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Threats to the long-term existence of *Eleocharis multicaulis* (Sm.) Desv. exposed to vegetation succession in dune slacks near Białogóra (Kashubian Seacoast, northern Poland)

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Abstract: Dynamic trends of *Eleocharis multicaulis* in wet dune slacks were determined on the basis of the present and historical differentiation of vegetation as well as local distribution and habitat conditions of the species. The results concern the only locality of the species in northern Poland, located far away east of its range limit. The total area covered by *E. multicaulis* and the number of species localities markedly decreased during the last ca. 60 years. The main reason for the disappearance of local stands of the species was the encroachment of *Myrica gale* thickets on the places previously occupied by phytocoenoses of herbaceous vegetation representing, among others, the class *Litorelletea* and the association *Eleocharitetum multicaulis*. The persistence of *Eleocharis multicaulis* individuals is favoured by the oligotrophic character of the site and the stable, high water level. For long-term existence of the species at the investigated site, its active conservation will probably be required.

Key words: *Eleocharis multicaulis*, dune slacks, vegetation succession, chorology, Atlantic element, northern Poland, plant conservation

1. Introduction

Eleocharis multicaulis is, apart from *Erica tetralix*, one of two representatives of the Euatlantic element in the Polish flora (Roisin 1969). Moreover, it is one of the rarest components of the Polish flora. Among 11 confirmed localities of this species in Poland, only the one discovered by Waldemar Żukowski in 1961 is located in Pomerania, near the village of Białogóra (Żukowski 1965). The Pomeranian locality is situated far away east of the main range of the species and the bigger clusters outside the main range. *Eleocharis multicaulis* is listed in the Polish Red Data Book (Herbichowa & Jackowiak 2001) as an endangered species (EN). On the Polish Red List (Zarzycki & Szeląg 2006) and in Pomerania (Żukowski & Jackowiak 1995), it is classified as endangered (E), and in the Gdańsk Pomerania (Markowski & Buliński 2004) as critically endangered (CR). Therefore, the problem of its persistence in its highly isolated Pomeranian locality is important and interesting not only from the phytogeographical point of view but also for the practice of species conservation.

The aim of the study was to determine if and what dynamic trends are characteristic of the Pomeranian population of *E. multicaulis* occurring in a very specific habitat: dune slacks. The slacks have developed in the period of free movement of the dunes. However, they have undergone secondary succession after the planned stabilization of dunes.

2. Material and methods

To determine the distribution of *Eleocharis multicaulis*, size of its clusters, habitat conditions and the phytosociological amplitude at the investigated site, we used all published data (Żukowski 1965; Herbichowa 1970, 1979; Herbichowa & Jackowiak 1988) and unpublished manuscripts (Mejer & Orzołek 1999; Herbichowa *et al.* 2005) as well as our original observations made between

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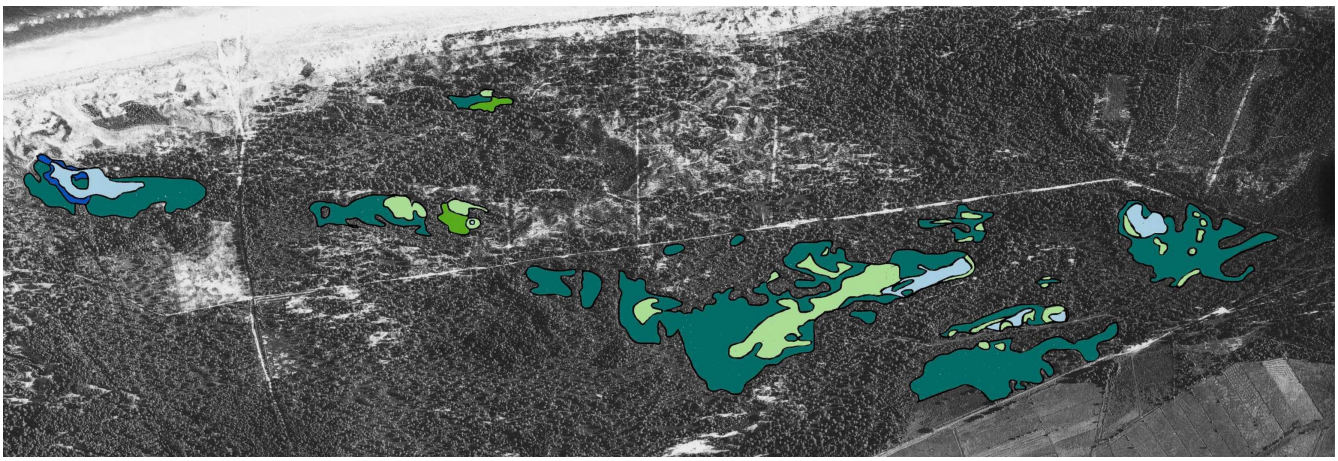

Fig. 1. Vegetation of non-forest dune slacks in 1947 (reconstructed)

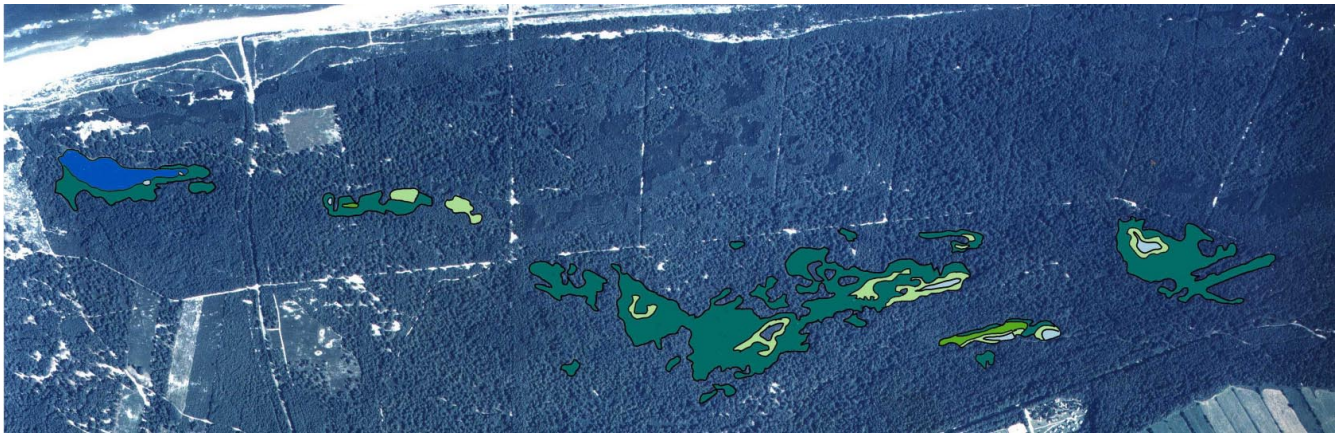

Fig. 2. Vegetation of non-forest dune slacks in 2004 (field mapped)

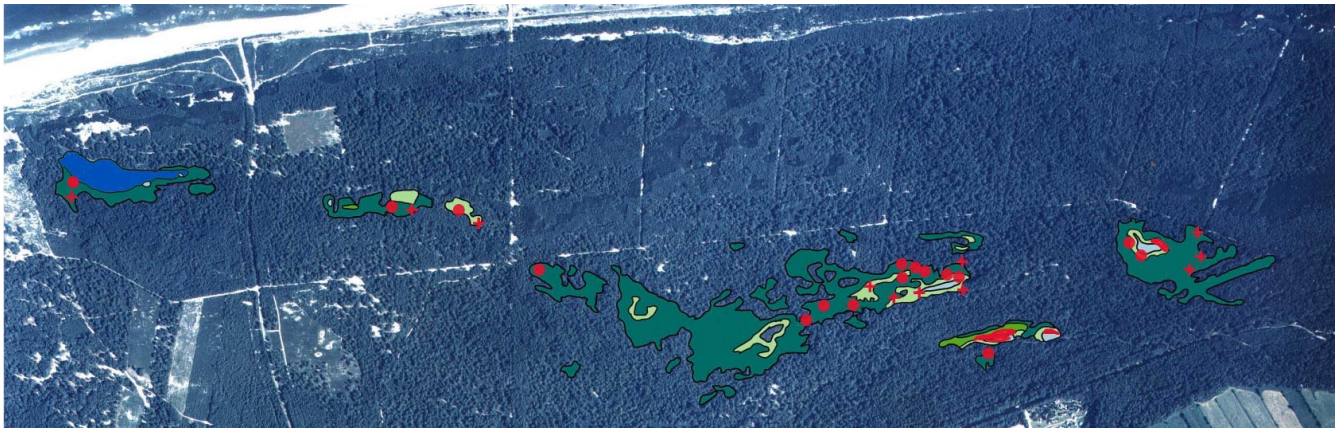

Fig. 3. Today and subfossil localities of *Eleocharis multicaulis* against the background of today real vegetation

Explanations to figures 1-3

herbal plant communities

dwarf shrub and/or initial low bushes of *Myrica gale*

mature bushes of *Myrica gale*

open water body

reed community

Eleocharitetum multicaulis

admixture of *Eleocharis multicaulis* in other plant communities

subfossil locality of *Eleocharis multicaulis*

sea

beach

yellow and grey dunes

mosaic of non-forest and forest dune vegetation

coastal pine forest *Empetro nigri-Pinetum*

0 500 1000 m

Aerial photographs:
Monochromatic stereo photo on the scale of 1:10 000; 1947. Panchromatic stereo photo on the scale of 1:26 000, enlarged to 1:5 000; 1996.

1968 and 2004. The direction of vegetation succession was analysed on the basis of aerial photos, which registered the diversity of vegetation between 1947 and 1996. The present state of vegetation was mapped in the field in 2004, on a coloured aerial photo taken in 1996 on the scale of 1: 26 000, and then enlarged to 1: 5 000. Moreover, the aerial photos of some slacks taken in 2003 were used. The reconstruction of historical vegetation was made on the basis of black-and-white aerial photos on original scales. Subfossil localities of *E. multicaulis* were identified as a result of an analysis of 46 soil samples taken at the places where the species is absent today or persists in small clusters in the neighbourhood. In all cases the sampling sites are still inhabited by small patches of the herbaceous vegetation, without or with a small admixture of the encroaching *Myrica gale* shrubs.

3. Results and discussion

The analysis of aerial photos showed qualitative and quantitative changes in vegetation, which occurred in the investigated, temporarily strongly flooded dune slacks during the last ca. 60 years. Due to spontaneous succession and planned afforestation with Scots pine, the area covered by the wettest form of coastal pine forest has considerably increased. At the same time, a distinct reduction of the area of herbaceous vegetation, resulting from an intensive encroachment of *Myrica gale* thickets, was noted in the slacks that have not been yet overgrown by pine forest. Such changes were observed in all slacks, irrespective of their size, flooding degree and water level fluctuations (Figs. 1, 2).

Floristic and phytosociological investigations also showed a gradual encroachment of mesotrophic species (e.g. *Eleocharis palustris, Juncus filiformis, J. effusus, Glyceria fluitans, Gnaphalium uliginosum*). For ca. 20 years, *E. palustris* and *J. filiformis* have been expansive at the places previously covered by phytocoenoses with species like *E. multicaulis, Rhynchospora fusca, Litorella uniflora* and *Juncus bulbosus*.

The comparison of the present distribution, abundance and contribution of *E. multicaulis* to local phytocoenoses (Fig. 3) with the precisely recognized state of the species in 1969-1975 showed that the total area covered by its population and phytocoenoses of the association *Eleocharitetum multicaulis* has significantly decreased. The biggest reduction was observed in the most extensive slack. This was accompanied by two simultaneous processes: the encroachment of *Myrica gale* thickets and the development of mesotrophic species. The above changes could be probably attributed to frequent drying out of the place and migrations of many flocks of cranes. The most persistent clusters of the taxon were found in the oblong slack situated southeast of the previous one and adjacent to an unused dirt road. This slack was characterized by a relatively stable, high water level and lack of qualitative floristic changes. The location of subfossil nuts of *Eleocharis multicaulis* proves that some local sites of the species have been lost, mainly as a result of *Myrica gale* succession.

Although the species has disappeared from some places, it is still capable of generative reproduction. Young individuals are recorded mainly at the places where wet or even temporarily flooded dune sand is sparsely covered by other species and almost deprived of organic matter admixture.

4. Conclusions

The persistence of *E. multicaulis* in wet dune slacks is threatened after the stabilization of dunes because of a clear tendency for their colonization by thickets and forest communities.

The present local population of the species is positively affected by the oligotrophic character of the site and relatively stable, high water level, which prevents the encroachment of *Myrica gale*.

It cannot be excluded that *E. multicaulis*, which is protected today in the reserve, will require active conservation, e.g. by habitat renewal and succession limitation.

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