Classification problems of European Littorelletea communities

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ABSTRACT. – The problems of classification are discussed on the basis of comprehensive material on vegetation conditions, of Littorelletea communities in Europe, America and Eastern Siberia. A proposal is presented to summarize communities rich in *Isoetes* in an own order in the class of Littorelletalia or in an own class of Isoetetea echinosporae Pietsch 1965. As an own order Juncetalia bulbosi Pietsch 1971 within Littorelletea the floating vegetation of acidiphile communities abounding with *Juncus bulbosus* should be distinguished from the community of the bottom-bound shoot vegetation of Littorelletalia.

KEY WORDS – Oligotrophic lakes, vegetation rich in *Isoetes* species, Juncetalia bulbosi, classification.

1. INTRODUCTION

More than 20 years have passed since the comprehensive monoghraphic treatment of communities of the class Littorelletea Br.-Bl. et TX.43 in the West and Northwest of Europe (Schoof van Pelt 1973), in Central and Eastern Europe (Pietsch 1977) and in the framework of the Prodromus treatment (Dierssen 1975).

In the meantime new descriptions and sociological material includes structures of species which make a classification in the previous subdivision of the class Littorelletea very difficult.

The evaluation of sociological records available to me entails the following major problems:

— classification of the Isoetes-rich vegetation in the previous version of Littorelletea;

— classification of the floating acidiphile vegetation abounding with *Juncus bulbosus*;

— classification of superimpositions of the isoetic bottom-bound shoot vegetation by species of the acidophile vegetation floating in water.

2. Vegetation rich in *Isoetes* species

Based on own phytosociological studies on structure and distribution of communities of aquatic *Isoetes* species in Siberia, Kamchatka, Eastern, Central and Western Europe, South America and Alaska (Pietsch 1991, 1994) and the evaluation of other works (Cleef 1981, Gutte 1980) the following findings could be derived:

— *Isoetes* species form an obvious monodominant species vegetation with only rare occurences of other species.

— In deeper water layers the majority of non-European dominance stands grows without *Littorella uniflora* and *Juncus bulbosus* or *Juncus pelocarpus*.

— In shallow waters and the inundation areas characteristic vegetation mosaics are formed with *Littorella uniflora, Juncus bulbosus* and other Littorelletea species.

— On both European and non-European sites *Eleocharis acicularis* is the Littorelletea species which most often occurs in communities with *Isoetes*. In general, however, this species colonizes oligotrophic waters only down to a depth of 2.40 m.

— The dispersal area for the majority of *Isoetes* species is small. Frequently there are endemic occurences which are limited to a few lake districts, volcanic lakes and islands only.

Worldwide, *Isoetes echinospora* Durieu is the most common of all *Isoetes* species. This species is common across North America and Eurasia.

Isoetes echinospora is a distinct species,but has considerable variations, especially with regard to size, colour and form of leaves. It is the most commonly encountered quillwort in oligotrophic, noncalcerous lakes and ponds of Northeastern North America. The *Isoetes echinospora* plants of North America bearing stomata were classified as *Isoetes muricata* or *I. echinospora* var. *braunii*. They are distinguished from European *Isoetes echinospora* plants not having any stomata.

In recent years the occurence of Isoetes echinospora in Central Europe declined remarkably. Their occurrence is mainly restricted to erosive shallow water zones, and compared with the European occurence of *Isoetes lacustris* they are far less common.

On the other hand, *Isoetes lacustris* is still growing at more than 100 lakes in the North of Poland. Together with other Littorelletea species they develop characteristic formations in shallow littoral zones which were described as Isoeto-Lobelietum Tx. 1937, the whole vegetation as Isoetion lacustris (Nordh. 37).

In the shallow littoral zones the submersed mats of *Isoetes* are interspersed with species of Littorelletea, i.e. formation of a vegetation structure with *Isoetes azorica, Littorella uniflora* and *Eleocharis multicaulis* (Pietsch 1984)

which is characteristic for Isoeto-Lobelietum of Central Europe. These penetration stages abounding with *Littorella uniflora* justify the classification in the class of Littorelletea.

Proposal of future classification:

We present two different proposals, i.e. a European version and a version of worldwide orientation for the sociological classification of aquatic *Isoetes* occurrences.

Proposal: Order: Isoetetalia echinospori-lacustris (Nordhagen 1936)
Alliances: Isoetion lacustris (Nordhagen 1936)
Subulario-Isoetion (Hadac 1971)

3. European bulbosus rush vegetation (Juncetalia bulbosi Pietsch 1971)

Since the differences between the real Littorellion communities which are mainly characterized by bottom-bound shoot plants and the common atlantic species of the floating acidiphile Juncus bulbosus vegetation in the West and southwest of Europe are essential with regard to floristic-sociological structure, platn-geographical distribution, forms of life and growth and, above all, the site conditions of soil substrate and water body, a separation of the two vegetation complexes was made at the level of alliances (Den Hartog & Segal 1964; Segal 1965) and orders (Pietsch 1971; Passarge 1978). There is a major tendency to classify them outside the Littorelletalia communities. The first indication of the particular originality of this vegetation dates back to Allorge (1922).

Therefore, we propose to summarize communities of the vegetation floating in water and abounding with *Juncus bulbosus* in the order Juncetalia bulbosi.

The differences in the vegetation structure and site conditions of the Littorelletalia and Juncetalia communities are presented in the following survey:

Vegetation structure:	*Littorella uniflora, Lobelia dortmanna, Isoetes*
Littorelletalia:	*lacustris, Eleocharis acicularis, Deschampsia setacea*
Juncetalia:	*Juncus bulbosus, Eleogiton fluitans, Apium inundatum, Pilularia globulifera, Potamogeton polygonifolius*
Form of vegetation:	bottom-found shoot mats, Isoetides vegetation
Littorelletalia:	
Juncetalia:	floating, submersed and emersed vegetation; no bottom-bound shoot species

Quality of water sediments:

Littorelletalia:	sand and clay soils of low humus and iron contents
Juncetalia:	sediments of high iron hydroxide contents on sand and peat substrates

Quality of water bodies:

Littorelletalia:	oligo-mesotrophic, oligohumic water bodies of moderate lime and low iron contents, pH values in the subacide to subalkaline range, poor in electrolytes
Juncetalia:	oligo-mesotrophic, oligohumic no-lime or low-lime waters, pH values in the extremely acid to acid range; calcium sulphate waters rich in free carbonic acid (CO_2); high electrolyte content

Forms of growth: dominated by the species of bottom-bound shoot

Littorelletalia:	mats growing as dense mats on the bottom of the water bodies
Juncetalia:	dominated by floating species; they form a floating vegetation occupying the whole water body

Extent of anthropogenic influence on colonized waters:

Littorelletalia:	species adapted themselves to the rhythm of pond management; they bloom after drainage of the ponds
Juncetalia:	species are note dependent on drainage or drying-up of waters, mainly vegetative propagation

Common features:

* virgin soil substrates must be kept open
* steady creation of new virgin soil sites as basis for the existence of species
* sensitive to nutrient concentration of sites
* sensitive to high-growing vegetation rich in biomass

A thorough description of vegetation and site conditions for the plant communities of Juncetalia bulbosi will be presented in a detailed paper.

4. Proposal of classification

In the following two subdivisions are proposed:

1. European version

Within the class of Littorelletea three independent orders are distinguished:

Class: Littorelletea Br.-Bl. et TX. 43

1st order:	Isoetetalia echinosporae-lacustris (Nordhagen 1937)
1st alliance:	Isoetion lacustris (Nordhagen 1937)
2nd alliance:	Subulario-Isoetion (Hadac) Pietsch 1971
2nd order:	Littorelletalia W. Koch 1926
1st alliance:	Lobelion uniflorae Duvigneaud 1968
2nd aliance:	Eleocharition acicularis Pietsch 1966
3rd alliance:	Deschampsion litoralis Oberd. et Dierssen 75
4th alliance:	Baldellion repentis Westhoff et Schamine 1992
5th alliance:	Eleocharition multicaulis (Duvigneaud 1968), Pietsch 1971
3rd order:	Juncetalia bulbosi Pietsch 1971
1st alliance:	Juncion bulbosi (Segal 1968) Pietsch 1971
2nd alliance:	Potamion polygonofoliae (Hejny 1968) Pietsch 1978

2. Worldwide version

Beside the class of Littorelletea another independent class of Isoetetea echinosporae Pietsch 1965 is distinguished.

In this class the great number of presently known communities rich in *Isoetes* and occuring in Eurasia, America (North and South America), Australia and New Zeland can be classified. An own publication on the vegetation of Isoetes-rich waters is in preparation.

Class: Isoetetea echinosporae Pietsch 1965

1st order:	Isoetetalia echinosporae-lacustris (Nordhagen 1937) Pietsch 1965
1st alliance:	Isoetion lacustris (Nordhagen 1937)
2nd alliance:	Subulario-Isoetion (Hadac 1962)

Class: Littorelletea uniflorae Br.-Bl. et TX.43

1st order:	Littorelletalia uniflorae W. Koch 1926
1st alliance:	Lobelion uniflorae Duvigneaud 1968
2nd alliance:	Eleocharition acicularis Pietsch 1966
3rd alliance:	Deschampsion litoralis Oberd. et Dierssen 75
4th alliance:	Baldellion repentis Westhoff et Schamine 1992
5th alliance:	Eleocharition multicaulis (Duvigneaud 1968)
2nd order:	Juncetalia bulbosi Pietsch 1971
1st alliance:	Juncion bulbosi (Segal 1968) Pietsch 1971
2nd alliance:	Potamion polygonifoliae (Hejny 1968) Pietsch 1978

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