

THE DISTRIBUTION OF CHARACTER SPECIES OF THE ISOËTO-NANOJUNCETEA CLASS IN POLAND. PART 4. *LIMOSELLA AQUATICA*, *CYPERUS FUSCUS* AND *JUNCUS CAPITATUS*

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Abstract: Distribution maps for *Limosella aquatica* L., *Cyperus fuscus* L. and *Juncus capitatus* Weigel. based on all accessible data were made and are discussed. Brief descriptions of their habitats and general distributions are also given. Nowadays these species are classified as endangered. The disappearance and transformation of habitats is presumably the main reason for their absence in some areas of Poland.

Key words: *Isoëto-Nanojuncetea*, *Limosella aquatica*, *Cyperus fuscus*, *Juncus capitatus*, vascular plants, distribution, Poland

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This paper is the last of a series on the distribution of selected character species of the *Isoëto-Nanojuncetea* Br.-Bl. & Tx. 1943 class in Poland (Popiela 1996a, 1998a, b, 1999a, b) and is concerned with *Limosella aquatica* L. (Scrophulariaceae), *Cyperus fuscus* L. (Cyperaceae) and *Juncus capitatus* Weigel. (Juncaceae).

Distribution maps for the species were made using the ATPOL grid square system (Zajac 1978) on the basis of revised herbarium material (KRA, KRAM, KTU, LBL, LOD, POZ, TRN, WA; abbreviations according to Holmgren *et al.* 1990 and Mirek *et al.* 1997), the literature and unpublished data (ATPOL). All the floristic data have been deposited in the ATPOL database in the Laboratory of Computer Chorology, Institute of Botany, Jagiellonian University, Cracow, Poland. The geographical elements to which the species belong are identified according to Pawłowska (1977), on the basis of published maps and literature (Hultén 1958; Meusel *et al.* 1965; Harl 1975; Meusel *et al.* 1978; Podlech 1980; Schultze-Motel 1980; Hultén & Fries 1986; Rothmaler 1990; Lampe 1996).

Limosella aquatica belongs to the Circumboreal subelement of the Holarctic element. The range of this species includes mainly temperate and subarctic zones of the Northern Hemisphere. In iso-

lated localities it grows in Mediterranean and subtropical areas (Mexico, North Africa, southern China). In Europe *L. aquatica* is a component of many communities of the *Isoëto-Nanojuncetea* class. Most often it occurs in associations classified to the alliance *Elatini-Eleocharion ovatae* Pietsch 1965, developing on the bottom of drying-up ponds, lake shores and rice fields (in southeastern Europe and Asia). Sometimes it occurs in communities of the *Radiolion linoidis* (Rivas Goday 1961) Pietsch 1965 alliance (e.g., *Cicendietum filiformis* Allorge 1922 occurring in heath and moorlands of Western Europe), and in southeastern Europe in associations of the *Heleocholeocyperion* (Br.-Bl. 1952) Pietsch 1961 alliance (see Pietsch 1973a; Täuber 2000). In Poland the first map showing the distribution of *L. aquatica* was published by Kotońska (1989); it covers the Carpathian Mts. area. My research indicates that *L. aquatica* occurs most often in big river valleys (Fig. 1). The taxon is associated with communities of the alliance *Elatini-Eleocharion ovatae* Pietsch 1965 (in general in the community *Cyperus fuscus-Limosella aquatica*) growing on gently sloping river and lake banks and drying-up fish ponds (e.g., Kępczyński 1965; Krzywański 1974; Brzeg & Ratyńska 1983; Brzeg 1989; Zajac M. & Zajac A. 1988; Popiela 1996b). Rarely the species

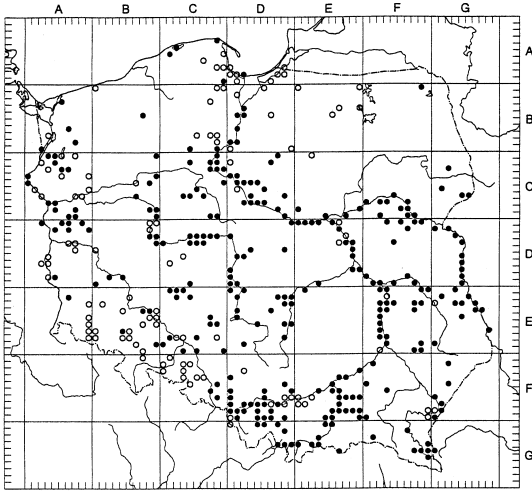


Fig. 1. Distribution of *Limosella aquatica* L in Poland. ● – extant locality; ○ – locality from the literature or herbaria not confirmed after 1945.

is found in wet depressions in arable fields (A. Popiela, B. Prajs, unpubl. relevés).

Cyperus fuscus belongs to the Holarctic-Mediterranean-Irano-Turanian connective element. In the north of Europe the taxon reaches 59° latitude; the southernmost localities are on the islands of the Mediterranean and in North Africa. Eastward the species is met in the Middle East, northwestern India, central Siberia and northern China. *C. fuscus* grows in the same communities as *Limosella aquatica*, and it is common in phytocoenoses of the *Eu-Nanocyperion flavescens* (Koch 1926) Pietsch 1965, developing in Central and southeastern Europe in pastures and at cattle watering ponds on alkaline or salty soils (e.g., Moor 1936; Pietsch 1973a, b; Pietsch & Müller-Stoll 1974; Oberdorfer 1983). The first map of the distribution of *C. fuscus* in Poland, made on the basis on revised herbarium materials only, was published by Żukowski (1969). The map presented here (Fig. 2) shows a much greater number of sites within the country. In Poland the habitat requirements and syntaxonomical position of *C. fuscus* are similar to those of *L. aquatica*. Both taxa can be treated as local character species of the alliance *Elatini-Eleocharition ovatae* (Popiela 1997).

Juncus capitatus belongs to the palaeotropical-holarctic connective element. In Europe the species occurs in the central and Mediterranean parts of the continent, reaching southern Sweden to the north and Ukraine to the east. It has scattered sites in Africa and southeastern Australia. The taxon is classified as a character species of the class *Isoëto-Nanojuncetea*, in view of the fact that it is recorded in communities of both orders of this unit: *Isoëtalia* Br.-Bl. 1931 (occurring in the Mediterranean zone) and *Cypereralia fusci* (Klika 1935) Müller-Stoll & Pietsch 1961 (temperate zone). The species is found mainly in the *Centunculo-Anthocerotum* Koch 1926, *Spergulario-Illecebrellum verticillati* Sissingh 1957 (arable fields) and *Cicendietum filiformae* (heath and moorland) associations (e.g., Moor 1936; Pietsch 1973a; Jansen *et al.* 1999; Rudner *et al.* 1999; Täuber 2000).

In Poland *Juncus capitatus* reaches the northeastern limit of its range (Fig. 3). Its contemporary stations are concentrated in the southeast, as with the sites of some other species of the class such as *Centuculus minimus* and *Radiola linoides* (see Popiela 1998b). *J. capitatus* reaches optimum development in anthropogenic habitats, in wet furrows and depressions in arable fields: *Centunculo-An-*

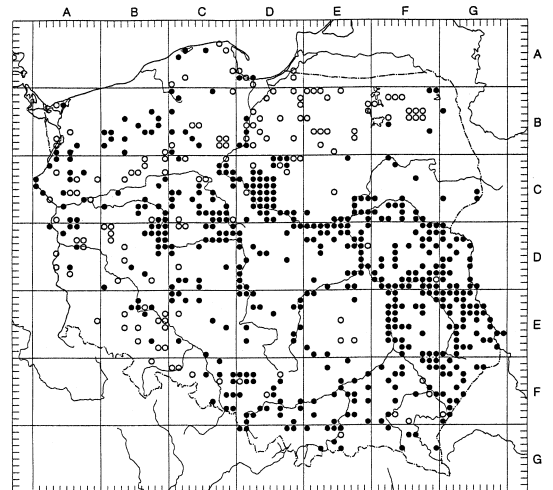


Fig. 2. Distribution of *Cyperus fuscus* L. in Poland. ● – extant locality; ○ – locality from the literature or herbaria not confirmed after 1945.

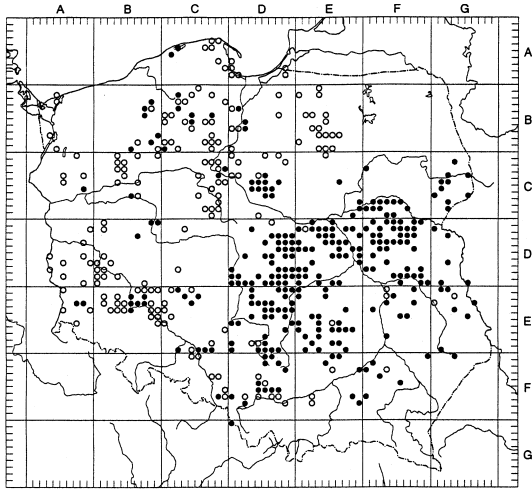


Fig. 3. Distribution of *Juncus capitatus* Weigel. in Poland. ● – extant locality; ○ – locality from the literature or herbaria not confirmed after 1945.

thoceretum and *Spergulario-Illecebretn verticillati*.

The three species show the so-called *Nanocyperion*-Syndrom (cf. von Lampe 1996), manifested as low height, individual fine and narrow leaves, fine green-white often cleistogamic flowers, and very fine seeds. The vegetation cycle of these annual plants is completed in a period of two months. Germination starts in April or May and may continue till September or even October, so two or even three generations may appear in one year. They take root at sites devoid of vegetation on sand, mud or clay. They need high moisture content and achieve optimum development under periodic flooding (in particular *Cyperus fuscus* and *Limosella aquatica*). *L. aquatica* is the least demanding species and grows even when the habitat is flooded to a height of 50 cm. It is also resistant to low temperatures – it has been noted in arctic localities (the northernmost localities exist at the isotherm of 60 days with temperature above 5°C). *C. fuscus* and *Juncus capitatus* have greater thermal demands and need a short but warm period for development. To the north their range does not reach beyond the isotherm of 17°C in July. The factor limiting their occurrence to the south and east is precipitation – they need minimum precipi-

tation of 100 mm (*J. capitatus* – 400 mm). They do not occur in the monsoon zone (von Lampe 1996).

At present in Poland the taxa are locally classified as threatened with extinction (see Żukowski & Jackowiak 1995 – *Juncus capitatus*) or as rare or endangered (e.g., Zajac & Zajac 1988 – *Cyperus fuscus*). In Germany, in Brandenburg (Benkert & Klemm 1990), Meklemburg-Vorpommern (Fukarek 1992) and Lower Saxony (Taüber 2000) they are described as vulnerable or critically endangered, and even (for *Juncus capitatus*) threatened with extinction.

It is hard to compare the previous studies on the distribution of the plants (Żukowski 1969; Kotońska 1989) with my research because they were limited to herbarium data, and to a certain area only. On the maps presented in this paper the absence of sites recorded after 1945 for some areas and species is clearly shown (e.g., northern and western Poland for *Juncus capitatus*, the Pojezierze Mazurskie lakeland and Silesia for *Cyperus fuscus* and *Limosella aquatica*). It is difficult to identify the direct causes of that. As in the case of other species of the class *Isoëto-Nanojuncetea*, it may be the disappearance and transformation of unstable habitats, the biology of the plants, and/or insufficient botanical recording.

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