to brackish waters. Its young leaves are slightly edible (1/5) (https://pfaf.org/user, Keskin M. et al., 2024), and it can be used for the restoration of humid environments with hydrophytes (Rodrigo M. A., 2021). Its roots accumulate arsenic (As), nickel (Ni), lead (Pb), and chromium (Cr) (Mazej Z., Germ M., 2008).

Najas minor All. has young leaves that are slightly edible (1/5), but it has not been utilized in Romania (Table 8).

Table 8. Species of the *Najadaceae* Family in Romania

No.	Species	Categories of use	Observations
1	*Najas marina* L.	slightly edible (1/5); ecological restoration; phytoremediation	–
2	*Najas minor* All.	slightly edible (1/5)	not used in Romania

Orchidaceae Family

Over time, the underground parts of orchids from temperate zones have been harvested for their tonic, aphrodisiac, and restorative properties, particularly for children suffering from colds, coughs, exhaustion, convalescence, or mild mental disorders. These plants are generally safe when used appropriately, with adverse effects rarely reported. Remedies targeting the reproductive system were especially sought after, which contributed significantly to the depletion of wild populations.

In Romania in past centuries, orchids were used only by folk connoisseurs of medicinal plants and by pharmacists who prepared salep. Currently, they are protected in many countries in Europe, there are numerous studies on the biology and cultivation of orchids of economic and protective interest. The most harmful of the disturbing factors that led to the thinning of orchids in meadows and forests were: commercial harvesting, the reduction of natural meadow areas by approximately 50% through overgrazing, habitat destruction, tourism, habitat disturbance or destruction, collected as ornamental species, etc. There are many species in this category on the territory of Romania. We cannot assess whether the cultivation of orchids as decorative and medicinal plants can locally save some wild populations from destruction.

Orchids are highly valued for their ornamental flowers, but they are rarely consumed. When analyzed as a species list rather than by frequency in nature, most Romanian orchids are included in red lists (Table 9). Harvesting from the wild is strictly prohibited for all rare and vulnerable species. However, suitable cultivation techniques exist; for example, the tubers of *Dactylorhiza fuchsii* (Druce) Soó and *D. incarnata* L. can be propagated through in vitro micropropagation techniques (Kryukov et al., 2024; Caleva, 2024).

Extensive information on the distribution of orchids in Romania can be found in Panțu (1915), *Flora R.S. România* (1972), Irimescu et al. (2019), Oprea (2019), and De Angelli & Anghelescu (2020). Reliable location data are available in numerous floristic and vegetation monographs covering the country. The list presented here synthesizes information from phytosociological studies, while detailed data on uses, biology, and modern cultivation methods can be found in international scientific databases for each species mentioned in Table 9.

Anacamptys pyramidalis (L.) Rich. are a sporadic distribution and is considered vulnerable. In Europe, its habitats are in decline due to grazing (Bazzicalupo M. et al., 2023).

Cypripedium calceolus L., commonly known as Lady's Slipper, is rare and grows on calcareous soils. It is protected as a natural monument, and harvesting is strictly prohibited. The species is globally threatened in Europe (Oprea Ad., 2005) and is often damaged by tourists (Bazzicalupo M. et al., 2023).

Dactylorhiza cordygera (Fr.) Soó ssp. *cordygera* is common in wet meadows from the beech to the subalpine level. Its subspecies *siculorum* (Soó) Soó, is a Carpathian endemic, sporadically found in peatlands, and is in decline in Europe due to overgrazing and tourism (Bazzicalupo M. et al., 2023).

Dactylorhiza maculata (L.) Soó ssp. *maculata* is common, while subsp. transsilvanica (Schur) Soó is sporadic. Subsp. *schurii* (Klinge) Soó is a Carpathian endemic with sporadic distribution, included in the red list. In Romania, it is used empirically as a medicinal plant, but rarely (Dihoru G., Boruz V., 2014).

Dactylorhiza majalis (Rchb.) P. H. Hunt & Summerh. is rarely distributed and, according to some sources, is sporadic in wet meadows and swamps at the beech and spruce levels. It is protected in Europe (Bazzicalupo M. et al., 2023) and considered threatened in Romania.

Dactylorhiza saccifera (Brong.) Soó is globally threatened and protected in Italy (Bazzicalupo M. et al., 2023). In Romania, it occurs sporadically, and its ecology has not been fully evaluated.

Dactylorhiza sambucina (L.) Soó is under threat.

Epipactis heleborine (L.) Crantz is common in hilly and mountainous areas but also considered under threat.

Goodyera repens (L.) R. Br. has a sporadic distribution in coniferous and mixed forests and is under threat.

Gymnadenia conopsea (L.) R. Br., ssp. conopsea is common but under threat; harvesting is prohibited (Dihoru G., Boruz V., 2014).

Herminium monorchis (L.) R. Br. is sporadic and under threat.

Himantoglossum jankae Solyay occurs sporadically in steppe and forest-steppe habitats, vulnerable in Romania and globally threatened in Europe (Oprea A., 2005).

Listera ovata (L.) R. Br. is frequently distributed in forests and thickets at the beech level, but it is under threat. It is harvested alternately every 2–3 years (Dihoru G., Boruz V., 2014).

Ophrys apifera Huds. ssp. apifera is rare and under threat.

Ophrys fuciflora (F. W. Schmidt) Moench ssp. *fuciflora* is also rare.

Ophrys scolopax Cav. ssp. *cornuta* (Steven) E.G. Camus is rare and under threat in Romania and globally threatened in Europe (Oprea A., 2005).

Ophrys sphegodes Miller is rare and under threat. In Europe it is destroyed by collectors (Bazzicalupo M. et al., 2023).
Orchis coriophora L. is common but under threat.
Orchis laxiflora Lam. ssp. *elegans* (Heuff.) Soó has decorative value, is medium melliferous (Kovacs A., 1979; Pop I., 1982), edible 2/5, medicinal 2/5, and non-toxic (pfaf.org/user; Keskin M., et al., 2024). It is well protected in humid marshy meadows from the plain to the beech level.
Orchis mascula (L.) L. ssp. *signifera* (Vest.) Soó is frequently distributed in the beech and spruce forests. It is threatened in Europe, including Romania, and protected in France and Belgium (Sârbu I. et al., 2013; Bazzicalupo M. et al., 2023).
Orchis militaris L. is a red list species, common but strictly protected; harvesting is prohibited (Dihoru G., Boruz V., 2014). It is critically endangered in many European countries (Bazzicalupo M. et al., 2023).
Orchis morio L. was once abundant; however, habitat destruction has significantly reduced its populations. It remains the most widespread species among orchids in Romania but is under threat, and harvesting is strictly prohibited.
Orchis pallens L. is rare in Romania, protected, and threatened in Europe.
Orchis papilionacea L. is a red list species, rare, with harvesting strictly prohibited (Dihoru G., Boruz V., 2014).
Orchis purpurea Huds. is a red list species, sporadically distributed in Romania, under threat, and strictly protected (Dihoru G., Boruz V., 2014).
Orchis simia Lam. is rare and under threat in Romania (Oltean M. et al., 1994; Sârbu I. et al., 2013) and protected in Europe (Bazzicalupo M. et al., 2023).
Orchis ustulata L. is common, edible 2/5, and medicinal 2/5.
Species of the genera *Orchis* and *Dactylorhiza* are used in the Balkans to treat respiratory diseases (Prazina N. et al., 2011).
Platanthera bifolia (L.) L. C. Rich. is common but under threat; harvesting is prohibited (Dihoru G., Boruz V., 2014). It is also threatened in Central Europe (Bazzicalupo M. et al., 2023). *Platanthera chlorantha* (Custer) Rchb. is sporadic in forests, under threat, with strict harvesting prohibition (Dihoru Gh., Boruz V., 2014), and is threatened in Europe (Bazzicalupo M. et al., 2023).
Spiranthes spiralis (L.) Cheval is sporadic in Romania, threatened in Europe (Bazzicalupo M. et al., 2023).
This synthesis highlights the delicate conservation and economic status of Orchidaceae species, indicating the need for further detailed studies.

Table 9. Species of Economic Importance from the Orchidaceae Family

No.	Species	Categories of Use	Observations
1	*Anacamptis pyramidalis* (L.) Rich.	medicinal; cosmetic; decorative; toxic	vulnerable in Romania; declining in Europe
2	*Cephalanthera longifolia* (Huds.) Fritsch	medicinal; decorative	sporadic; low risk of threat
3	*Coeloglossum viride* (L.) Hartm.	medicinal	frequent; under threat
4	*Corallorhiza trifida* Chatel.	veterinary medicine	sporadic; under threat
5	*Cypripedium calceolus* L.	medicinal; decorative	rare; protected as a natural monument; harvesting strictly prohibited
6	*Dactylorhiza cordigera* (Fr.) Soó	medicinal	declining in Europe; ssp. *siculorum* (Soó) Soó is a Carpathian endemic
7	*Dactylorhiza fuchsii* (Druce) Soó	medicinal	–
8	*Dactylorhiza incarnata* (L.) Soó	medicinal	–
9	*Dactylorhiza maculata* (L.) Soó	edible; medicinal; medium melliferous; veterinary medicine; decorative	under threat; included on the Red List
10	*Dactylorhiza majalis* (Rchb.) P.F. Hunt & Summerh.	medicinal	threatened in Romania; protected in Europe
11	*Dactylorhiza saccifera* (Brongn.) Soó	medicinal	globally threatened; protected in Italy
12	*Dactylorhiza sambucina* (L.) Soó	medicinal; decorative	under threat
13	*Epipactis atrorubens* (Hoffm.) Besser	medicinal	sporadic; under threat
14	*Epipactis helleborine* (L.) Crantz	medicinal	under threat in Romania; cultivated in several European countries
15	*Epipactis microphylla* (Ehrh.) Sw.	medicinal	sporadic; under threat
16	*Epipactis palustris* (L.) Crantz	medicinal	sporadic; under threat
17	*Epipogium aphyllum* Sw.	medicinal	sporadic; under threat
18	*Goodyera repens* (L.) R. Br.	medicinal; veterinary medicine	under threat
19	*Gymnadenia conopsea* (L.) R. Br. subsp. *conopsea*	edible (2/5); medicinal; decorative	common; under threat; harvesting prohibited; threatened in Europe
20	*Gymnadenia odoratissima* (L.) Rich.	medicinal	insufficiently studied

No.	Species	Categories of Use	Observations
21	*Herminium monorchis* (L.) R. Br.	medicinal	sporadic; under threat
22	*Himantoglossum jankae* Somlyay, Kreutz & Óvári	decorative; medicinal	vulnerable in Romania; globally threatened (incl. Europe)
23	*Limodorum abortivum* (L.) Sw.	medicinal	insufficiently studied
24	*Listera ovata* (L.) R. Br.	medicinal; veterinary medicine; decorative	under threat; harvested alternately every 2–3 years
25	*Neottia nidus-avis* (L.) Rich.	medicinal	harvested in small quantities or at intervals of 2–3 years
26	*Nigritella nigra* (L.) Rchb. f.	decorative; medium melliferous	vulnerable; protected
27	*Nigritella rubra* (Wettst.) K.Richt.	decorative; medium melliferous	vulnerable; protected
28	*Ophrys apifera* Huds. subsp. *apifera*	edible (2/5); medicinal (2/5)	rare; under threat in Romania
29	*Ophrys fuciflora* (F.W. Schmidt) Moench	medicinal	rare
30	*Ophrys insectifera* L.	edible (2/5); medicinal (2/5); decorative	rare; under threat
31	*Ophrys scolopax* Cav. subsp. *cornuta* (Steven) E.G. Camus	edible (2/5); medicinal (2/5); decorative	rare; under threat in Romania; globally threatened
32	*Ophrys sphegodes* Mill.	edible (2/5); medicinal (2/5); decorative	rare; under threat in Romania; declining in Europe
33	*Orchis coriophora* L.	edible (2/5); medicinal (2/5); veterinary medicine; decorative	–
34	*Orchis laxiflora* Lam. subsp. *elegans* (Heuff.) Soó	edible (2/5); medicinal (2/5); decorative; medium melliferous	well protected in marshy meadows; no known risks
35	*Orchis mascula* (L.) L. subsp. *signifera* (Vest) Soó	edible (2/5); medicinal (2/5); poor melliferous	common; under threat
36	*Orchis militaris* L.	edible (2/5); medicinal (2/5); veterinary medicine; decorative; medium melliferous	harvesting strictly prohibited; tubers can be micropropagated
37	*Orchis morio* L.	edible (2/5); medicinal (2/5); veterinary medicine; decorative; medium melliferous	under threat; harvesting strictly prohibited
38	*Orchis pallens* L.	medicinal	rare in Romania; protected; threatened in Europe
39	*Orchis papilionacea* L.	medicinal; decorative	rare; harvesting strictly prohibited
40	*Orchis purpurea* Huds.	medicinal; decorative	sporadic; under threat; harvesting strictly prohibited
41	*Orchis simia* Lam.	medicinal; decorative	rare; under threat in Romania; protected in Europe
42	*Orchis tridentata* Scop.	medium melliferous; poorly edible	under threat
43	*Orchis ustulata* L.	edible (2/5); medicinal (2/5); decorative; medium melliferous	–
44	*Platanthera bifolia* (L.) L.C. Rich.	edible (2/5); medicinal (2/5); veterinary medicine; decorative	under threat
45	*Pseudorchis albida* (L.) Á. Löve & D. Löve	medicinal	sporadic; not sociologically evaluated
46	*Spiranthes spiralis* (L.) Chevall.	medicinal; decorative	under threat in Europe; insufficiently studied
47	*Traunsteinera globosa* (L.) Rchb.	edible; decorative; melliferous	under threat

Potamogetonaceae Family

Potamogeton species are submerged freshwater plants, some of which tolerate brackish water. Historically, their young leaves have occasionally been consumed by various peoples. Currently, these species serve as indicators of eutrophication in aquatic ecosystems. They are also capable of retaining heavy metals, thereby reducing their concentrations in water. Most species in wetlands, aquatic, and marshy areas can tolerate excess Pb (Deng H. et al., 2004). While specific data are lacking for *P. gramineus* L. and *P. pusillus* L., it is reasonable to assume that

these species can also accumulate heavy metals (Table 10). *Potamogeton* species are a source of food for aquatic animals (Matache M. et al., 2013), and together with *Chara* species, they serve as indicators of lake quality.
In the artificial colonization of eutrophicated lakes, the following species have been used: *Potamogeton alpinus* Balb., *P. berchtoldii* Fieber, *P. crispus* L., and *P. pusillus* L. (Hilt S. et al., 2006; Rodrigo M.A., 2021).
Groenlandia densa (L.) Fourr. is sporadically distributed in plains and hilly areas and is considered vulnerable in Romania. It accumulates heavy metals in the following order: Mn, Zn, Cu, Cr, Cd, and Hg (Podlasinska J. et al., 2021). If harvested from clean waters, it is edible (Keskin M. et al., 2024).
Potamogeton alpinus Balb. is a very rare, glacial relict species. It is considered vulnerable in Romania and is widespread in stagnant or gently flowing waters from the beech to the spruce forest level (Oprea A., 2005). It functions as a bioindicator and performs moderate phytoremediation, accumulating Cu, Fe, Ni, Zn, and Mn (Chukina N.V. et al., 2013; Friioff A. et al., 2005; Borisova G. et al., 2016).
Potamogeton berchtoldii Fieber (formerly *P. pusillus* auct., non L.) has edible leaves (Keskin M. et al., 2024) and is sporadically distributed in plains and hilly areas. It performs weak to moderate decontamination for As, Hg, Ni, Zn, and Cu (Monferran et al., 2009; Sood A., et al., 2012; Borisova G., et al., 2016; Munteanu V., Munteanu G., 2007; Harguinteguy C.A. et al., 2015).
Potamogeton crispus L., known as Frog's grass, is common in stagnant or gently flowing waters from the steppe to the beech forest level. Young leaves and roots harvested from clean waters are edible (2/5) (https://pfaf.org/user; Keskin M. et al., 2024). It is tolerant to heavy metals and demonstrates good phytoremediation capacity, concentrating Cd, Cu, Zn, Cr, Pb, and As (Deng H. et al., 2015; Seenivasagan R. et al., 2022; Nourouzina H., Hmidian A.H., 2014). Additionally, it contributes to the biodegradation of polycyclic aromatic hydrocarbons (Meng F., Chi J., 2016), weak desalination (Yang Y.N. et al., 2015), and plastic degradation through rhizospheric microbiota (Chi J., Yang Q., 2012).
Potamogeton gramineus L. is sporadic from the steppe zone to the beech forest level. Traditionally, it was used by Turks for nutritional purposes (Keskin M. et al., 2024). It coexists with *P. perfoliatus* and likely accumulates heavy metals.
Potamogeton lucens L. is sporadic and occurs from the steppe to the beech level. Very young leaves from clean waters can be consumed occasionally (Keskin M. et al., 2024). It is also suitable for wetland restoration with hydrophytes (Rodrigo M.A., 2021) and can accumulate heavy metals such as As, Ni, Pb, Cr, Cu, Zn, and Fe (Pajević S. et al., 2008; Harguinteguy C.A. et al., 2015; Krems P. et al., 2013; Matache M. et al., 2013; Mazej Z., Germ M., 2008).
Potamogeton natans L., known as Frog weed, is sporadic from the steppe to the spruce forest level. Its roots and stems are edible (3/5) and have febrifuge properties (https://pfaf.org/user). It is effective in heavy metal removal, frequently used in Poland, and accumulates Cd, Pb, Zn, Cu, and Mn (Fritioff A. et al., 2005; 2012; Trojanowski J. et al., 2013; Rahman M.A., Hasegawa H., 2011). It has also been reported to assist in uranium decontamination (Mora-Ravelo S.G. et al., 2016; Prats J. et al., 2014).
Potamogeton nodosus Poir. is nutritious and medicinal (Keskin M. et al., 2024; Alan Z. et al., 1999). It accumulates heavy metals (As, Ni, Pb, Cr) primarily in roots and is used for reducing Cd, Pb, and Mn from wastewater (Matache M. et al., 2013; Mazej Z., Germ M., 2008; Shehata H.S., 2018).
Potamogeton pectinatus L. (Frog's grass) is widely distributed in eutrophic waters, from plains to mountainous areas. Leaves harvested from plants in clean waters are moderately edible (3/5) (https://pfaf.org/user). This species is a reliable bioindicator for monitoring waters polluted with Hg, Mn, Cd, Ni, Zn, and Cu (Munteanu V., Munteanu G., 2007; Pajević S. et al., 2008; Harguinteguy C.A. et al., 2015; Costa M.R. et al., 2018). According to Matache et al. (2013), it hyperaccumulates Cd, Cu, Zn, and Pb in the waters of the Danube. It exhibits rapid growth and significant biomass production, making it effective in the assessment of aquatic ecosystem quality. The species can also accumulate Cr, Fe, Mn, Zn, Cd, and Pb and is capable of reducing concentrations of Fe, Cu, Zn, and Pb in wastewater by 70–85% (Upadhyay A.K. et al., 2014; Rai U.N. et al., 2002; Ibrahim et al. 2016; Qayoon I., Jaies I., 2022). Additionally, it demonstrates bioremediation potential for waters contaminated with other heavy metals such as Ni and As, as well as for certain radioactive elements like uranium (Krems P. et al., 2013; Rahman M.A., Hasegawa H., 2011; Prats J. et al., 2014; Mora-Ravelo S.G. et al., 2016).
Potamogeton perfoliatus L. is both nutritious and medicinal (Keskin M. et al., 2024; Mahmoud M.F. et al., 2021) and is commonly used for the restoration of wetlands with hydrophytes (Rodrigo M.A., 2021). This species serves as a moderate bioindicator for Fe and Cd pollution and demonstrates moderate phytoremediation capacity, accumulating Ca, Cu, Zn, and Pb (Pajević S. et al., 2008; Borisova G. et al., 2016; Matache M. et al., 2013).

Table 10. Species from Potamogetonaceae Family with importance in ecological economy

No.	Species	Categories of Use	Observations
1	*Groenlandia densa* (L.) Fourr.	phytoremediation	vulnerable in Romania
2	*Potamogeton alpinus* Balb.	moderate phytoremediation; bioindicator	vulnerable; very rare; glacial relict
3	*Potamogeton berchtoldii* Fieber	weak–moderate phytoremediation	–
4	*Potamogeton crispus* L.	edible; good phytoremediation	–

No.	Species	Categories of Use	Observations
5	*Potamogeton gramineus* L.	weakly edible	–
6	*Potamogeton lucens* L.	ecological restoration; phytoremediation	–
7	*Potamogeton natans* L.	popular beliefs; edible; very good phytoremediation	–
8	*Potamogeton nodosus* Poir.	medicinal; edible; weak phytoremediation	–
9	*Potamogeton pectinatus* L.	edible; good bioindicator; good phytoremediation	–
10	*Potamogeton perfoliatus* L.	weakly edible; medicinal; moderate phytoremediation	–
11	*Potamogeton pusillus* L.	ecological restoration	–

Rupiaceae Family

Ruppia maritima L. is sporadically found in saline and shallow waters. It can be used for wetland restoration with hydrophytes and for the remediation of coastal wastewater (Ahmadi M. et al., 2017; Rodrigo M.A., 2021) (Table 14).

Scheuchzeriaceae Family

This family has only one representative, *Scheuchzeria palustris* L., a rare species, from peaty, acidic, marshy and sunny soils, in hilly and mountainous areas; it is toxic (Zanoschi V. et al., 1981) (Table 14).

Sparganiaceae Family

Sparganium erectum L. is a marsh plant suitable for phytoremediation. It improves wastewater quality and produces abundant biomass, forming dense vegetation that can exceed 1 m above the water surface. On muddy bottoms, it retains suspended solids and various heavy metals, including Na, Fe, Zn, Cu, Pb, Mn, Ni, Cd, and Cr (Lojko R. et al., 2015; Parzych A.E., 2015). Additionally, it attracts fauna and is of interest for microbiological studies (Table 11).

Table 11. Species from Sparganiaceae Family

No.	Species	Categories of use	Observations
1	*Sparganium erectum* L.	phytoremediation; ecological restoration; biomass production	–

Tofieldaceae Family

Tofieldia calyculata (L.) Wahlenb. is a rare species found in swampy meadows from the beech to the subalpine level. It is under threat and considered a glacial relict in the Flora of Romania. The species is suitable for ecological restoration (Giupponi L., Leoni V., 2020) and also has decorative value (Preda M., 1989) (Table 12).

Table 12 - Species from Sparganiaceae Family

No.	Species	Categories of use	Observations
1	*Tofieldia calyculata* (L.) Wahlenb.	ecological restoration; decorative	rare; under threat; considered a glacial relict in Romania

Typhaceae Family

Typha species are widely recognized for their ecological, medicinal, and industrial value. According to *Plants For A Future*, *Typha latifolia* is highly appreciated as an edible plant (5/5), medicinal (3/5), and for other uses (4/5). In Romania, its leaves have traditionally been used for sealing wooden barrels and weaving.

The pollen of *T. latifolia* has multiple health benefits, including effects on kidney stones, hemorrhage, menstrual disorders, and lymphatic cancers. It is used in traditional Chinese medicine to improve microcirculation and wound healing due to its flavonoid content. Alcoholic and aqueous extracts of pollen efficiently eliminate free radicals (Chen P. et al., 2017). Stamens from all Typha species can be applied to stop external bleeding. In veterinary medicine, the plant is used to treat diarrhea. The flower extract is useful in cosmetics for cleansing irritated or sensitive skin and treating eczema and dermatitis (Ionescu-Călineşti L., 2009).

Typha biomass is abundant, though high moisture content limits its direct use. It can be used as an energy crop (Dubbe D.R. et al., 1988), occasionally as a fuel source, or for the production of cellulose and paper, though the fiber quality is poor (Pop I., 1982; Moghan M.K., 2021). It is effective in ecological restoration of wet environments with hydrophytes (Rodrigo M.A., 2021) and can reduce soil salinity (Yang Y.N. et al., 2015; Guesdon G. et al., 2016).

Young plants provide low-quality fodder, yet over time areas dominated by cattails become mineral-rich and suitable for high-quality dry grasses, serving as a source of organic fertilizer (Poveda J., 2022). *Typha minima* Funck in Hoppe and *T. schuttleworthii* Koch & Sonder can be introduced into cultivation; both species are sporadic in Romania.

Typha latifolia efficiently retains solid organic substances, tolerates high levels of toxic metals, and survives flooding. It acts as a bioindicator for waters contaminated with Ni, Cu, Pb, Cd, Mn, and Zn, and is effective in phytoremediation of metals including Mn, Cr, As, Cd, Pb, Ni, Zn, Cu, and Hg. It is particularly suitable for decontaminating ash ponds from thermal power plants, where its roots accumulate Zn, Mn, Cu, Pb, Cd, Cr, and Ni (Daniel G.M.H. et al., 2016; Pandev V.C. et al., 2014; Rahman M.A., Hasegawa H., 2011; Gajic G. et al., 2019; Gupta D.K. et al., 2020; Upadhyay K. et al., 2019). It can also remove pesticides (Syranidon E. et al., 2016) and restore vegetation in wet mining areas contaminated with heavy metals, reducing soil Hg by 55–71% (Daniel G.M.H. et al., 2016).

Typha angustifolia is effective in industrial wastewater treatment, accumulating Cd, Cr, Pb, Ni, Zn, and Cu (Rahman M.A., Hasegawa H., 2011; Bareen F., Khilji S., 2008; Sood A. et al., 2012) and performing well in phytoremediation of Fe and Mn (Ibrahim R. et al., 2020). It efficiently removes Pb, produces high biomass, and surpasses *Potamogeton pectinatus* in heavy metal accumulation (Demirezeu D., Aksoy A., 2004).

Cattails are also decorative, with leaves used for mats and seedless inflorescences for floral arrangements (Preda M., 1989; Oakes A.J., 1990; Khanbabyeva O.E., et al., 2021). For dried bouquets, inflorescences are harvested before seed ripening to prevent seed loss. *Typha laxmanii* shares similar uses.

In conclusion, Typha species are easily recognizable and of significant ecological, culinary, and therapeutic interest. However, careful distinction must be made between uses, and water and soil quality must be assessed prior to utilization (Table 13).

Table 13. Species with economic and ecological value from the Typhaceae Family

No.	Species	Categories of Use	Observations
1	*Typha angustifolia* L.	medicinal; veterinary medicine; chemical industry; decorative; household uses; ecological reconstruction; good phytoremediation	–
2	*Typha latifolia* L.	medicinal (3/5); edible (5/5); household uses (4/5); good phytoremediation; veterinary medicine; cosmetics; decorative	–
3	*Typha laxmannii* Lepech.	medicinal; edible (4/5); decorative	–
4	*Typha minima* Funck in Hoppe	decorative; medicinal; edible (3/5 pollen); ecological reconstruction	threatened; harvesting prohibited in Romania; globally threatened
5	*Typha shuttleworthii* Koch & Sonder	decorative	vulnerable; harvesting prohibited in Romania; globally threatened

Zannichelliaceae Family

Zannichellia palustris L. is sporadic in plains and hilly areas. It is used for ecological restoration of freshwater and saltwater basins with hydrophytic plants (Rodrigo M.A., 2021) (Table 14).

Table 14. Species of the Rupiaceae, Scheuchzeriaceae, and Zannichelliaceae families in Romania

No.	Species	Categories of Use	Observations
1	*Ruppia maritima* L.	ecological restoration	
2	*Scheuchzeria palustris* L.	toxic; ecological restoration	rare
3	*Zannichellia palustris* L.	ecological restoration	

Zosteraceae Family

Zostera marina L., sea grass, is rare and occurs only in coastal lakes of Constanța County. Its leaves, roots, and seeds are edible (2/5) and possess therapeutic properties (https://pfaf.org/user; Keskin M. et al., 2024). It is used as fodder in fish farming and as filling for pillows and mattresses (Pârvu C., 2003; Romanian Flora XI). The species accumulates large amounts of Fe from salt waters (Terebova E.N. et al., 2022) and is globally threatened (Oprea A., 2005). *Zostera noltii* Hornem. shares similar uses.

Table 15. Species of the Zosteraceae Family in Romania

No.	Species	Categories of Use	Observations
1	*Zostera marina* L.	edible (2/5); medicinal; feed in fish farming; household uses; rare phytoremediation	rare, from coastal lakes in Constanța County; globally threatened
2	*Zostera noltii* Hornem.	edible (2/5); medicinal; feed in fish farming; household uses; rare phytoremediation	rare, from coastal lakes in Constanța County; globally threatened

CONCLUSION

In the **Asparagaceae family**, there are 25 species with economic uses, grouped as follows: 17 ornamental species (68%), 1 species used in the perfume industry, 4 species with cosmetic applications, 1 edible species that is rare in Romania, 7 species with low nutritional value, 3 dye plants, 2 species with limited fodder value, 12 species with medicinal properties, 1 species used in veterinary medicine, 4 species with medium melliferous value, 2 weakly melliferous species, 1 species used as a spice, and 1 bioindicator species. Among these, 7 species are toxic, most of which have been studied for medicinal purposes.

In the **Asphodelaceae family**, there is a single rare species, *Asphodeline lutea* (L.) Rchb., which is cultivated in some countries for ornamental, medicinal, and culinary purposes.

The **Juncaceae family** includes 14 useful species, with 20 citations for economic uses and 10 for ecological applications. Regarding economic uses, there are 8 ornamental species, 5 with domestic uses, 4 used for forage, 1 medicinal species, 1 biomass source, and 1 dye plant. For ecological applications, 5 species are used for phytoremediation, 1 for ecological restoration, 1 as a bioindicator, and 3 for soil coverage and protection. Additionally, 1 species is noted specifically for conservation purposes.

The **Juncaginaceae family** includes 2 toxic species with 3 citations for ecological uses. Both species contribute to soil coverage, and 1 is also suitable for phytoremediation.

The **Lemnaceae family** comprises 5 species, with 10 uses related to ecological economy and 6 uses relevant to rural economy. Among these, 1 species is considered vulnerable.

The **Liliaceae family** includes 14 ornamental species, of which 10 are threatened in their natural habitats.

The **Melanthyaceae family** comprises 3 highly toxic species (*Veratrum* and *Paris*), which were historically used for external deworming in animals.

Najadaceae family has 2 very poorly edible species, one of which is of ecological importance for restoration and phytoremediation.

The **Orchidaceae family** comprises 47 species with documented uses, of which 41 are medicinal, 7 are used in veterinary medicine, 20 are ornamental, 15 are edible, 9 are melliferous, and 1 is used in cosmetics. Only 5 species have no protection status, while 28 species are threatened, 4 are vulnerable, 8 are rare, and 1 is endemic. Over time, orchid populations have declined in Europe and Asia; it is hoped that the information accumulated in numerous publications and accessible to the general public will contribute to their conservation.

The **Potamogetonaceae family** includes 11 species with 20 recorded uses: 9 for phytoremediation, 2 as bioindicators, 2 for ecological restoration, and 5 edible.

The **Ruppiaceae family** has 1 species suitable for ecological restoration.

The **Scheuchzeriaceae family** comprises only 1 toxic species.

The **Sparganiaceae family** includes 1 species effective for phytoremediation.

The **Tofieldiaceae family** includes a single species, *Tofieldia calyculata* (L.) Wahlenb., which has ornamental value.

The **Typhaceae family** comprises 5 species with 20 recorded uses, of which 4 are related to ecological economy. Among these species, 4 are medicinal, 3 are edible, 2 are used in veterinary medicine, 1 is utilized in the chemical industry, 4 are ornamental, and 1 has cosmetic applications. On the Red Lists, 1 species is classified as vulnerable and 1 as under-threatened.

The **Zannichelliaceae family** includes 1 species used for ecological restoration.

The **Zosteraceae family** comprises 2 rare species that are edible, medicinal, used for domestic purposes, and suitable for phytoremediation, totaling 6 economic uses and 2 ecological uses.

For phytoremediation and ecological restoration in wetlands, species such as *Juncus*, *Lemna*, *Potamogeton*, *Typha*, and others can be used. The most widespread species include: *Juncus effusus* L., *J. inflexus* L., *J. littoralis* C.A. Mey., *J. maritimus* Lam., *Najas marina* L., *Lemna minor* L., *L. trisulca* L., *L. gibba* L., *Spirodela polyrhiza* (L.) Schleid., *Sparganium erectum* L., *Potamogeton crispus* L., *P. lucens* L., *P. natans* L., *P. pectinatus* L., *P. perfoliatus* L., *P. pusillus* L., *Typha angustifolia* L., and *T. latifolia* L. These species can also be used as bioindicators in monitoring studies to determine pollution levels.

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