

Vegetation and ecology of ephemeral wetlands – an introduction

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with 1 figure

Vegetation ecologists prefer to study plants in extreme environments, because selective forces are strong and adaptations are more obvious than under mesic conditions. Concerning the environmental factor “water”, most scientists cluster either to the “permanent wet group” or to the “dry fraction“. There is however a third, small party of colleagues dealing with sites, which switch every year from the littoral to the terrestrial phase. These habitats offer an extreme environment, too. Favourable edaphic conditions exist only for a very short time of the growing season (during the limosal ecophase) and year-to-year variability is high. It is a plant life between inundation and desiccation, shifting periodically from flooding to water shortage.

The aim of this thematic volume is to enhance the knowledge about the fascinating ecosystem “ephemeral wetlands” and to compile studies from all over the world (see Fig. 1), covering a broad spectrum of topics like habitat typology, vegetation classification, seasonal and year-to-year dynamics, ecophysiology of resurrection plants, seed banks, experimental approaches for habitat restoration and conservation aspects.

The volume starts with a series of regional monographs, dedicated to vegetation analysis and classification according to floristic similarity. Seasonal wetlands are mostly linked to subhumid or semiarid conditions and therefore are widespread in mediterranean climates. In the Neoarctis for example, vernal pools and their flora have been considered as quite unique to the State of California already in early papers. This claim is confirmed by the contribution of BARBOUR and co-workers: Based upon a recently sampled set of some hundred relevés, they classify vernal pool vegetation as a class of its own, restricted to the californian phytogeographical sector, the *Downingio bicornutae*-*Lastenietea fremontii*. Pool depth and inundation period are important differentiating environmental factors. The plant cover of long submerged sites, floristically well characterised, is grouped in the new order *Lastenietalia glaberrimae*.

The vegetation with small and short living wetland species in the Southwestern corner of the Australian continent with annual rainfall of 500 to 1000 mm was studied by PIGNATTI & PIGNATTI. In 1994 they described the class *Centrolepidi-Hydrocotyletea alatae*, endemic to SW Australia.

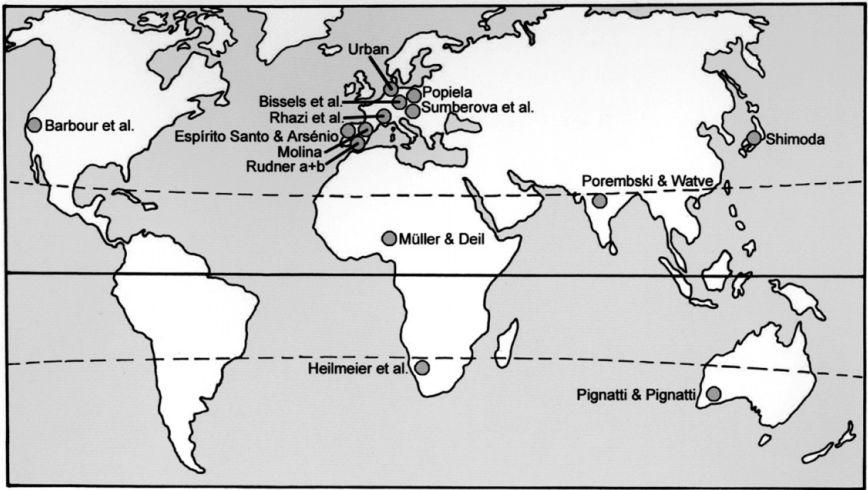


Fig. 1. Location of studies on ephemeral wetland vegetation included in the present volume.

Based upon new data for the deserts of Western Australia, they now compare the floristic composition of the periodic winter wet habitats under subhumid conditions with those of episodic lakes and erratic flooded clay-pans in an arid climate. The questions of convergent evolution, niche equivalence and paleogeographic patterns between the Australis and the Western Palearctis are discussed by comparing the genus and family spectra of ephemeral wetlands in SW Australia with those in Central Italy.

A centre of diversity in ephemeral wetland vegetation and flora is the western part of the Iberian Peninsula. This area is submitted to an atlantic subtype of the mediterranean climate. Four *Isoetes* species (*I. duriei*, *I. histrix*, *I. setaceum*, *I. velatum*) occur sympatrically there and MOLINA studies the distribution patterns, ecological requirements and floristic combinations of these Quillwort swards. Macroscale pattern varying with altitude and slope aspect as well as microscale pattern depending on soil properties are analysed by RUDNER in the Serra de Monchique (Portugal) and on the Campo de Gibraltar (Spain). Soil water potential, soil texture, soil depth, air capacity, gravel import rate and the duration of seeping water are some of the edaphic and hydrologic factors explaining the floristic patterns. The relationships between land use and seasonal pond communities, as well as their spatial and temporal distribution in relation to the flooding period, have been investigated by ESPÍRITO SANTO & ARSÉNIO in the Guadiana Valley in Southern Portugal. Soil mobilisation by agricultural activities is a human impact threatening these habitats.

Like in the mediterranean bioclimate, the oceanic parts of the temperate climatic zone of Europe are richer in plant species and phytocoenoses than the subcontinental regions. Poland constitutes the eastern periphery of the

distribution range of some taxa and syntaxa of the Isoeto-Nanojuncetea. POPIELA presents a synthesis of this class for the Polish territory and raises the interesting question, whether the ecological and sociological amplitude is reduced at the margins of the distribution range. Based upon the observation, that secondary, man-made habitats become more and more important to Eastern Europe, she formulates the hypothesis of an anthropogenic expansion of these species.

At the Eastern fringes of the Eurasian continent, ephemeral wetland vegetation on nutrient-poor soils is characterised by *Eriocaulon* species. SHIMODA gives a synthesis of the *Eriocaulon hondoensis* communities in Japan. Numerous ponds have been constructed and managed for rice field irrigation over hundreds of years. Their emerging shores offer a suitable habitat for short living plants and amphibious perennials. Current changes in rural societies and land management affect the pond environment, and the ephemeral wetland specialists are becoming more and more outcompeted by weedy annuals.

Until now, ephemeral wetlands have been poorly studied in tropical regions. MÜLLER & DEIL present a synopsis of the plant communities of seasonal ponds and semipermanent freshwater lakes in tropical West Africa. Water depth, duration of flooding, and the trophic level of the soil and the water body are the most important differentiating ecological factors. The new class *Rhamphicarpo fistulosae-Hygrophiletea senegalensis* combines the vegetation of amphibious environments with short-term inundation at meso- and eutrophic sites. The communities of the *Eriocaulo pumili-Ophioglossion gomezianum* colonise seasonal ponded rock pools and depressions over lateritic crusts with oligotrophic conditions. The latter communities belong to the class *Drosero-Xyridetea*. They have close floristic and ecological relationships to ephemeral flush vegetation on tropical inselbergs. POREMBSKI & WATVE outline the environmental conditions and the flora of this habitat in tropical Africa and present initial data for India.

Variations in time and vegetation dynamics are prominent characters of temporary wet habitats. Two contributions are dedicated to these aspects, both based upon permanent plot studies. RUDNER investigated the seasonal fluctuations and the year-to-year variations in two regions of the Iberian Peninsula. He documents floristic composition, species diversity and soil water content in the autumnal, spring and summer ecophases and analyses the species turnover from Isoeto-Nanojuncetea to Helianthemetea communities. The interannual fluctuations of the apparent vegetation equal or surpass the intraannual species turnover, indicating the strong influence of the temporal rainfall patterns on the germination of the annual satellite species.

Vegetation dynamics on exposed bottoms of nursery fish ponds and storage ponds in Southern Bohemia (Czech Republic) are analysed by ŠUMBEROVÁ and co-workers. The study attempts to explain the relationship of vegetation cover and floristic spectrum on the one hand and abiotic factors and management of the ponds on the other hand. According to the

type of summer drying and vegetation phase, spring and summer ponds can be distinguished. Annual species with extremely short life cycles like *Coleanthus subtilis* are restricted to nursery fish ponds, drained shortly between April and June. In the storage ponds, dried mostly in summer and early autumn, thermophilic annuals such as *Lindernia dubia* are to be found.

Seasonal rock pools on granitic outcrops are carbon-limited ecosystems in the aquatic phase and water-limited ecosystems in the terrestrial phase, characterised further by an extreme nutrient shortage. One functional plant type highly adapted to these stressful conditions are aquatic resurrection plants. HEILMEIER and his team study *Chamaegigas intrepidus*, the "fearless giant dwarf". This poikilohydric cormophyte species is endemic in ephemeral rock pools of the Namib desert. The dehydration tolerance mechanisms of *C. intrepidus* are compared with the less desiccation-tolerant species *Limosella grandiflora*. Niche-partitioning and gene-flow between subpopulations are further topics of this paper.

The importance of a large and persistent seed bank for the long term survival of ephemeral wetland vegetation in highly disturbed habitats is demonstrated by BISSELS and co-authors. Seed bank analyses and inundation experiments with soil samples from arable fields in the Upper Rhine Valley in Germany are carried out, and apparent vegetation and underground floristics are compared in primary vs. secondary habitats. Arable fields are characterised by the predominance of mudflat species of the classes Isoeto-Nanojuncetea and Bidentetea, and the additional occurrence of weed species. Seed densities were exceptional high (a maximum of 707,072 seeds m^{-2} for *Juncus bufonius*).

Two contributions record results of restoration projects and management experiments, carried out in different climatic zones. RHAZI and co-workers study the consequences of shrub clearing at Roque-Haute, a former basalt quarry in Southern France. Since the abandonment of the traditional grazing regime, the pond floor was colonised by trees and by *Typha angustifolia*. Removal of the high growing perennials initiates the re-establishment of annual ephemeral wetland species from the seed bank and increases the vitality of *Isoetes setacea*. The positive effects of litter removal and ribbon cutting for the establishment of Isoeto-Littorelletea species in oligotrophic heathland ponds in Northwestern Germany are proved by URBAN in long-term observations. Colonisation processes on bare soil were studied for up to nine years.

In the final review article DEIL tries to work out some common characters of ephemeral wetland vegetation on the one hand, and to outline the variability in flora, life forms and ecology in seasonal wet habitats on the other hand. Beyond the aim to review the available literature and to summarise the present state of knowledge, such a global perspective of ephemeral wetlands offers the opportunity of asking for co-evolved adaptations of keystone species and for niche-equivalent taxa in different floristic kingdoms.

The IAVS-Congress 2003 in Naples (Italy) was dedicated to the topic "water and vegetation". In one section of this meeting, a series of lectures

related to ephemeral wetland vegetation were presented and most of these contributions are included in this issue of PHYTOCOENOLOGIA. Some other colleagues, studying temporarily ponded or flooded habitats, were invited to participate, and to my great pleasure, they accepted. Last but not least, I am very grateful to all authors for respecting the strict time schedule in the publication process.

Freiburg, February 2005

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