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MORPHOLOGICAL ANALYSIS OF DAFFODIL POPULATION FROM THE NATURAL RESERVE "FÂNAŢELE CU NARCISE NUCŞOARA – 2.506"

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Abstract

In Romania, there are over 20 places with wild daffodils (Narcissus poeticus subsp. radiiflorus (Salisb.) Baker), most being part of the Natura 2000 network. This paper presents morphological data on daffodils from Nucşoara, a botanical reserve within the community importance site Strei-Haţeg (ROSCI0236). The daffodil population is considered a post-glacial relict, coexisting with other remarkable species, such as Peucedanum rochelianum Heuff. Biometric measurements indicated an aerial stem height ranging from 14 to 36.5 cm and a flower diameter between 1.9 and 5 cm. Statistical analysis (Pearson's R) revealed a weak correlation between the perigon and the coronule diameter. Compared with other populations in Romania, the Nucşoara daffodils display distinct morphological traits: the plants are smaller, and the length of the leaves and the diameter of the flower are also smaller. These variations may be attributed to the population's isolation and specific local environmental conditions, highlighting the scientific importance of this reserve.

Key words*: botanical reserve, Nucşoara, Narcissus poeticus subsp. radiiflorus (Salisb.) Baker, biometric measurements, morphological traits.*

INTRODUCTION

In Romania, significant natural heritage resources are distributed across a continuum of scales, from large-scale biosphere reserves to fragmented local ecosystems. Western Romania is characterized by a pronounced diversity of habitats and a high degree of taxonomic variety. (Coste & Arsene, 2000; Arsene et al., 2005, 2006, 2015; Turcean et al., 2014; Bâtea et al., 2014; Neacşu et al., 2023 etc.).

By implementing the European Network NATURA 2000 in Romania, the prevention, conservation, preservation, or rehabilitation of important species and habitats is pursued, and the status of natural areas is regulated. In this context, our study provides information about a small protected area that preserves a valuable population of wild daffodils.

This is the Nucșoara Daffodil Meadows Nature Reserve ("Fânaţele cu narcise Nucşoara" – national code 2.506), which is located at the foot of the Retezat Mountains, in the Nucșoara river meadow, between the villages of Sălașu de Sus-Mălăiești-Nucșoara, Hunedoara County, and which extends over approximately 20 ha (Figures 1, 2). There are over 20 glades, meadows, and hayfields with wild daffodils in Romania. By Law No. 5/2000, the following 17 natural reserves with wild daffodils are declared: The Negrileasa daffodil meadow, Bucium commune, 5 ha, Alba County; The Tecşeşti daffodil meadows, Întregalde commune, Tecşeşti village, 2 ha, Alba County; Rovina daffodil meadow, Ineu town, 0.10 ha, Arad County; Negraşi daffodil meadow, Negraşi commune, 4.10 ha, Argeş County; Oşorhei daffodil forest, Oşorhei commune, 2 ha, Bihor County; Goronişte daffodil meadow, Tinca commune, 1 ha, Bihor County; Mogoşenilor plain daffodil meadow, Nimigea commune, 6 ha, Bistriţa-Năsăud County; Saca massif daffodil meadow Rodna, Valea Vinului village, 5 ha, Bistriţa-Năsăud County; Daffodil meadow on the Buda Valley Plain, Cetate commune, Orheiu Bistriţei village, 6 ha, Bistriţa-Năsăud County; Daffodil meadows in Dumbrava Vadului, Şercaia commune, Vad village, 394.9 ha, Braşov County; Zerveşti daffodil meadow, Turnu Ruieni commune, 40 ha, Caraş-Severin County; Daffodil meadow from Vlăhiţa, Vlăhiţa town, 20 ha, Harghita County; Nucşoara daffodil meadows, Sălaşu de Sus commune, 20 ha, Hunedoara County; Tomnatec-Sehleanu daffodil meadow, Repedea commune, 100 ha, Maramureş County; Gurghiu daffodil meadow,

Gurghiu commune, 3 ha, Mureş County; Racâş-Hida daffodil meadow, Hida commune, Racâş village, 1.5 ha, Sălaj County; Daffodil meadow Bateşti, Făget Town, 20 ha, Timiş County. Nucşoara Daffodil Meadow 2.506 is part of the ROSCI0236 Strei-Haţeg site of community importance and is a botanical reserve, IUCN category IV. The reserve represents a vestige of ancient hydrophilic associations with the endemic *Peucedanum rochelianum*. In addition to daffodils, other important species grow here, such as *Iris sibirica, Peucedanum rochelianum, Gladiolus imbricatus,* and wild orchid species: *Anacamptis morio, Dactylorhiza incarnata, Dactylorhiza sambucina.*

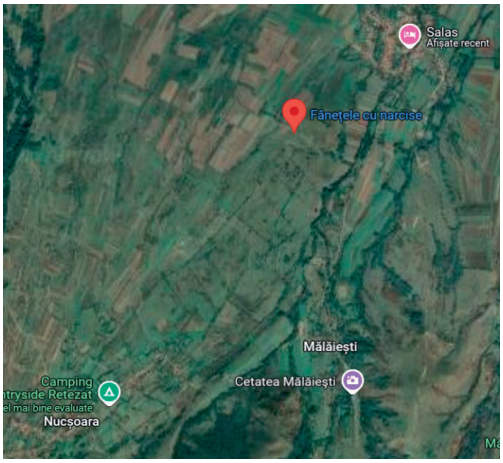

Figure 1. Location of the Narcissus Meadows Nature Reserve in Nucșoara (https://maps.google.com/)

The provenance of the daffodil population is sometimes contested. Certain local accounts dispute its natural and relict character, positing instead that the population was initially established by a Dutch national. For over 20 years, the local administration has organized an annual festival dedicated to these plants. However, numerically, the daffodil population is in decline.

Daffodils are ornamental plants, commonly grown in parks and gardens, as well as for cut flowers. Most species are toxic because they contain the alkaloid narcissine; their toxic and narcotic properties have been known since antiquity. It is believed that the etymology of daffodils starts from the Greek *narkissos*, the name of the plant in Homer and other ancient authors, or from the *narkao*, which means to produce drowsiness, alluding to the intoxicating scent of the flowers or their narcotic properties. According to other versions, daffodils appeared on the tomb of Narcis, known in mythology as the young man in love with his own face, a personality disorder characterized by excessive self-admiration.

In religious symbolism, daffodils have a profound meaning. It is said that daffodils were the first flowers to bloom in the Garden of Gethsemane when Jesus was resurrected, symbolizing purity and rebirth through their presence, and the bowed stem signifying deep gratitude for the Savior's suffering.



Figure 2. The boundaries of the Narcissus Meadows Reserve in Nucșoara (Google Earth image)

The genus *Narcissus* includes about 40 species spread mainly in the Mediterranean region, a few in the Caucasus and in Asia, up to China and Japan.

Table 1. Variability of *Narcissus*

R.S.R. flora (1966)	Ciocârlan, 2009	Sârbu, 2013	Plants of the World Online *
9 species	8 species 2 subspecies	1 species	76 Accepted Species (37 Synonyms)

In the old flora (R.S.R. Flora, volume XI) 9 species are described: **Narcissus bulbocodium, *Narcissus pseudonarcissus, *Narcissus incomparabilis, *Narcissus odorus, *Narcissus tazetta, *Narcissus jonquilla, *Narcissus biflorus, Narcissus poeticus, Narcissus angustifolius*. Of these, Ciocârlan (2009) considers only 8 species: **N. jonquilla, N. poeticus* (with subspecies *poeticus* and *radiiflorus*), **N. x medioluteus, *N. tazetta, *N. bulbocodium, *N. pseudonarcissus, *N. x incomparabilis, *N. odoratus*.

Comparing the 2 references, we found that Ciocârlan mentions **Narcissus bulbocodium, *Narcissus pseudonarcissus, *Narcissus*

*incomparabilis, *Narcissus odorus, *Narcissus tazetta, *Narcissus jonquilla, Narcissus poeticus* and considers synonymous **Narcissus biflorus* for **N. x medioluteus* and *Narcissus angustifolius*, for *N. poeticus* subsp. *radiiflorus*. On the other hand, he presents the hybrid **N. x medioluteus*. Another important reference - Sârbu et al. (2013) - it only points to *N. poeticus* subsp. *radiiflorus*, the only spontaneous species in our country (Table 1). Digital database Plants of the World Online (POWO) (https://powo.science.kew.org/results?q=narcissus) accepts 76 species.

The daffodils from the Nucşoara meadow are mentioned in most information materials under the name *Narcissus stellaris*, but now this is a synonym and the valid name is *Narcissus poeticus* subsp. *radiiflorus* (Salisb.) Baker.

Narcissus poeticus L. (wild daffodils, coprines) belongs to the *Amaryllidaceae* family and is a 25-60 cm geophyte, with an ovoid-spherical bulb covered in blackish tunics. The leaves are glaucous, flat, linear, obtuse or sub-obtuse at the tip, about 30 cm long, 5-10 mm wide, more or less keeled. The aerial stem is compressed, acute, thin, 20-40 (60) cm. The pedicels of the flowers are 15-18 mm. The flowers are white, fragrant, and solitary, rarely 2-3 (Figure 3), sometimes extended; white at first, often greenish or yellowish, large, 50-65 mm in diameter.

Below the flower, there is a membranous spathe/bract. The perigone tube is 20-30 mm, with 6 tepals expanded into a star, elliptical, oblong-elliptic, or obovate, narrowed cuneately at the base, rounded or acuminate at the apex, with non-overlapping edges. The coronule is campanulate, very short, 2-4 mm high, yellowish, with a reddish, slightly crenulated edge. 2n=14. The currently used synonyms are: *Narcissus radiiflorus* Salisb., *Narcissus angustifolius* Curtis ex Haw., *Narcissus poeticus* L. subsp. *angustifolius* Hegi. Reference Handb. Amarull. 12 (1888). *Narcissus poeticus* has 2 subspecies, *radiiflorus* and *poeticus*. The distinction between the subspecies is made at the level of the tepals / perigonal lacinia: the subspecies *radiiflorus* has non-overlapping perigonal lacinia of obovate-cuneate shape (Figure 3), and the subspecies *poeticus* has overlapping lacinia of obovate-elliptic shape. Wild daffodils are of European origin, occurring in the Alps, Jura, Tyrol, Carpathians, Istra, the former Yugoslavia, and Northern Greece. According to Flora Europea, the species is endemic to southern and central Europe and the western Pannonian Peninsula and prefers habitats such as meadows, glades, and orchards in low and humid places, from the mountainous region to the subalpine. The subspecies *radiiflorus* is found in moist, slightly to moderately acidic meadows. From the point of view of autecological factors, it is a mesophilic species (U=3), mesothermic to moderately thermophilic (T=3.5) and amphitolerant to soil pH (R=0).



Figure 3. *Narcissus poeticus* L. subsp. *radiiflorus* (Salisb) Baker (original 2024, 2025)

The plant associations in which wild daffodils grow belong to the order *Molinietalia caeruleae* Koch 1926 (Sanda et al., 2003).

MATERIALS AND METHODS

During 2021-2025, we conducted observations on the daffodil population in Nucşoara. We noted the accompanying species, and last year (2025), during the anthesis period, we performed morphological measurements. We identified the species using current plant identification guides and floras. For measurements, we crossed the reserve diagonally, considering a horizontal transect;from the starting point to the end of the transect, we established 10 observation points. Every 10 m, we analysed the group of plants. We counted the individuals in each group, noted the flowering specimens, and measured the height of the aerial stem, the number of leaves, the length and width of the leaves, and the diameter of the flower and coronule. To measure the

length, width, and height, we used a ruler and a tape; to estimate the diameter of the flowers, we also used a disk made of paper.

RESULTS AND DISCUSSIONS

Floristic ambience. The daffodils from Nucşoara (Figure 4) grow in a meadow, edified by red fescue (*Festuca rubra*) and colonial bentgrass (*Agrostis capillaris*), *Festuco rubrae-Agrostetum capillaris* association. In this meadow, we noted the following 55 species: *Achillea millefolium* L.; *Agrostis capillaris* L.; *Alchemilla vulgaris* L.; *Anacamptis morio* (L.) R.M. Bateman, Pridgeon & M.W.Chase; *Anthoxanthum odoratum* L.; *Betonica officinalis* L.; *Betula pendula* Roth.; *Carex hirta* L.; *Carex pallescens* L.; *Centaurea kerneriana* subsp. *kerneriana* (*Centaurea nervosa* Griseb.); *Colchicum autumnale* L.; *Dactylorhiza incarnata* (L.) Soó; *Dactylorhiza sambucina* (L.) Soó; *Deschampsia cespitosa* subsp. *cespitosa* (*Deschampsia caespitosa* P.Beauv.); *Dryopteris filix-mas* (L.) Schott; *Erica spiculifolia* Salisb. (*Bruckenthalia spiculifolia* (Salisb.) Rchb.); *Erigeron annuus* (L.) Desf.; *Eriophorum vaginatum* subsp. *fauriei* (E.G. Camus) Á. Löve & D. Löve (*Eriophorum vaginatum* L.); *Euphorbia amygdaloides* L.; *Festuca rubra* L.; *Fragaria vesca* L.; *Fragaria viridis* Weston; *Galium verum* L.; *Genista sagittalis* L.; *Genista tinctoria* L.; *Gentiana pneumonanthe* L.; *Gladiolus imbricatus* L.; *Iris sibirica* L.; *Juncus effusus* L.; *Lotus corniculatus* L.; *Luzula campestis* (L.) DC.; *Luzula luzuloides* subsp. *luzuloides* (*Luzula albida* (Hoffm.) DC.); *Narcissus poeticus* subsp. *radiiflorus* (Salisb.) Baker; *Ononis pusilla* L.; *Peucedanum rochelianum* Heuff.; *Pilosella officinarum* F.W. Schultz & Sch. Bip. (*Hieracium pilosella* L.); *Poa pratensis* L.; *Polygala amarella* Crantz; *Potentilla recta* subsp. *recta* (*Potentilla erecta* Maiden); *Pulicaria dysenterica* (L.) Bernh.; *Ranunculus bulbosus* L.; *Rosa canina* L.; *Rumex acetosa* L.; *Scabiosa ochroleuca* L.; *Seratulla tinctoria* L.; *Stellaria palustris* Ehrh. ex Hoffm.; *Taraxacum* sect. *Taraxacum* F.H. Wigg. (*Taraxacum officinale* F.H.Wigg.); *Trifolium pratense* L.; *Trifolium repens* L.; *Vaccinium myrtillus* L.; *Verbascum phlomoides* L.; *Verbascum nigrum* L.; *Veronica chamaedrys* L.; *Vicia pannonica* Crantz; *Viola canina* L.

In floristic studies from Ţara Haţegului, we found that in the swampy meadows of Sălaşu de Sus, Mălăieşti and Pui (localities near the daffodil reserve), Boşcaiu et al. (1965) identified 93 species. Of these, we found inside the reserve: *Anthoxanthum odoratum, Betonica officinalis, Carex pallescens, Galium verum, Genista sagittalis, Genista tinctoria, Gentiana pneumonanthe, Gladiolus imbricatus, Lotus corniculatus, Luzula campestis, Peucedanum rochelianum, Rumex acetosa, Seratulla tinctoria, Scabiosa ochroleuca, Viola canina*.

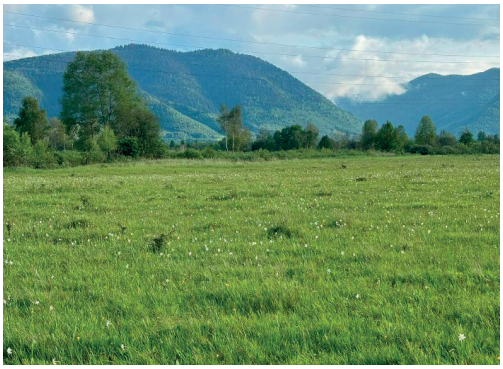

Figure 4. Overview of the daffodil population in Nucşoara (original 2024)

Considering the short distance between the localities and the specifics of the soil (swampy meadows), from Boşcaiu's list of species, we consider many to be likely in the Nucşoara meadow and therefore list them below. These are: *Achillea ptarmica, Anthericum ramosum, Anthyllis vulneraria, Asperula cynanchyca, Cerastium triviale, Chrysanthmum leucanthemum, Cirisium rivulare, Cirsium canum, Lathyrus pratensis, Leontondon hispidus, Linum catharticum, Lysimachia vulgaris, Lythrum salicaria, Molinia caerula, Myosotis palustris, Nardus stricta, Oenanthe peucedanifolia, Orchis coriophora, Orchis elegans, Orchis morio, Orchis ustulata, Ornithogalum flavescens, Peucedanum cervaria, Peucedanum oreoselinum, Pimpinella saxifraga, Plantago lanceolata, Platanthera bifolia, Prunella grandiflora, Prunella vulgaris, Thalictrum lucidum, Trifolium alpestre, Trifolium dubium, Trifolium hybridum,*

Trifolium montanum, Trifolium ochroleucum, Veratrum album.

Morphological analysis of the daffodil population. Following measurements carried out in the 10 points from the reserve, we analysed 114 daffodil specimens. The number of individuals (bulbs) measured varied between 6-15/point. The height of the aerial stem varied between 14-36.5 cm. The number of leaves/ bulbs was between 2-8. In two points, we found an individual with a single leaf. The length of the leaves varied between 4-32 cm, and the width between 1-8 mm.

Table 2. Statistical values of measured parameters

	Plant height (cm)	Number of leaves / plants	Leaf length (cm)	Leaf width (mm)	Number of flowers / plants	Perigon diameter (cm)	Coronule diameter (cm)
Minimum	12	1	4	1	1	1.9	0.5
Maximum	36.5	8	30	8	2	4	1.3
Average	25.39	2.81	15.94	3.513	1.009	2.62	0.986
Amplitude	24.5	7	26	7	1	2.1	0.8
Standard deviation	4.87	0.93	4.358	1.473	0.096	0.35	0.14

We noticed that there are no very large differences between them. The plants measured at points 1, 5, 7, 8 and 10 have taller stems, exceeding 25 cm (for example, 27.69 cm at point 8), compared with the others, which have values below 25 cm (22.52 cm at point 4). The length of the leaves clearly exceeds 15 cm in the individuals at points 1, 6, 7, 8 (18.66 cm), while in the plants measured at points 2 (13.2 cm) and 9 the leaves are below 15 cm. Regarding the leaf width, a large difference is observed in the measurements at point 4-9.07 mm, compared with the others,, which are between 2.91-3.86 mm. The diameter of the flowers is similar at all poatts, the values being between 2.47-2.89 mm. The coronule exceeds 1 mm at the plants measured at points 1, 7, 8, 9 and is below 1 mm in the other points, without significant variations (0.89 mm - point 5 and 1.05 mm - point 10).

The total averages of all individuals measured in the 10 points are as follows (Table 2): average stem height = 25.39 cm; average number of leaves/plants = 2.81; average leaf length = 15.87 cm; average leaf width = 4.04 mm; average number of flowers/plants = 1.009; average flower diameter = 2.62 cm; average coronule diameter = 0.97 cm.

The Pearson correlation coefficient calculated between the perigon diameter and the coronule diameter has a value between 0.3165. The weak correlation of the two parameters is reinforced by the small value of the coefficient of determination (R^2 = 0.1002, Figure 5).

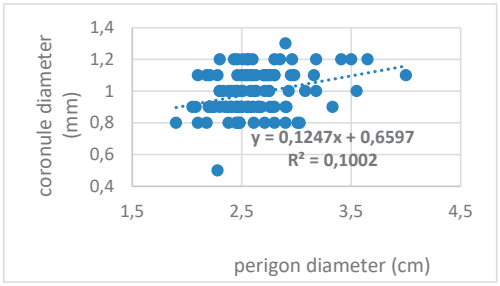

Figure 5. Correlation between coronule diameter and perigon diameter (107 data pairs)

The same conclusions are valid for the correlation between plant height and perigon diameter (r = 0.1025, R^2 = 0.1005) - Figure 6.

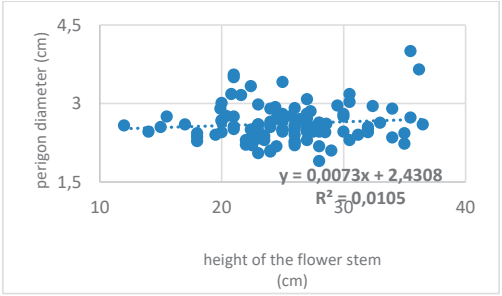

Figure 6. Variation of perigon diameter as a function of floral stem height (107 data pairs)

In contrast, there is a better correlation between leaf length and leaf width, with a Pearson correlation coefficient value of 0.566, calculated for 298 data pairs (measurements); in this case (Figure 7), the value of the coefficient of determination is also higher (R^2 = 0.3207). In order to have a situation to refer to, we compared our data with the measurements made by Drăgulescu & Rica (2000) on the daffodil population in the Dumbrava Vadului Botanical Reserve, Brașov County. This is the largest wild daffodil reserve in our country, occupying 394.9 ha, the population being estimated at tens of millions of individuals. As the authors describe

it, the population is vigorous and is found in an oak forest in the pre-mountain plain of Făgăraş at about 500 m altitude.

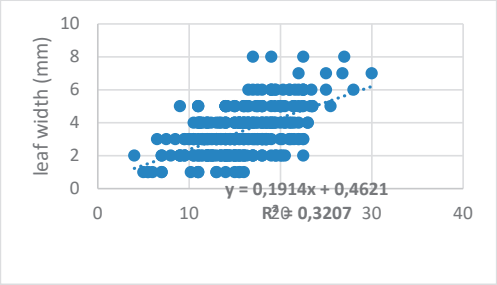

Figure 7. Variation of leaf width depending on leaf length (298 data pairs)

Comparing the measurements, we found that the plants measured by us are shorter and have smaller leaves, and the flower diameter is obviously smaller. The number of leaves and flowers, respectively the diameter of the coronule, have similar values (Table 3). We believe that the size of the population at Dumbrava, the area of the reservation, and the climatic conditions explain these morphological differences. Regarding the population from Nucşoara, following our field observations, we found that *Narcissus poeticus* L. subsp. *radiiflorus* does not have a favorable conservation state. Although the species grows in a protected area, anthropogenic pressures are significant. The picking of flowers and the removal of bulbs by some locals or visitors, especially during the festival, which is attended by hundreds of people, seriously affect the perpetuation and regeneration of the species, leading to a significant decline. On the other hand, failure to respect the information panels and ignoring the marked trails for visiting the reserve led to the destruction of the surface of the vegetation. Many specimens are trampled by both people and cars/ATVs/motorcycles that enter the reserve. Excessive grazing also creates problems, with animals digging the bulbs deep by trampling them. Sometimes the clearing is also burned. A negative imprint is also left by the storage of garbage in the vicinity of the reserve. The lack of civic spirit, ecological education, and low interest in implementing monitoring, control, and protection measures for this species are major causes of the decline in the daffodil population.

Table 3. Statistical values of measured parameters

Parameter / Population	Height of stem (cm)	Number of leaves	Leaf length (cm)	Leaf width (mm)	Number of flowers	Flower diameter (cm)	Coronule diameter (cm)
Nucşoara	14-36.5	2-8	4-30	1-8	1 (2)	1.9-4	0.5-1.2
Dumbrava Vadului	20-54	2-6	15-44	4-10	1 (2)	4-8.4	0.6-1.4

CONCLUSIONS

The Nucşoara daffodil meadow is of remarkable importance from a scientific, botanical, and landscape point of view. The meadow hosts the species *Narcissus poeticus* subsp. *radiiflorus*, but also other important cormophytes such as *Peucedanum rochelianum, Iris sibirica, Gladiolus imbricatus, Dactylorhiza incarnata, and Dactylorhiza sambucina*.

The minimum and maximum values recorded following biometric measurements in this daffodil population are the following: the number of individuals in the studied points varied between 6-15/point; the height of the aerial stem was between 14-36.5 cm; the number of leaves/bulb was 2-8; the length of the leaves had values between 4-32 cm; the width of the leaves was 1-8 mm; the diameter of the flowers varied between 1.9-4 cm; and the diameter of the coronule was between 0.5-1.2 cm.

From the calculation of the Pearson correlation coefficient (r) and the coefficient of determination (R^2), we found a weak correlation between the variables perigon diameter and coronule diameter ($r = 0.3165$, $R^2 = 0.1002$), and between plant height and perigon diameter ($r = 0.1025$, $R^2 = 0.1005$) and a stronger correlation between the variables leaf length and leaf width ($r = 0.566$, $R^2 = 0.3207$).

Comparing our measurements with those made by Drăgulescu & Rica (2000) in the Dumbrava Vadului reserve (Braşov County), we found that the daffodils from Nucşoara have smaller dimensions.

In order to preserve this area of outstanding value, we propose and recommend: limiting and monitoring tourism, prohibiting the burning of the meadow as a maintenance measure, creating a grazing calendar, prohibiting the breaking and picking of flowers and severely punishing those who do not respect the law, respecting marked trails and information boards, installing trash

cans, and supporting environmental education campaigns.

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