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Endemic species of *Narcissus* in Central Spain: Biodiversity and conservation under grazing pressure by wild and domestic herbivorous

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Abstract. The genus *Narcissus* (Amaryllidaceae) has its diversity center in the Iberian Peninsula, where 90% of species are present. Generally, their populations are small. They grow in microhabitat quickly modifiable to changes in their environmental, biotic or human factors, mainly due to changes in land uses, to abandonment of grazing and in traditional land management. We have evaluated the effect of grazing on the type of habitat and population size from 25 species of this genus from Castilla-La Mancha Community, yielding some patterns in the development of these species. The variables used in this analysis allow us to evaluate inter- and intraspecific status of the genus, also confirming the role of these species as bioindicators of biodiversity

Keywords. *Narcissus* diversity – Grazing – Conservation – Iberian Peninsula.

Les espèces endémiques de* Narcissus *dans le centre de l'Espagne : Biodiversité et conservation sous la pression de pâturage par des herbivores sauvages et domestiques

Résumé. *Le genre des narcisses (Amaryllidaceae) a son centre de diversité dans la Péninsule Ibérique, où sont présentes 90% des espèces. En général, leurs populations sont faibles. Elles poussent en micro-habitats rapidement modifiables face aux changements des facteurs environnementaux, biotiques ou humaines, principalement en raison de l'évolution des utilisations des terres, de l'abandon du pâturage et de la gestion traditionnelle des terres. Nous avons évalué l'effet du pâturage sur le type d'habitat et de la taille des populations de 25 espèces de ce genre dans la communauté de Castilla-La Mancha, ce qui donne quelques tendances concernant le développement de ces espèces. Les variables utilisées dans cette analyse nous permettent d'évaluer les qualités inter-et intra-spécifiques du genre, ce qui confirme également le rôle de ces espèces comme bio-indicateurs de la biodiversité.*

Mots-clés. *Diversité de* Narcissus *– Pâturage – Conservation – Péninsule Ibérique.*

I – Introduction

The Iberian Peninsula has the largest diversity of the genus *Narcissus*. It is the center of origin of *Pseudonarcissi* Section (Fernandes, 1957) and is accepted that *N. nevadensis* is the ancestor of the whole group. Is very common the hybridization among various sub-genera and about 50 hybrids have been detected (Fernandes, 1957; Ríos *et al.*, 1999). Castilla-La Mancha (central Spain) present a high number of endemics species of *Narcissus* more of them treathened. Grazing response of them is variable, but in general, improve the competence balance between species and maintain or increase the size of the *Narcissus* populations.

II – Materials and methods

The results correspond to a project which principal aim is the characterization, conservation and propagation the endemic *Narcissus* of Castilla-La Mancha to upgrade the plant resources for a sustainable development of the Biosphere Reserve "La Mancha Húmeda", located in this Spanish Community. Our area of study is placed in central Spain, one of the very rich in *Amaryllidaceae* of the Iberian Peninsula.

We have visited 82 populations of the 25 species present in this area, from autumn 2007 to winter 2009, collected material for botanical, genetic and phytochemical characterization and to made *in vitro* culture and germplasm conservation. Also we have done ethnobotanical interviews to know more about the uses of this species and phytosociological inventories to study the biogeography of this genus.

III – Results and discussion

Over 50% of the studied species of *Narcissus* which are present in Castilla-La Mancha (excluding hybrids) belong to Section *Pseudonarcissii*. As we can see in Table 1, the preferred habitat of 10 of them are the meadows. This habitat, found around the waterfalls, springs and humid ravines, and on high lands with clay soils remaining humid during the whole part of the year, is rich in productive and high quality species of the genus *Festuca, Agrostis, Lolium, Hordeum, Trifolium, Medicago,* etc. (Correal *et al.*, 2009) but should be carefully managed because excessive grazing pressure could degrade them. On the other hand, the absence of grazing would make them evolve towards reed communities with low diversity and palatablility (Ríos *et al.*, 1990). For *Narcissus* populations, a normal grazing improve competence conditions regarding other species found there. Five of the thirteen species of this section grows in secondary mesoforests of deciduous oaks (*Q. pyrenaica*, *Q. faginea*) and in perennial mesophytic grasslands of *Festuco-Brometea* or high-mountain supramediteranean grasslands of *Festuco-Ononidetea*. Here, we can find positive and negative effects, depending on the species. *N. perez-chiscanoi* and *N. muñozii-garmendiae* have its sexual reproduction threatened, because wild ungulates often eat all the flower scapes during flowering time. For this reasons, these species prioritize vegetative reproduction. On the other hand, we found that grazing by wild ungulate (*N. eugeniae*, *N. segurensis*) or domestic cattle (*N. confusus*), have relatively different results, improving competence or increasing-maintaining the population.

Moreover, the anthropogenic effect on the proper development of some species is apparent. As we have seen in the first locality of *N. alcaracensis* in Peñascosa (Albacete), the abandonment of traditional land management for accessibility of livestock, such as summer burning on the lagoon borders, decrease notably its richness. These burning activities allows the control of rhizomatous helophyte communities dominated by *Carex hispida* and *C. elata* and limit the development of some big helophyte graminoids like *Pragmites australis* that could clog the lagoon, denying the access of the flocks to it and reducing the correct development of other interesting species like this *Narcissus*.

Importantly, most species of *Narcissus* from *Bulbocodii, Jonquillae, Apodanthae, Ganymedes* and *Tazettae* Sections, have a total population size greater than 100,000 individuals. In contrast, these values are different in species from *Pseudonarcissii* Section, which have less than 50,000 individuals. Exceptionally *N. segurensis* has fewer than 100 individuals in the population currently known. For this reason, many species of this Section have some type of protection (Moreno *et al.*, 2003).

Except for some cases, the effect of grazing on the abundant and widespread species of *Narcissus* –most of them growing in perennial calcicolous or siliceous grasslands–, is the maintenance or increase number of individuals of their populations.

Additionally, an important aspect still to be studied is the degree of toxicity in *Narcissus* species.

Although in this project we have analyzed their intra- and interspecific alkaloid contents, nothing is known about their effects and interactions with herbivores and insects that consume them. But it's possible that it explains the difference of grazing and consequently the different population development.

Table 1. Evaluation of the grazing effect on various *Narcissus* species present in Castilla-La Mancha (Spain), with its phytosociological analysis and the total estimated population (number of individuals)

Species	Habitat	Total population size	Grazing effect
Section *Pseudonarcisii*			
N. alcaracensis Ríos, D. Rivera, Alcaraz & Obón.	Lacustrine rhizomatous helophytes dominated by *Carex hispida*	10,001-50,000	Improve competence conditions
N. bugei (Fern. Casas) Fern. Casas	Meadows and chionophilous grassland vegetation	1,001-10,000	Improve competence conditions
N. calcicarpetanus Fern. Casas	Meadows and chionophilous grassland vegetation	101-1,000	Improve competence conditions
N. confusus Pugsley	Secondary mesoforests of deciduous oaks. High-mountain supramediterranean acidophilous grasslands and perennial mesophitic grasslands of *Festuca* in rocky slopes	>100,000	Maintain or increase size population
N. eugeniae Fern. Casas	Secondary mesoforests of deciduous oaks. Perennial mesophitic grasslands. Semi-shaded perennial herb communities of external fringe woodlands	10,001-50,000	Improve competence conditions
N. genesii-lopezii Fern. Casas	Meadows and chionophilous grassland vegetation. Perennial mesophytic grasslands	1,001-10,000	Improve competence conditions
N. longispathus Pugsley	Riparian wet deciduous woodland and willow communities. Meadows and chionophilous grassland vegetation	10,001-100,000	Improve competence conditions
N. muñozii-garmendiae Fern. Casas	Secondary mesoforests of deciduous oaks	10,001-50,000	Flowering damage
N. nevadensis Pugsley	Meadows and chionophilous grassland vegetation	10,001-50,000	Protected areas without grazing
N. perez-chiscanoi Fern. Casas	Secondary mesoforests of deciduous oaks. Perennial mesophytic grasslands	101-1,000	Flowering damage
N. radinganorum Fern. Casas	Meadows and chionophilous grassland vegetation	1,001-10,000	Improve competence conditions
N. segurensis Ríos, D. Rivera, Alcaraz & Obón.	Secondary mesoforests of deciduous oaks and *Corylus* forests. Semi-shaded perennial herb communities of external fringe woodlands	<100	Improve competence conditions
N. yepesii Ríos, D. Rivera, Alcaraz & Obón.	Meadows and chionophilous grassland vegetation. Perennial mesophytic grasslands	10,001-50,000	Improve competence conditions
Section *Bulbocodii*			
N. bulbocodium L.	Perennial grasslands of *Poa bulbosa*. Silicicolous perennial grasslands of *Quercus* potential forests	>100,000	Maintain or increase size population
N. cantabricus DC.	Perennial grasslands of *Poa bulbosa*	>100,000	Maintain or increase size population
N. subnivalis Fern. Casas	Perennial grasslands of *Poa bulbosa*. Perennial mesophytic grasslands	>100,000	Maintain or increase size population
N. conspicuus (Haw.) Sweet.	Meadows and chionophilous grassland vegetation. Perennial mesophytic grasslands	101-1,000	Improve competence conditions
N. hedraeanthus (Webb & Heldr.) Colmeiro	Meadows and chionophilous grassland vegetation. Calcicolous perennial grasslands of *Quercus* potential forests	>100,000	Maintain or increase size population

Table 1. (cont.) Evaluation of the grazing effect on various *Narcissus* species present in Castilla-La Mancha (Spain), with its phytosociological analysis and the total estimated population (number of individuals)

Species	Habitat	Total population size	Grazing effect
Section *Jonquilla*			
N. assoanus Dufour.	Perennial succulent *Crassulaceae* and other chamaephytes and geophytes in rock open communities. Perennial mesophytic grasslands and high-mountain mesophytic grasslands	>100,000	Maintain or increase size population
N. fernandesii G. Pedro	Perennial succulent *Crassulaceae* and other chamaephytes and geophytes in rock open communities.	1001-10,000	Unknown
N. jonquilla L.	Meadows and chionophilous grassland vegetation. Swampy, fenny, lacustrine and riverine helophyte graminoids communities	50,001-100,000	Flowering damage
Section *Apodanthi*			
N. rupicola (L.) Dufour.	Perennial succulent *Crassulaceae* and other chamaephytes and geophytes in rock open communities. Perennial high-mountain mesophytic grasslands	>100,000	Improve competence conditions
Section *Tazettae*			
N. tazzeta L.	Cultivar (in Baleares cited in perennial mesophytic grasslands)	Cultivated	Orchards. Without grazing
N. dubius Gouan.	Thermo- and mesomediterranean semiarid and dry grassland calcareous communities of *Stipa tenacissima*. Perennial mesophytic grasslands	>100,000	Maintain or increase size population
Section *Ganymedes*			
N. triandrus s. *pallidulus* (Graells.) Rivas Godoy ex Fern. Casas	Perennial mesophitic grasslands and bare sandy soils	>100,000	Maintain or increase size population

IV – Conclusions

Changes in land uses, abandonment of grazing and other traditional land management, are the factors that cause a significant decline in the biodiversity of these areas. We consider that *Narcissus* species are bioindicators of that biodiversity. These species grow in microhabitat and through them we can perceive the fluctuations, both positive and negative, that suffer their habitat. In this case, we have evaluated the effect of grazing on the type of habitat and population size from 25 species of the genus from Castilla-La Mancha, yielding some patterns in the development of these species clearly predictable depending on the type of management.

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