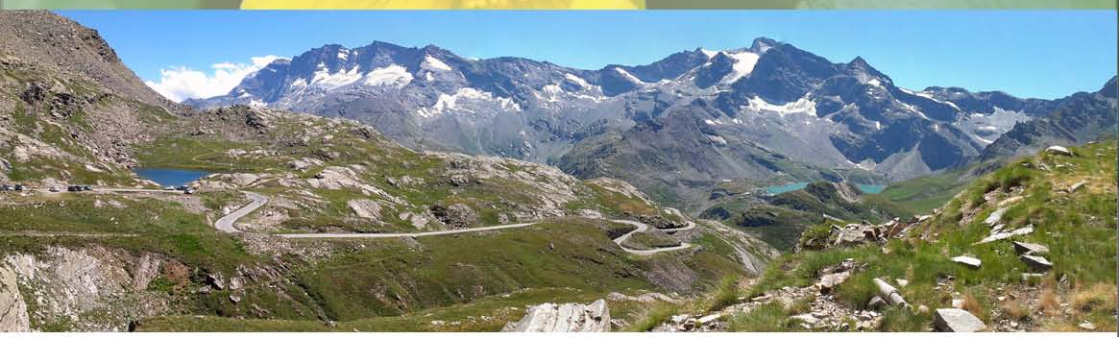
# 25th Meeting of European Vegetation Survey

Roma (Italy), April 6-9 2016

# Book of Abstracts
# Lectures



European Vegetation Survey

Dipartimento di Biologia Ambientale

Sapienza Università di Roma

Società Botanica Italiana

# 25TH MEETING OF THE EUROPEAN VEGETATION SURVEY

## Roma 6-9 April 2016

**Editors: Emiliano Agrillo, Fabio Attorre, Francesco Spada & Laura Casella**

*Chairman of Organising Committee:*
Fabio Attorre, Department of Environmental Biology, Sapienza University of Roma, P.le A. Moro, 5 00185 Roma, Italy. Email: fabio.attorre@uniroma1.it

*EVS Meeting Secretary:*
Emiliano Agrillo, Department of Environmental Biology, Sapienza University of Roma. Orto Botanico, L.go Cristina di Svezia, 24 00165 Roma, Italy. Email – emiliano.agrillo@uniroma1.it.

*EVS Meeting support staff:*

- Luca Malatesta
- Luisa Battista
- Laura Casella
- Marco Massimi
- Marta Gaia Sperandii
- Nicola Alessi
- Michele De Sanctis

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## *CONTENTS*

## 400 YEARS BIODIVERSITY

SANDRO PIGNATTI

DEPARTMENT OF ENVIRONMENTAL BIOLOGY, LA SAPIENZA UNIVERSITY OF ROME

In the current books of Ecology is written that the "concept of biodiversity" was first introduced by the brothers Odum in 1953 and Macarthur in 1955. This is a double mistake, because (1) the diversity of living beings was introduced and discussed in a much earlier time and (2) biodiversity is not a concept (impossible to give a general definition).

As to (1), we found the first use of the word Diversity in a rare book with a Latin paper by Federico Cesi "Tabulae Phytosophicae" at the Tab. 18 "*Diversitas plantarum*", written ca. 1620 but published posthumous 30 years later. The meaning is surprisingly similar to the actual one. This remained forgotten until 2004 (except for a comment in a paper by R. Pirotta in 1904).

"Biodiversity is the variety of life at all levels of organisation, from the level of genetic variation ...to the level of variation within and among ecosystems and biomes. For convenience or necessity, biologists tend to focus biodiversity on the number of species etc." (Tilman, 1997). The reduction of biodiversity to the number of species is an error (unfortunately very diffuse). The historic expression by Magurran (1988, 2004) "the non-concept of biodiv." seems fully confirmed.

In our book "Plant Life of the Dolomites" published in 2014, biodiversity is discussed in the final chapter with a detailed analysis of the possible application to the results of our investigation (2400 species, 120 associations, 1700 relevés, 450 landscape surveys etc.). As a result, in this mountainous territory, biodiversity can be perceived as a phenomenon of 3 different meanings, which can be defined and expressed in numerical form:

- Structural Biodiversity
- Functional Biodiversity
- Evolutionary Biodiversity

Other possible forms of biodiversity may be described in the future for biota living under different environmental conditions, mainly in the tropics.

## ANECDOTAL GEOBOTANY REVISED

FRANCESCO SPADA

DEPARTMENT OF ENVIRONMENTAL BIOLOGY, SAPIENZA UNIVERSITY OF ROMA, L.GO CRISTINA DI SVEZIA, 24 00165 ROMA, ITALY

In the last decades, the contribution of Numerical Ecology to the advances of Geobotany in its broadest meaning has ben invaluable.

Nevertheless, the need of setting up data matrices dealing with biological, physical, chemical and spatial variables in order to reach the ultimate goal of predictive models in Ecology, unfortunately entailed the sacrifice of a large *corpus* of information embedded in the traditional narrative accounts of vegetation.

Since the latest frontiers of interest about the indicator values of species and communities, community structure and diversity patterns focus on strictly site-dependent evaluations and on the causalistic assessment of the present time, the updated Geobotanical disciplines increasingly overlooked the fact that the distribution of species and communities are by no means equivalent and that the interpretation of the distribution patterns of individual species, rather needs a treatment which takes no account of their ecology and is irrespective of the communities in which they are hosted. Otherwise patterns of the spatial arrangement of species throughout their total distribution ranges might be overshadowed. Particularly sensitive is the distribution of species along topographical gradients, where disjuctions and isolated outposts, in the framework of phylogenetic affinities, traditionally were the accepted evidence for changes in the plant cover across time, relictuality, persistence, in one word the legacy of environmental history. Anecdotes on extant residual populations or individuals, statistically difficult to assess, apparently ceased to vitalize the power of interpretation of diversity in Geobotany.

Here, selected anecdotes from older descriptive literature and own records on patterns of species distribution along the altitudinal zonation in Italy and their relationships with neighbouring Mediterranean and Eurasian Zono – and Orobiomes are reviewed. This stresses the need in biodiversity studies to consider the individualistic behaviour of species in space in order to understand omologies in the plant cover at the continental scale and to interpret the legacy of past environmental changes.

## *LECTURES*

## DIVERSITY AND ECOLOGICAL DIFFERENTIATION OF FOREST VEGETATION IN ELMACIK MOUNTAIN OF DUZCE, TURKEY

NECMI AKSOY[1], SULEYMAN COBAN[2]

[1] DUZCE UNIVERSITY, FACULTY OF FORESTRY, DEPARTMENT OF FORESTRY BOTANY & DUOF HERBARIUM, DUZCE
[2] ISTANBUL UNIVERSITY, FACULTY OF FORESTRY, DEPARTMENT OF SILVICULTURE, BAHCEKOY-ISTANBUL

Questions: Altitudinal distribution of forest communities are mainly effected by exposure and soil conditions (soil depth, soil type) in the region. In this study, we are investigating varied ecological conditions which cause this vegetation diversity using multivariate techniques.
Locations: Elmacik Mountain is situated in Duzce City of Turkey.
Methods : The vegetation was collected and classified according to Braun-Blanquet methods. Since the varied ecological conditions cause this vegetation diversity, vegetation-environment relation were analysed with multivariate statistical techniques. For this purpose, a total of 92 relevés and 268 plant taxa from forest vegetation of the region were stored into TURBOVEG and further analysis were carried out in JUICE and CANOCO 5 softwares.
Results : The forest vegetation is presented by 2 classes : *Quercetea pubescentis* (Ober, 1948) Doing Kraft.1955, *Querco-Fagetea* (Braun-Blanquet et Vliegler 1937) Fukarek-Fabijanik 1968 which contain 2 orders, 4 alliances and 11 associations. Where in, northern slopes of the colline zone is covered by broad-leaved forests which composed of *Tilia argentea* and *Carpinus betulus* forest communities, southern slopes with relatively steeper areas are covered with pure or mixed stands of *Quercus petraea* and *Pinus nigra*. Similarly, in high mountain zone, *Abies nordmanniana ssp. bornmulleriana* covers northen slopes and *Pinus sylvestris* southern slopes. This situation was also indicated with average indicator values derived from species composition of sample plots for light and temperature on DCA graph. In CCA, all of the considered environmental variables explain together 16.1 % of total variation in species composition.
Conclusion: Within this explained variation, altitude is the most important factor effecting species composition (23.1 %) and soil depth (19.1 %) was found to be second significant variable. However, when conditional effects of variables considered, forest cover (16.7 %) had the highest contribution following altitude (23.1 %). *Hyperico calycinum-Quercetum petraea* has the highest species diversity because of one-storied and light penetrating leaf structure. However, *Rhododenro ponticum-Fagetum orientalis* has the lowest species diversity due to a dense shrub cover consisting of *Rhododendron ponticum*. It is showed that less canopy cover promotes species diversity.

KEYWORDS: DIVERSITY, ECOLOGICAL DIFFERENTIATION, FOREST VEGETATION, ELMACIK MOUNTAIN, DUZCE, TURKEY

## MACROPHYTE VEGETATION OF RIVERS IN CROATIA

ANTUN ALEGRO[1], VEDRAN ŠEGOTA[1], ANJA RIMAC[2], IGOR STANKOVIĆ[3]

[1] DEPARTMENT OF BOTANY, FACULTY OF SCIENCE, UNIVERSITY OF ZAGREB, MARULIĆEV TRG 20/II ZAGREB
[2] ELEKTROPROJEKT, ALEXANDERA VON HUMBOLDTA 4, 10000 ZAGREB
[3] HRVATSKE VODE, CENTRAL WATER MANAGEMENT LABORATORY, ULICA GRADA VUKOVARA 220, 10000 ZAGREB

Questions: The aim of this study was to gain insight in diversity and distribution of river macrophytes in Croatia, to develop typology of macrophyte vegetation and to apply these data in establishing of macrophyte based index for the ecological quality assessment of rivers.

Location and methods: In the period 2009-2014 over 300 sampling spots randomly scattered through all biogeographical regions of Croatia were surveyed. This included almost all Croatian rivers and replicates along the watercourses. Abundances of macrophytes (flowering plants, bryophytes and charophytes) were assessed using Kohler scale. The chemical and physical parameters of water, as well as geomorphology and bank vegetation were also surveyed following standard protocol. Different correlation and ordination procedures were employed to identify main ecological gradients and to define vegetation units.

Results: Several types of macrophyte vegetation were recognized: (i) moss communities, (ii) communities with *Berula erecta* and other herbids, (iii) communities with submerged and flotant macrophytes, (iv) communities with narrow leaved submerged macrophytes, (v) communities of broad leaved *Potamogeton* species and (vi) communities with *Callitriche* species. Each vegetation type was associated with river types, water quality and biogeographical regions. Changes of each vegetation type due to river degradation were also described and used for establishing of macrophyte-based index for the ecological quality assessment of rivers.

KEYWORDS: FRESHWATERS, MACROPHYTES, PHYTOGEOGRAPHY, ECOLOGICAL QUALITY, BIOINDICATION

## CLASSIFICATION OF *SCHOENUS FERRUGINEUS* L. COMMUNITIES IN THE EASTERN BALTIC REGION AND IN THE SOUTH URAL

LIENE AUNINA[1], TATIANA IVCHENKO[2]

[1] INSTITUTE OF BIOLOGY, UNIVERSITY OF LATVIA, 3 MIERA STREET, SALASPILS, LATVIA
[2] KOMAROV BOTANICAL INSTITUTE OF THE RUSSIAN ACADEMY OF SCIENCES, 2 PROFESSOR POPOV STREET, SAINT PETERSBURG, RUSSIA

Aim: The aim of our study was to classify and to compare *Schoenus ferrugineus* L. communities in the eastern Baltic region (Latvia) and in the South Ural (Russian Federation). We selected extremely rich fen and calcareous fen vegetation where *Sch. ferrugineus* was dominant. Our data set included 165 relèves.
Methods: We used cluster analysis for data classification. Non-metrical multidimensional scaling was applied to determine the main vegetation gradients.
Results: Three clusters were obtained. The first one included extremely rich fen vegetation on deep peat deposits from the South Ural, the second – extremely rich fen and calcareous fen vegetation on shallow peat or calcareous mud in Latvia, but third – extremely rich fen vegetation on deep peat deposits in Latvia. The main vegetation gradient reflected: 1) site hydrology – from vegetation on deep peat deposits with relatively stable water level to vegetation of springs and that of fens with more fluctuating water level than in fens with deep peat layer 2) west-east floristic gradient. Species with eastern distribution, such as *Spiranthes amoena*, *Saussurea parviflora* and *Gentianopsis barbata* were highly diagnostic for extremely rich fens in the South Ural, but were absent in Latvia. As a contrary, species with European distribution, e.g. *Carex davalliana*, *C. hostiana*, *Primula farinosa* were absent from the fens in the South Ural. We had thirteen diagnostic species of *Caricion davallianae* common in both regions; additionally seven diagnostic species were recorded only in Latvia.
Conclusions: 1) *Sch. ferrugineus* dominated extremely rich fen vegetation from the South Ural was most similar to that one found in extremely rich fens on deep peat deposits in Latvia; 2) All three groups showed clear affinity to *Caricion davallianae*. The question, whether all three groups should be assigned to *Primulo farinosae-Schoenetum ferruginei* or other associations should be distinguished, remains open for discussion.

KEYWORDS: *SCHOENUS FERRUGINEUS* COMMUNITIES, SYNTAXONOMY, EASTERN BALTIC, SOUTH URAL

## IDENTIFICATION AND CONSERVATION OF THE HABITATS OF EUROPEAN IMPORTANCE ON THE RUSSIAN CAUCASUS

ELENA BELONOVSKAYA[1], NIKOLAI SOBOLEV[1]

[1] INSTITUTE OF GEOGRAPHY, RUSSIAN ACADEMY OF SCIENCES

Questions and Location. In order to establish the Emerald Network for North-Caucasian steppe we need identifying high representative mountain steppe site and checking the conservation adequacy of their actual land use.

Methods. Floristic classification of the Caucasian mountain steppe communities established to describe habitat diversity. The map of habitat distribution compiled by combining field data, thematic maps, multispectral (three colour filters) Resurs-F satellite 1:200 000 images, and aerial 1 : 30 000 photos.

Results and Conclusion. Mountain steppes are well identified by remote sensing. The actual map shows the distribution of the mountain steppe vegetation in intramontane depressions in conditions of low-precipitation, high insolation, hot summer. Pastures and hay lands predominated there during millennia. Such land use and ecological conditions formed structure and species composition of the vegetation. Studied habitats match descriptions of several subtypes of the EUNIS classification type E1.2 *Perennial calcareous grassland and basic steppes*, especially the subtype E1.24 *Central alpine arid grassland* (*Stipo-Poion*). Lack of strong definitions of the habitats types complicates interpretation of field data. Nevertheless, we consider the identified habitat types of mountain steppes showing more conformity to corresponding E1.2 subtaxa, than similarity between themselves. We are ready to collaboration for more precious comparing steppe communities of various plain and mountain regions.

Many identified steppe sites undergo negative changes out of protected areas. Lack of moderate traditional herbage use or analogous special conservation management leads to the forest expansion into grasslands. We propose the set of mountain steppe potential sites for the Emerald Network.

Gratitude to the Russian Fund for Basic Researches for the support by the grant N° 14-05 00233A.

KEYWORDS: INTRAMONTANE DEPRESSIONS, MOUNTAIN STEPPES, HABITATS TYPES, EUNIS CLASSIFICATION, EMERALD NETWORK

## REVISING ELLENBERG'S INDICATOR VALUES FOR CONTINENTALITY

CHRISTIAN BERG[1], ERIK WELK[2], ECKEHART J. JÄGER[3]

[1] INSTITUTE OF PLANT SCIENCES - UNIVERSITY OF GRAZ - HOLTEIGASSE 6 - 8010 GRAZ - AUSTRIA
[2] GERMAN CENTRE FOR INTEGRATIVE BIODIVERSITY RESEARCH (IDIV) HALLE-JENA-LEIPZIG - DEUTSCHER PLATZ 5E - 04103 LEIPZIG - GERMANY
[3] DEPARTMENT OF GEOBOTANY AND BOTANICAL GARDEN - MARTIN-LUTHER-UNIVERSITY - AM KIRCHTOR 1 - 06108 HALLE (SAALE)

Background: Ellenberg approached the development of his EIV in two ways: (1) for light, moisture, soil reaction and, nutrients, he empirically deduced the values drawing on decades of field observation, and (2) for the values for temperature (EIV-T) and continentality (EIV-K) he used the condensed formalized descriptions of large scale geographical and altitudinal species distribution (range formulas) developed by the Halle school of phytogeography.
Question: Can we improve the Ellenberg Indicator values for continentality based on the increasing knowledge in species distribution and phytogeographical continentality?
Location: Northern Hemisphere, Central Europe
Methods: We take a centred distribution along the ten-class oceanity-continentality gradient of the Holarctic. Species that extend over more than four continentality classes are considered to be indifferent (C-value x).
Results: We provide new indicator values for continentality (C-values) for 2984 vascular plant taxa for central Europe. The C-vales eliminate some drawbacks of Ellenberg's continentality values. Testing four different datasets from Central Europe, the C-values show a more balanced frequency distribution and widening the scale of means.
Conclusions: We present indicator values for continentality derived with a consistent method that is strictly based on distribution data. Global flora and vegetation data are becoming increasingly available, while changing climatic conditions inevitably accelerate species range dynamics, therefore the application of biogeographical indicator values will increase.

KEYWORDS: BIOINDICATION, CENTRAL EUROPE, CLIMATE NICHES, ECOGEOGRAPHICAL GRADIENTS, GLOBAL DISTRIBUTION RANGE, OCEANITY, RANGE FORMULAS

## CLIMATE PATTERNS MATTER FOR THE CLASSIFICATION OF FLOODPLAIN FORESTS OF THE IBERIAN PENINSULA

IDOIA BIURRUN[1], ITZIAR GARCÍA-MIJANGOS[1], MERCEDES HERRERA[1], JAVIER LOIDI[1], JUAN ANTONIO CAMPOS[1]

[1] DEPT. OF PLANT BIOLOGY AND ECOLOGY. UNIVERSITY OF THE BASQUE COUNTRY AP. 644 48080 BILBAO, SPAIN

This work deals with the classification of floodplain forests in the Iberian Peninsula. Our aims were to produce a formalized classification of these forests and to assess their main bioclimatic gradients.

A data set with more than 3000 vegetation plots of floodplain forests was compiled from vegetation-plot databases, while climatic data were derived from a digital climatic atlas. Unsupervised classification methods (Fuzzy C-means, agglomerative hierarchical clustering) were used to build a typology from association to order level. The phi fidelity index was used to determine the diagnostic species of the syntaxa in the proposed classification. Main climatic gradients were explored using NMDS analysis, and ANOVA was carried out in order to define the bioclimatic features of Iberian floodplain forests.

A total of 41 floodplain forest associations were distinguished for the Iberian Peninsula, five ot them proposed as new associations. They are grouped in nine suballiances, four alliances and two orders. Summer aridity was the main climatic driver, as it separates the temperate floodplain forests of the order *Alno-Fraxinetalia* from the Mediterranean forests of the *Populetalia albae*. Continentality and precipitation were mainly relevant at alliance level, as they separated both the temperate alliances *Alnion incanae* and *Hyperico-Alnion*, the latter more oceanic, and the Mediterranean alliances *Populion* and *Osmundo-Alnion*, the latter from more rainy areas. Temperature was an important driver at association level.rnrnConclusions: One new alliance, *Hyperico-Alnion*, is proposed for the Cantabrian watershed as well as 5 new suballiances and 5 new associations. Mediterraneity, continentality and precipitation drive floodplain forest diversity at broad scale, while temperature is the main bioclimatic driver at fine scale. The proposed classification provides the scientific basis for the conservation of this habitat type in southern Europe.

KEYWORDS: BIOCLIMATIC INDEX, DIAGNOSTIC SPECIES, FCM, HARDWOOD RIPARIAN FOREST, NMDS, PHYTOSOCIOLOGY, SOFTWOOD RIPARIAN FOREST, SOUTHWEST EUROPE, VEGETATION

## FROM REGIONAL TO LOCAL SCALE : WHAT DID WE LEARN ABOUT THAT HABITATS AND ADAPTATIVE ABILITIES OF CHAROPHYTES?

AURÉLIE BOISSEZON[1,2], DOMINIQUE AUDERSET JOYE[3], PATRICE PRUNIER[4]

[1] HEPIA GENEVA, HES-SO UNIVERSITY OF APPLIED SCIENCES AND ARTS WESTERN SWITZERLAND, ROUTE DE PRESINGE 150, CH-1254 JUSSY, GENEVA, SWITZERLAND
[2] INSTITUTE OF ENVIRONMENTAL SCIENCES, UNIVERSITY OF GENEVA, FRESHWATER ECOLOGY, CARL-VOGT 66, CH-1211 GENEVA 4, SWITZERLAND
[3] INSTITUTE OF ENVIRONMENTAL SCIENCES AND F. A. FOREL INSTITUTE, UNIVERSITY OF GENEVA, FRESHWATER ECOLOGY, CARL-VOGT 66, CH-1211 GENEVA 4, SWITZERLAND
[4] HEPIA GENEVA, HES-SO UNIVERSITY OF APPLIED SCIENCES AND ARTS WESTERN SWITZERLAND, ROUTE DE PRESINGE 150, CH-1254 JUSSY, GENEVA, SWITZERLAND

Aims: The main objectives of this work was to describe the charophyte species habitats, to predict their distribution in a climate warming context.
Location: Switzerland and neighboring France
Data and methods: At the regional scale, environmental data were obtained for 1402 localities distributed across the whole swiss territory and were used to fit species distribution models. These models were used as a basis for the prediction of current and future species occurrences in the 21 000 localities listed in Switzerland. At the local scale, a 5 years survey realized on a single site allowed the analysis of the response of aquatic plants communities in particular charophytes ones, in term of function, abundance and phenology, to water level fluctuations and accumulated heat over time.
Results: Regional parameters relative to the waterbody size and the climate are playing a major role in the distribution of charophytes in Switzerland. All species do not occupy the same macro-habitat and have different tolerance ranges to the environmental parameters. On the horizon 2050, under a warmer and drier climate, the distribution area of species that are currently colonizing larges lakes should regress whereas those that are linked to small waterbodies which are capable of dry should increase.rnrnThe monitoring of a former semi-permanent gravel-pit highlighted that the variability of inundation conditions influence the dynamics of the aquatic plant community.
Conclusion: Our results improved our understanding of charophyte ecology and raised several phytosociological questions. Several charophyte species would have adaptative abilities to a larger variety of habitats than those observed in Switzerland. The vulnerability of species to global changes will depend on their intrinsic biological attributes and to extrinsic factors related to the changes in habitats and to the politics and tools that will be adopted by the government.

KEYWORDS: CHARACEAE, SPECIES DISTRIBUTION MODEL, PHYTOSOCIOLOGY, PHENOLOGY, PERTURBATION, DROUGHT, DEGREE-DAY, PLASTICITY, RESILIENCE, CLIMATE WARMING

## THE BIODIVERSITY AND SPATIAL STRUCTURE ANALYSIS OF LAKE BAIKAL EASTERN COAST VEGETATION

ELENA BRIANSKAIA[1], REINHARD BÖCKER[1], KLAUS SCHMIEDER[1], ZHARGALMA ALYMBAEVA[2]

[1] UNIVERSITÄT HOHENHEIM, INSTITUTE OF LANDSCAPE AND PLANT ECOLOGY
[2] ZHARGALMA ALYMBAEVA - BAIKAL INSTITUTE OF NATURE MANAGEMENT SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES

Questions: The object of the study is the terrestrial vegetation of the central zone of Lake Baikal eastern coast. The studying territory represents predominantly the low and medium mountain taiga landscapes. In this study we are questioning by possibility of minimizing the field work by means of the informational content of high resolution satellite images for creating large scale landscape vegetation models.
Location: The central zone of Lake Baikal eastern coast, Republic of Buryatia, Russia.
Methods: The vegetation was collected and classified according to Braun-Blanquet methods. JUICE package was crucial for management and analysis of relevés. The mapping was developed by means of ArcGIS software.
Results: After the first field expedition in 2015, we identified 210 plant species and 4 subspecies. The vegetation is presented by 4 classes *Vaccinio-Piceetea* Br.-Bl. In Br.-Bl. et al. 1939, *Oxyccoco-Sphagnetea* Br.-Bl. &Tx., *Lemnetea* de Bolos et Masclans 1955, *Brometea korotkyi* Hilbig et Korolyuk 2000, which contain 5 orders, 7 alliances, 11 associations and 1 subassociation. The soil cover was investigated by soil profile cuts. We studied 10 soil types.
Conclusion: Despite the relatively small territory under study, the Katkovskaya mountain range is represented by different habitat types. Lake Baikal plays the crucial role in the conservation of macrothermophyte plant species on the coastal line. The close presence of the seasonal frost soil layer forms suitable habitat conditions, which contribute flowering of tundra and peatland species. The location of the study area within the zonal light coniferous taiga belt shows the obvious dominance of the forest type habitat. Thus, we assume that this territory can be considered as the model forestland of Lake Baikal which contiguous to it from the east.

KEYWORDS: LAKE BAIKAL, VEGETATION, FLORA, CLASSIFICATION, SPATIAL STRUCTURE

## HOW TO CONSERVE AND DEVELOP *LITTORELLETEA* VEGETATION (HABITAT TYPE 3130) OF NW-GERMANY OVER DIFFICULT ECOLOGICAL PERIODS?

RAINER BUCHWALD[1] & SUNTJE STUTZMANN[1]

[1]AG VEGETATIONSKUNDE UND NATURSCHUTZ, INSTITUT FÜR BIOLOGIE UND UMWELTWISSENSCHAFTEN, IBU-A1, CARL VON OSSIETZKY UNIVERSITÄT OLDENBURG, D – 26111 OLDENBURG, GERMANY; RAINER.BUCHWALD@UNI-OLDENBURG.DE

Due to the intensification of land use in the last decades, the number of nature-near oligotrophic heath ponds and sandy Geest lakes has strongly declined. Actually in Lower Saxony and Bremen exist only five waters with populations of *Lobelia dortmanna*, *Isoetes lacustris*, *Sparganium angustifolium*, *Littorella uniflora* and/or other typical species of the habitat type 3130 (Littorelletea vegetation). They are endangered particularly by eutrophication from surrounding fields as well from atmospheric nitrogen depositions (traffic, industrial livestock farming) and from bathing, by herbivory (fish, muskrat, geese, ducks, sheep) and by isolation and succession of the remaining populations. The same is true for other regions of Central and probably whole Europe.

We studied water chemistry, population trends and (partly) seed bank in these waters over 8-12 years. The chemical parameters show a stable, but critical situation, the trophic state having changed from formerly oligotrophic to actually mesotrophic. Additionally to the eutrophication, we found in the Ahlder Pool low values of pH (3,8-5,0) and base contents indicating an insufficient buffer system and increasing acidification.

As most endangered species we consider the fern *Isoetes lacustris* that - as a glacial relict - has ever been rare in the northern parts of Germany, but actually exhibits just only one occurrence each in Lower Saxony and Schleswig-Holstein. *Lobelia dortmanna,* however, is actually found in five Littorelletea waters, the population size ranging from very small (2 populations) to medium (1 p.) to (very) large (2 p.).

In order to develop the last populations of these highly endangered species, we started to establish various conservation measures, among these:
- lowering of the water table in July and August, in order to increase germination and establishment rates of *Lobelia* and *Littorella* in the heath ponds
- removal of the competing plant stands (*Typha latifolia*, *Carex rostrata* and others) near the unique *Isoetes* population
- liming of the Ahlder Pool shores, in order to elevate pH from moderately acid up to slightly acid
- ex-situ conservation in an artificial heath pool of the Botanical Garden Oldenburg
- re-introduction of *Isoetes* and *Lobelia* to former sites, protected by iron cages against fish herbivory

KEYWORDS: HABITATS DIRECTIVE, HABITAT TYPE 3130, OLIGOTROPHIC STANDING WATERS, *LOBELIA DORTMANNA*, *ISOETES LACUSTRIS*

## CONTEXT-DEPENDENT PLANT TRAITS DRIVE FINE-SCALE SPECIES PERSISTENCE IN OLD-GROWTH FORESTS

GIANDIEGO CAMPETELLA[1], ENRICO SIMONETTI[1], SANDOR BARTHA[2], STEFANO CHELLI[1], CAMILLA WELLSTEIN[3], DANIELE GIORGINI[4], NICOLA PULETTI[5], MARCO CERVELLINI[1], ROBERTO CANULLO[1]

1 SCHOOL OF BIOSCIENCES AND VETERINARY MEDICINE, PLANT DIVERSITY AND ECOSYSTEMS MANAGEMENT UNIT, UNIVERSITY OF CAMERINO, VIA PONTONI, 5, I-62032 CAMERINO, ITALY
2 INSTITUTE OF ECOLOGY AND BOTANY, MTA CENTRE FOR ECOLOGICAL RESEARCH, H-2163 VÁCRÁTÓT, HUNGARY
3 FACULTY OF SCIENCE AND TECHNOLOGY, FREE UNIVERSITY OF BOZEN-BOLZANO, PIAZZA UNIVERSITÀ 5, I-39100 BOZEN, ITALY
4 DEPARTMENT OF LIFE SCIENCES, UNIVERSITY OF SIENA, VIA P.A. MATTIOLI, I-53100 SIENA, ITALY
5 CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA, FORESTRY RESEARCH CENTRE (CREA-SEL), ITALY

Questions: we studied old growth beech forest vegetation in Permanent Monitoring Plots (PMPs) located in Italy, with the following questions: is species turnover the main component of the observed changes or the present species assemblages is an impoverished sub-sets of the former ones?; 2) how compositional changes are reflected by specific plant functional traits?

Location: we selected 4 PMPs (50 x 50 m) of the CONECOFOR network, placed along a latitudinal and climatic gradient in Italy, from south to north: CALABRIA03, CAMPANIA04, ABRUZZO01 and VENETO20.

Methods: presence/absence of herb layer species were recorded in 100 permanent micro-plots of 50 x 50 cm over 12 years (1999-2011). For all sampled species we chose a set of 8 easy-to-measure functional traits. We compared the persistence, nestedness and turnover components of compositional changes. The role of plant traits explaining species persistence were analyzed by classification and regression tree.

Results: Analysis in species diversity reveal antithetical ecological phenomena due to the diversity and complexity of the 4 different forest stands. ABRUZZO01 and CALABRIA03 show a clear nestedness trends over time with persistent species in ABR01 having higher seed mass and persistent species in CALABRIA03 having scleromorphic leaves and mesoporphic leaves, with large below-ground budbank. On the other hand, VENETO20 and CAMPANIA04 exibit a significant turnover trends over the 12 years characterized by persistent species in VENETO20 having helomorphic leaves, while in CAMPANIA04 large below-ground budbank and smaller SLA were the most important traits for species survival.

Conclusion: Fine-scale approach highlight different mechanisms for the maintenance of species diversity in different complex forest systems driven significantly by specific traits, influenced by context-dependent factors.

KEYWORDS: FOREST, PLANT FUNCTIONAL TRAITS, VEGETATION, SPECIES TURNOVER

## NUMERICAL SYNTAXONOMY AND BIOGEOGRAPHY OF WOODY VEGETATION OF MACARONESIA

JORGE CAPELO[1,2], JOSÉ CARLOS COSTA[2], CARLOS AGUIAR[3], SALVADOR RIVAS-MARTÍNEZ[4]

[1] INSTITUTO NACIONAL DE INVESTIGAÇÃO AGRÁRIA E VETERINÁRIA OEIRAS PORTUGAL
[2] LEAF RESEARCH CENTER INSTITUTO SUPERIOR DE AGRONOMIA LISBON PORTUGAL
[3] INSTITUTO POLITÉCNICO DE BRAGANÇA BRAGANÇA PORTUGAL
[4] PHYTOSOCIOLOGICAL RESEARCH CENTER LOS NEGRALES MADRID SPAIN

Questions:
'Does the current syntaxonomical model for zonal woody vegetation of Macaronesia expresses correctly a coherent coenological similarity structure?'
'Is there a common vegetation class to stand for the whole or the greater part of Macaronesia?'
'What changes in the syntaxonomical model might be proposed to ameliorate it?'
'Does the putative biogeographical unity of Macaronesia hold?'
'Is there evidence that syntaxonomy of macaronesian woody vegetation might suport a distinct bieogeographic affiliation?'
Location: The set of Azores, Madeira (including Porto Santo, Desert and Salvages islands), Canary Islands and Cape Vert archipelagos.
Methods: i) minimum-variance agglomerative classification constrained to mandatory spatially connex clusters; ii) TWINSPAN with *post hoc* simple discriminant analysis using bioclimate independent variables.
Results: Syntaxonomical commonalities are feeble or nonexistent among archipelagos, as Azores, the group 'Madeira-Canaries' and Cape Vert are each characterized by independent endemic vegetation classes and share no *syntaxa* among them. Only the group 'Madeira-Canaries', in spite of having each several endemic *syntaxa* at alliance level, nevertheless, they share two alliances in the scope of the two correspondent shared vegetation classes. *Post hoc* bioclimatic interpretation confirms this scheme. Syntaxonomical consequences to biogeographical units for each archipelago /group is thus: Azores as Holartic Eurosiberian; 'Madeira and Canaries' as Holartic Mediterranean; and Cape Vert as Paleotropical Sahelian Sudanian.
Conclusion: The current syntaxonomical model, in spite of differences in details at or bellow alliance level, is confirmed in rank and circumscription. Namely, the hypothesis that a common vegetation class (in turn differentiated in subclasses) is rejected. Even as a polythetic set, the biogeographical unit of Macaronesia does not hold as a consequence of absence of shared high-rank syntaxa, except for the case of Madeira and the Canaries. Only analysis of vicariance phenomema among taxa and syntaxa, not approached here, would eventually support such geographical unit. From the strict point of view of vegetation composition as criteria for Biogeography, Macaronesia is an informal geographical unit.

KEYWORDS: MACARONESIA, ZONAL VEGETATION, SYNTAXONOMY, BIOGEOGRAPHY, MULTIVARIATE METHODS

## PLANT SPECIES AND COMMUNITIES INDICATORS TO ASSESS THE CONSERVATION STATUS OF THE HABITAT TYPE 6210(*) IN MOLISE (CENTRAL ITALY)

EMANUELA CARLI[1], SABINA BURRASCANO[1], PIERA DI MARZIO[2], CARMEN GIANCOLA[2], ATTILIO DI GIUSTINO[3], BRUNO PAURA[4], GIOVANNI SALERNO[5], AGNESE TILIA[1], CARLO BLASI[1]

[1] DEPT OF ENVIRONMENTAL BIOLOGY, 'SAPIENZA' UNIVERSITY OF ROMA, ROMA
[2] DEPT BIOSCIENCE AND TERRITORY, UNIVERSITY OF MOLISE, PESCHE (IS)
[3] VIA DELLE METAMORFOSI 4, SULMONA (AQ)
[4] DEPT OF AGRICULTURAL, ENVIRONMENTAL AND FOOD SCIENCES, UNIVERSITY OF MOLISE, CAMPOBASSO
[5] VIA G. ALBIMONTE 9, ROMA

Accurate and sound monitoring conservation status assessment of secondary calcareous grasslands are of utmost urgency since these habitats are among the most threatened in Europe due to their intrinsic dynamic nature.

We aim at assessing the conservation status of the habitat 6210(*) based on surrogates of structure and functions at the site level, as it is required by the article 17 of the Habitat Directive.

We used vegetation data from South-Western Molise, where traditional pastoralism is still common.

After selecting those areas most likely to host the Habitat, we built a geodatabase including 334 vegetation relevés (161 original, 173 published). Based on this training dataset, we selected those structural and floristic indicators that most effectively indicate the conservation status of the habitat across the study area. We used the ratio between forbs and graminoids, the presence of woody species, the floristic consistency with the habitat, and the presence of species of conservation or biogeographic interest. We also added information on plant traits as grazing and mowing tolerance, spinescence, and clonality.

Our results displayed that only 8% of our grasslands relevés is in favourable status (FV), showing a substantial floristic consistency with the Habitat; these are mostly located in areas, where grazing is still the main management practice. The majority of the analysed grasslands resulted in unfavourable conservation status (51% as UF1, 41% as UF2). Also grasslands which host a high percentage of forbs, generally indicating high pastoral values, showed an unfavourable status due to the occurrence of woody species. This was found in mowed grasslands, since mowing is less effective than grazing in contrasting woody encroachment.

Our methodology effectively highlighted differences in conservation status also in relation to the habitat management, indeed grazing resulted as the most effective practice to preserve the biodiversity of the habitat in Molise.

KEYWORDS: ARTICLE 17, DIAGNOSTIC SPECIES, ENCROACHMENT, GRASSLAND MANAGEMENT, MONITORING STRATEGY, PLANT TRAITS

## THE RED LIST OF ECOSYSTEMS IN FRANCE: OVERVIEW AND OUTCOMES OF THE ASSESSMENT OF FRENCH MEDITERRANEAN FOREST ECOSYSTEMS, ACCORDING TO THE IUCN METHODOLOGY

AURÉLIEN CARRÉ[1], MAGALI ROSSI[1], PAULINE TEILLAC-DESCHAMPS[1], VINCENT GAUDILLAT[2], GUILLAUME GIGOT[2]

[1] ECOSYSTEM MANAGEMENT PROGRAM, IUCN FRENCH NATIONAL COMMITTEE, 17 PLACE DU TROCADÉRO - 75016 PARIS, FRANCE
[2] NATIONAL MUSEUM OF NATURAL HISTORY, SERVICE DU PATRIMOINE NATUREL, 36 RUE GEOFFROY SAINT-HILAIRE, CP 41, 75231 PARIS CEDEX 05, FRANCE

Aim: IUCN Red lists are broadly used to influence policies and assist societies to improve regulations for biodiversity conservation. In line with Red lists of species, IUCN has developed a similar approach based on ecosystem risk assessment. Since 2008, the IUCN French National Committee has been involved in the development and test of this new methodology, with a particular focus on its declination at a national level.

Location: Following the Resolution adopted in 2012 at the previous IUCN World Conservation Congress, the French Committee and the National Museum of Natural History, with many other partners, are implementing the project of a National Red List of French Ecosystems. Its purpose is to assess the risk of collapse for all ecosystems occurring in France and its overseas territories.

Method: The Red List of Ecosystems has been developed in order to assess the risk of ecosystem collapse, thanks to a set of criteria and quantitative thresholds of decline. After having defined those ecosystems, we achieved assessments for the French Mediterranean forest ecosystems.

Results: 21 ecosystem types have been assessed. The most vulnerable ecosystems are those with restricted distribution, mostly threatened by a unique driver of change. Others are threatened by natural dynamics, their decline in both distribution and processes being linked to decline in human activities that were implicated in their maintenance.

Conclusion: Declining the IUCN Red List of Ecosystems methodology to a national level and assessing French Mediterranean forest ecosystems brought us to answer to many critical issues, such as the choice of ecosystem classification, the definition of the native characteristic biota, the integration of different facies and functional traits or the interpretation of the risk of collapse. Discussing the outcomes of these various questions and the choices we have made is a way to build a common method, in order to develop national Red Lists of Ecosystems.

KEYWORDS: IUCN, RED LIST OF ECOSYSTEMS, NATIONAL LEVEL, PARTNERSHIP, FRENCH MEDITERRANEAN FORESTS

## TO BE OR NOT TO BE A HABITAT TYPE: A QUESTION TO BE SOLVED

LAURA CASELLA*, PIERANGELA ANGELINI*, PIETRO M. BIANCO*

* ISPRA, INSTITUTE FOR ENVIRONMENTAL PROTECTION AND RESEARCH, NATURE PROTECTION DEPARTMENT, ROMA, ITALY

Habitat Directive aims to protect nature across Europe by the means of a network of protected sites and a list of habitat types and species which protection must be guaranteed. The list of habitat types has been selected according cross-walking references between formerly established habitat classification systems (Corine Biotopes earlier, Palaearctic Classification later) and updated during the years accordingly to new entering EU Member States. This changes resulted in some misunderstandings in the interpretation of the types in different member states and also inside the single member state, weakening the strength of the protecting framework.

Specifically, the framework of the Directive is a powerful tool for protecting nature in Italy. It empowered and revitalized the network of national and regional protected sites contributing to halting the loss of biodiversity.

The urgent need for comparative definitions could be satisfied by rationalizing the existing list, taking into account the history of local vegetation and stressing the role of vegetation as indicator and the importance of common characteristics instead of differences among habitats.

Again, without clear limits in the interpretation of the Annex I habitat types, we think it's necessary to consider giving to some habitat regional or national importance rather than over-extend the meaning of original Habitat Directive Annex I definition.

KEYWORDS: HABITAT DIRECTIVE, ANNEX I, NATURE PROTECTION, VEGETATION HISTORY

## EXPERT SYSTEM FOR CLASSIFICATION OF EUROPEAN WOODLAND, SCRUB AND HEATHLAND HABITATS

MILAN CHYTRÝ[1], LUBOMÍR TICHÝ[1], STEPHAN M. HENNEKENS[2], ILONA KNOLLOVÁ[1], CORRADO MARCENÒ[1], BORJA JIMÉNEZ-ALFARO[1], PAVEL NOVÁK[1], JOHN A.M. JANSSEN[2], JOHN S. RODWELL[3], JOOP H.J. SCHAMINÉE[2], AND DATA CONTRIBUTORS

[1] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, 611 37 BRNO, CZECH REPUBLIC
[2] ALTERRA WUR, P.O. BOX 47, 6700 AA, WAGENINGEN, THE NETHERLANDS,
[3] 7 DERWENT ROAD, LANCASTER, LA1 3ES, UK

Aims: (1) To develop a computer expert system for unequivocal classification of European vegetation plots to woodland, scrub and heathland habitat types compatible with the classification of EUNIS and Red List of European habitats; (2) To characterize distributions of individual habitat types; (3) To identify diagnostic, constant and dominant species of habitat types based on uniform statistical criteria.

Methods: Using a new formal language implemented in the JUICE program, we created definitions of habitat types based on species composition and cover. We applied the expert system containing these definitions to more than 1.1 million vegetation plots of the European Vegetation Archive and Braun-Blanquet project. Groups of classified plots were mapped and used to extract diagnostic, constant and dominant species based on the statistical fidelity measures, constancy thresholds and cover values.

Results: A total of 43 habitat types of woodlands and 48 types of scrub and heathlands were defined, identified in the available vegetation-plot databases, mapped and characterized by diagnostic, constant and dominant species.

Conclusions: The new expert system is an open tool which will be further developed by adding new habitat/vegetation types and refining the classification of the already included types. The ultimate aim is to integrate classifications developed in various studies of European vegetation into a single, transparent and flexible classifier to be used in nature management and research.

KEYWORDS: CLASSIFICATION, EXPERT SYSTEM, HABITAT, VEGETATION

## CONTACT BETWEEN TEMPERATE (SUB)ALPINE AND OROMEDITERRANEAN GRASSLANDS IN THE SOUTHERN BALKANS

RENATA ĆUŠTEREVSKA[1], VLADO MATEVSKI[1,2], MITKO KOSTADINOVSKI[1], ANDRAŽ ČARNI[2,3,4]

[1] INSTITUTE OF BIOLOGY, FACULTY OF NATURAL SCIENCES AND MATHEMATICS, UNIVERSITY OF SS. CYRIL AND METHODIUS, GAZI BABA BB, MK-1000 SKOPJE, REPUBLIC OF MACEDONIA
[2] MACEDONIAN ACADEMY OF SCIENCES AND ARTS, BUL. KRSTE MISIRKOV, 2, P. O. BOX 428, MK-1000 SKOPJE, REPUBLIC OF MACEDONIA
[3] INSTITUTE OF BIOLOGY, SCIENTIFIC RESEARCH CENTER OF THE SLOVENIAN ACADEMY OF SCIENCES AND ARTS, NOVI TRG 2, SI-1000 LJUBLJANA, SLOVENIA.
[4] UNIVERSITY OF NOVA GORICA, VIPAVSKA 13, SI 5000 NOVA GORICA, SLOVENIA

This study present phytosociological analysis to understand vegetation diversity of the (sub) alpine grasslands vegetation of the *Elyno-Seslerietea* and the oromediterranean grasslands of the *Daphno-Festucetea* , in the transitional belt between two biogeographic regions (southeastern European and Mediterranean biogeographic regions). The class *Elyno-Seslerietea*, represented by the order *Onobychido-Seslerietalia* in the research area appearing in the north and class *Daphno-Festucetea*, represented by order *Daphno-Festucetetalia* in the south. In the most southern parts of Balkans oromedediterranean grasslands of the *Daphno-Festucetea* are dominant. Contact of *Daphno-Festucetea* with the class *Elyno-Seslerietea* has mosaic distribution, depending on microclimate conditions and exposure, as a result of their intermediate location between central-European and sub-Mediterranean influence. The influence of the Mediterranean climate, that is mild rainy winters and hot dry summers, and of the Continental one with cold, snowy winters and hot and dry summers, can be recognized in the investigated area. On the top of mountains in the central part of the Balkan appear the *Elyno-Seslerietea* vegetation and replaces the *Daphno-Festucetea* entirely towards the north.

The study is based on relevés from literature sources (Greece, Albania. Macedonia, Bulgaria and Serbia) and own relevés from the territory of Macedonia, Albania and Greece, that have been carried out during the years 2009-2015. We determined the chorological spectrum, ecological variables and the influence of the geomorphological variables in the distribution of researched plant communities. Numerical calculations were performed to compare results with several other studies and drew conclusions. The analysis indicated a distinction on the basis of their altitudinal levels and geographic location, and revealed different ecological responses and environmental variables along the studied areas.

KEYWORDS: *ELYNO-SESLERIETEA*, *DAPHNO-FESTUCETEA*, SOUTHERN BALKANS

## MODELLING PIN-POINT COVER DATA OF COMPLEMENTARY VEGETATION CLASSES

CHRISTIAN DAMGAARD

BIOSCIENCE, AARHUS UNIVERSITY, DENMARK

It is often ecologically meaningful to divide the vegetation into a number of complementary vegetation classes or functional types. Here, a method for modelling pin-point plant cover data for such complementary classes is presented. The joint distribution of pin-point cover data of complementary vegetation classes is modelled using a mixture distribution of the multinomial distribution and the Dirichlet distribution, where the Dirichlet distribution is used to model the effect of spatial aggregation. In order to demonstrate the method, the variation in cover with space or time is modelled using a hierarchical Bayesian approach, where the mean cover of each site at a specific time is modelled by a latent variable.

The statistical modelling procedure is exemplified in a case-study of pin-point cover data of the two dominating species *Calluna vulgaris* and *Deschampsia flexuosa*, and the abundance of the complement species class of all other higher plants on Danish dry heathlands. The cover of *C. vulgaris* increased significantly with annual precipitation and the cover of *D. flexuosa* decreased significantly with annual precipitation. Furthermore, the mean cover of *C. vulgaris* and *D. flexuosa* within-sites was negatively correlated. There were no significant changes in the cover of the three complementary dry heathland vegetation classes from 2007 to 2012.

The presented model allows information of complementarity to be incorporated and whereby increasing the statistical power. Furthermore, the spatial aggregation of the vegetation is modelled so that statistical inference tests will not be deflated due to pseudo-replication.

KEYWORDS: JOINT DISTRIBUTION OF PLANT ABUNDANCE, PLANT COVER, HIERARCHICAL MODELS, PLANT ECOLOGY, POINT-INTERCEPT, STRUCTURAL EQUATION MODELLING

## CARBON SEQUESTRATION IN HUMUS FORMS IN A MEDITERRANEAN FOREST ECOSYSTEM. EVIDENCES FROM AN INTEGRATED STUDY ON HUMUS AND VEGETATION

CRISTINA DE NICOLA[1], AUGUSTO ZANELLA[2], ANNA TESTI[1], SANDRO PIGNATTI[1]

[1] DEPARTMENT OF ENVIRONMENTAL BIOLOGY, LA SAPIENZA UNIVERSITY OF ROME
[2] DEPARTMENT OF LAND, ENVIRONMENT, AGRICULTURE AND FORESTRY, UNIVERSITY OF PADUA

Aim: Organic carbon storage in different humus systems and different forest type.
Location: Castelporziano Reserve.
Methods: Soil/humus profiles and phytosociological relevés were performed in different substrates, soil and vegetation types, covering the whole range of vegetation units and humus forms of the Reserve.
According to the methods adopted by Italian Society of Soil and by USDA Soil Survey Staff, pH, organic carbon and total nitrogen parameters were measured in the humus systems to support field observations. Carbon stock was obtained using the formula proposed by Garlato et al. 2009.
Results: Carbon stock stored in humus systems, expressed in Tons/Ha, had a wide range for each vegetation type, reflecting the high diversity of forest vegetation and the variability within each type.
The humus systems surveyed are well related to the main vegetation units:
Moder dominates in *Echinopo-Quercetum frainetto* with *Erica arborea* characterized by superficial water table. Acid and hardly decomposable litter of sclerophyllous or *Erica arborea* species and periodic asphyxia in the topsoil slow the process of litter biodegradation;
Amphi dominates under *Echinopo-Quercetum frainetto* and *Quercetum ilicis* in typical Mediterranean climate when periodic dryness and hard conditions for biological activity at soil surface coexist with water availability in deep soil layers;
Mull dominates when the organic layers, accessible to earthworms, disappear rapidly replaced by well transformed organic matter, integrated in well structured, thick and rich in nutrients A horizon; the vegetation corresponds to *Lauro-Carpinetum betuli* or azonal *Carici remotae-Fraxinetum oxycarpae* woodlands.
Conclusion: The vegetation with the highest value of carbon stock was the humid woodlands dominated by *Fraxinus oxycarpa*, a relic forest occurring in the dune slacks, which gives an important contribute to the climate warming reduction.

KEYWORDS: MEDITERRANEAN ECOSYSTEM, CARBON STOCK, VEGETATION, HUMUS FORMS, GLOBAL WARMING

## STRONG NICHE CONSERVATISM OF CHASMOPHYTES AND THE CONSEQUENCES FOR HISTORICAL REMINISCENCES IN PRESENT DAY ROCK COMMUNITIES

ULRICH DEIL

UNIVERSITY OF FREIBURG, FACULTY OF BIOLOGY, DEPARTMENT OF GEOBOTANY, SCHAENZLESTRASSE 1, D-79104 FREIBURG

Evolutionary relationships between associated species and phylogenetic niche conservatism are intensively debated. Surprisingly, the role of habitats is rarely discussed in this context.

Since a long time, vegetation scientists consider rock habitats as evolutionary traps, as refugia for ancient lineages and as sites to survive climatic fluctuations. Reasons are some traits in chasmophytes (mostly stress tolerators respectively perennial stayers), and two ecological features of rocks, favouring relictic vegetation: 1) Mountain chains act as "sky islands", stimulating allopatric speciation and genetic drift. 2) The small scale environmental variability concerning exposure, inclination, water supply and soil depth can buffer macroclimatic changes by shifting to another microsite, a precondition for the existence of palaeoendemics on cliffs and the ancestral stock of the rock flora.

Molecular methods allow new insights into the phylogeny, phylogeography and history of plant communities. This presentation will apply results of such studies to three rock vegetation types from the Western Holarctic and Palaeotropical Kingdoms:

Palaeo- and neoendemics in rock communities of SW Arabia and the vicariance between the Eritreo-Arabian phytochorion and Macaronesia, a pattern dating back to the Upper Miocene and known as African Randflora

Cliffs and halve-caves with soaking water (*Adiantetea*) sheltering vicariant species of *Pinguicula*, *Primula* and *Hypericum* as remnants of a pluvial period

Grassland on limestone (*Caricetum firmae* s.l.) in the European Alps with local endemics, indicating ice-free refugia during the last glaciation by the occurrence of taxa with poor dispersal capacity.

Niche conservatism seems to play a major role in chasmophyte evolution. It results in an outstanding rate of stenochorous species and primitive taxa among saxicolous plants and in obvious examples for parallel evolution and synvicariism.

KEYWORDS: RELICTS, VICARIANCE, PHYLOGEOGRAPHY, ENDEMISM, HISTORICAL PATTERN

# ECOLOGICAL INDICATOR VALUES OF EUROPE (EIVE) 1.0: A POWERFUL OPEN-ACCESS TOOL FOR VEGETATION SCIENTISTS

JÜRGEN DENGLER[1,2], ELISABETH HÜLLBUSCH[1], CLAUDIA BITA-NICOLAE[3], MILAN CHYTRÝ[4], YAKIV P. DIDUKH[5], MARTIN DIEKMANN[6], HARTMUT DIERSCHKE[7], THORSTEN ENGLISCH[8], NIKOLAI ERMAKOV[9], HEIKE FELDHAAR[10], ANNA MARIA FOSAA[11], DIETER FRANK[12], FRANÇOIS GILLET[13,14], RICCARDO GUARINO[15], STEPHAN M. HENNEKENS[16], MARK O. HILL[17], SVEN D. JELASKA[18], BORJA JÍMÉNEZ-ALFARO[4], PHILIPPE JULVE[19], ZYGMUNT KĄCKI[20], GERHARD KARRER[21], MICHAEL P. NOBIS[22], WIM A. OZINGA[16,23], SANDRO PIGNATTI[24], THOMAS RAUS[25], MARCELA ŘEZNÍČKOVÁ[4], ESZTER RUPRECHT[26], URBAN ŠILC[27], MANUEL J. STEINBAUER[28], JEAN-PAUL THEURILLAT[29,30], LUBOMIR TICHÝ[4], FLORIAN JANSEN[31]

[1] PLANT ECOLOGY, BAYREUTH CENTER OF ECOLOGY AND ENVIRONMENTAL RESEARCH (BAYCEER), UNIVERSITY OF BAYREUTH, UNIVERSITÄTSSTR. 30, 95447 BAYREUTH, GERMANY
[2] SYNTHESIS CENTRE (SDIV), GERMAN CENTRE FOR INTEGRATIVE BIODIVERSITY RESEARCH (IDIV) HALLE-JENA-LEIPZIG, DEUTSCHER PLATZ 5E , 04103 LEIPZIG, GERMANY
[3] INSTITUTE OF BIOLOGY BUCHAREST, ROMANIAN ACADEMY, 296 SPL. INDEPENDENTEI, 060031 BUCHAREST, ROMANIA
[4] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLARSKA 2, 61137, BRNO, CZECH REPUBLIC
[5] DEPARTMENT OF GEOBOTANY AND ECOLOGY, M.G. KHOLODNY INSTITUTE OF BOTANY NATIONAL ACADEMY OF SCIENCE OF UKRAINE, 01004 KYIV, UKRAINE
[6] VEGETATION ECOLOGY AND CONSERVATION BIOLOGY, INSTITUTE OF ECOLOGY, FB 2, UNIVERSITY OF BREMEN, LEOBENER STR., 28359 BREMEN, GERMANY
[7] DEPARTMENT OF VEGETATION ANALYSIS AND PHYTODIVERSITY, ALBRECHT-VON-HALLER INSTITUTE FOR PLANT SCIENCES, UNIVERSITY OF GÖTTINGEN, UNTERE KARSPÜLE 2, 37073 GÖTTINGEN, GERMANY
[8] V-P-N BÜRO FÜR VEGETATIONSMONITORING, POPULATIONSÖKOLOGIE UND NATURSCHUTZFORSCHUNG, RUBIN-BITTMANN-PROMENADE 5/1/14, 1030 VIENNA, AUSTRIA
[9] LABORATORY OF ECOLOGY AND GEOBOTANY, CENTRAL SIBERIAN BOTANICAL GARDEN, RUSSIAN ACADEMY OF SCIENCE, SIBERIAN BRANCH, ZOLOTODOLINSKAYA STR., 101, 630090 NOVOSIBIRSK, RUSSIAN FEDERATION
[10] ANIMAL ECOLOGY I, BAYREUTH CENTER OF ECOLOGY AND ENVIRONMENTAL RESEARCH (BAYCEER), UNIVERSITY OF BAYREUTH, UNIVERSITÄTSSTR. 30, 95447 BAYREUTH, GERMANY
[11] DEPARTMENT OF BOTANY, FAROESE MUSEUM OF NATURAL HISTORY, V.U. HAMMERSHAIMBSGOETA 13, P.O. BOX 1155, 110 TORSHAVN, FAROE ISLANDS
[12] DEPARTMENT OF NATURE CONSERVATION, STATE AGENCY FOR ENVIRONMENTAL PROTECTION SAXONY-ANHALT, REIDEBURGER STRASSE 47, 06116 HALLE, GERMANY
[13] LABORATOIRE CHRONO-ENVIRONNEMENT, UMR CNRS 6249, UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ, 16 ROUTE DE GRAY, 25030 BESANÇON CEDEX, FRANCE
[14] LABORATORY OF ECOLOGICAL SYSTEMS, ECOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE, STATION 2, 1015 LAUSANNE, SWITZERLAND
[15] DEPT. STEBICEF, BOTANICAL UNIT, UNIVERSITY OF PALERMO, VIA ARCHIRAFI 38, 90134 PALERMO, ITALY
[16] ALTERRA, WAGENINGEN UR, DROEVENDAALSESTEEG 3, 6708 PB WAGENINGEN, NETHERLANDS
[17] 11 CHAUCER ROAD, CAMBRIDGE CB2 7EB, UNITED KINGDOM
[18] DEPARTMENT OF BIOLOGY, FACULTY OF SCIENCE, UNIVERSITY OF ZAGREB, MARULICEV TRG 20, 10000 ZAGREB, CROATIA
[19] LABORATOIRE ECOLOGIE ET BIODIVERSITÉ, FGES – UNIVERSITÉ CATHOLIQUE DE LILLE, 83 BOULEVARD VAUBAN, 59016 LILLE CEDEX, FRANCE
[20] DEPARTMENT OF VEGETATION ECOLOGY, INSTITUTE OF ENVIRONMENTAL BIOLOGY, UNIVERSITY OF WROCLAW, UL. KANONIA 6/8, 50-328 WROCLAW, POLAND
[21] INSTITUTE OF BOTANY, UNIVERSITY OF NATURAL RESOURCES AND LIFE SCIENCES, GREGOR MENDEL STR. 33, 1180 VIENNA, AUSTRIA
[22] SWISS FEDERAL RESEARCH INSTITUTE WSL, ZÜRICHERSTR. 111, 8903 BIRMENSDORF, SWITZERLAND
[23] EXPERIMENTAL PLANT ECOLOGY, INSTITUTE FOR WATER AND WETLAND RESEARCH, RADBOUD UNIVERSITY NIJMEGEN, 6500 GL NIJMEGEN, NETHERLANDS
[24] ORTO BOTANICO DELL'UNIVERSITÀ, LARGO CRISTINA DI SVEZIA 23, 00153, ROMA, ITALY
[25] BOTANIC GARDEN AND BOTANICAL MUSEUM BERLIN-DAHLEM (BGBM), FREIE UNIVERSITÄT BERLIN, KÖNIGIN-LUISE-STR. 6–8, 14195 BERLIN, , GERMANY
[26] HUNGARIAN DEPARTMENT OF BIOLOGY AND ECOLOGY, BABEŞ-BOLYAI UNIVERSITY, REPUBLICII STREET 42, CLUJ-NAPOCA, 400015, ROMANIA, ROMANIA
[27] ZRC SAZU, INSTITUTE OF BIOLOGY, NOVI TRG 2, 1000 LJUBLJANA, SLOVENIA

[28] SECTION ECOINFORMATICS & BIODIVERSITY, DEPARTMENT OF BIOSCIENCE, AARHUS UNIVERSITY, 8000 AARHUS, DENMARK
[29] FONDATION J.-M. AUBERT, C.P. 71, 1938 CHAMPEX-LAC, SWITZERLAND
[30] SECTION OF BIOLOGY, UNIVERSITY OF GENEVA, C. P. 60, 1292 CHAMBÉSY, SWITZERLAND
[31] LANDSCAPE ECOLOGY AND ECOSYSTEM DYNAMICS (LEED), INSTITUTE OF BOTANY AND LANDSCAPE ECOLOGY, UNIVERSITY OF GREIFSWALD, SOLDMANNSTR. 15, 17487 GREIFSWALD, GERMANY

Background: Ecological indicator values (EIVs) have a long tradition in vegetation ecological research in Europe. EIVs characterise the ecological optimum of species along major environmental gradients using ordinal scales. Calculating mean indicator values per plot is an effective way of bioindication. Following first systems in Russia and Central Europe, about two dozen EIV systems have been published for various parts of Europe.

Aims: As there was no EIV system available at European scale that could be used for broad-scale analyses, e.g. in the context of the European Vegetation Archive (EVA), we develop such a system for the first time for the vascular plants of Europe.

Methods: We compiled all national and major regional EIV systems and harmonized their plant nomenclature with a newly developed contemporary European taxonomic backbone (EuroSL 1.0). Using regression, we rescaled the individual EIV systems for the main parameters to continent-wide quasi-metric scales, ranging from 1 to 99. The data from each individual system were then translated into a probability curve approximated with a normal distribution, weighed with the logarithm of the area represented and summed up across the systems. From the European density curve we extracted then a mean and a variance, which characterise the distribution of this species along this particular ecological gradient.

Results and conclusions: Our consensus approach of integrating the expert knowledge of all existing EIV systems allowed deriving the first consistent description of the ecological behaviour for a significant part of the European vascular flora. The resulting Ecological Indicator Values of Europe (EIVE) 1.0 will be published open access to allow bioindication beyond country borders. Future releases of EIVE might contain more parameters, non-vascular plants and regionalisation or could be re-adjusted and extended to hitherto non-covered species through co-occurrence data from EVA.

KEYWORDS: BIOINDICATION, ELLENBERG INDICATOR VALUE, ECOINFORMATICS, ECOLOGICAL OPTIMUM, EUROPEAN VEGETATION ARCHIVE, SITE CONDITION, VEGETATION-PLOT DATABASE

## A COENOLOGICAL AND BIOGEOGRAPHICAL SURVEY ON THE ACIDOPHILOUS AND CHIONOPHILOUS HIGH-ALTITUDE GRASSLANDS OF THE APENNINES (PENINSULAR ITALY)

ROMEO DI PIETRO[1], MASSIMO TERZI[2], PAOLA FORTINI[3]

[1] DEPARTMENT OF PLANNING, DESIGN AND ARCHITECTURE TECHNOLOGY (SECTION ENVIRONMENT AND LANDSCAPE) SAPIENZA UNIVERSITY OF ROME.
[2] INSTITUTE OF BIOSCIENCE AND BIORESOURCES (IBBR), ITALIAN NATIONAL COUNCIL OF RESEARCH. VIA AMENDOLA 165/A, 70126 BARI, ITALY
[3] UNIVERSITY OF MOLISE, DIPARTIMENTO DI BIOSCIENZE E TERRITORIO (DIBT), PESCHE, IS, ITALY.

The high-altitude grasslands of the central Apennines were the topic of the first phytosociological studies on the Peninsular Italy mountains and were performed in the first decade of the 60ies. The majority of the names of the syntaxa used in that period were drown up from the syntaxonomical frameworks already known for the Alps and the Balkans. Subsequently new endemic associations and alliances were proposed. The new alliances linked to the vegetation of dry environments such as the limestone ridges, screes and cliffs (namely *Seslerion apenninae*, *Festucion dimorphae*, *Saxifragion lingulatae*) were characterized by a strong Apennines endemic component whereas the acidophilous grasslands showed a higher number of mesophilous species shared with the Alps and the C-Europe. The acidophilous grasslands of the northern Apennines, majorly developed on siliceous substrates and rich in boreal and arctic-alpine species, were immediately classified in the *Nardion strictae*. Different was the situation of the central and the southern Apennines, being these sectors almost completely composed of limestone substrates and majorly influenced by the Mediterranean climate. This led Bonin to propose the new endemic alliance *Ranunculo-Nardion*, in a first moment solely for the high-altitude acidophilous grasslands of the southern Apennines and subsequently for those of the central Apennines too. This proposal was shared by the majority of the authors who published later on this topic. The chionophilous and sub-acidophilous grassland communities occurring between the *Seslerion apenninae* and the *Ranunculo-Nardion*, however, remained for a long period in an undefined syntaxonomical position and were classified, depending on the case, as the "mesophilous fringe" of the *Seslerion apenninae*, the "xerophilous fringe" of the *Ranunculo-Nardion*, or in new endemic alliances (*Caricion kitaibelianae*, *Festucion violaceae,* and *Festucion macratherae*) created especially for them. The aim of this paper is to clarify the coenological, syntaxonomical and nomenclatural position of these grasslands and to discuss their role in a European syntaxonomical context.

KEYWORDS: APENNINES, BIOGEOGRAPHY, CHIONOPHILOUS GRASSLANDS, ICPN, *NARDUS*-RICH GRASSLANDS, NOMENCLATURE, SNOW-BEDS, SYNTAXONOMY

## CONSERVATION STATUS ASSESSMENT OF HABITAT TYPES IN GREECE: METHODOLOGICAL ASPECTS, IMPLEMENTATION AND RESULTS

PANAYOTIS DIMOPOULOS[1], FOTIOS XYSTRAKIS[1], IOANNIS TSIRIPIDIS[2], ERWIN BERGMEIER[3], PETROS GANATSAS[4], KYRIACOS GEORGHIOU[5], ATHANASIOS S. KALLIMANIS[1,2], MARIA PANITSA[1]

[1] FACULTY OF ENVIRONMENTAL AND NATURAL RESOURCES MANAGEMENT, UNIVERSITY OF PATRAS, G. SEFERI 2, GR-30100, AGRINIO
[2] DEPARTMENT OF BOTANY, SCHOOL OF BIOLOGY, ARISTOTLE UNIVERSITY OF THESSALONIKI, GR-54124 THESSALONIKI, GREECE
[3] DEPARTMENT OF VEGETATION AND PHYTODIVERSITY ANALYSIS, ALBRECHT VON HALLER INSTITUTE OF PLANT SCIENCES, UNIVERSITY OF GÖTTINGEN, UNTERE KARSPÜLE
[4] FACULTY OF FORESTRY AND NATURAL ENVIRONMENT, ARISTOTLE UNIVERSITY OF THESSALONIKI, GR-54124 THESSALONIKI, GREECE
[5] FACULTY OF BIOLOGY, DEPARTMENT OF BOTANY, NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, PANEPISTIMIOPOLIS, GR-15784, ATHENS, GREECE

Question: Conservation status assessment of habitats of the Council's Directive 92/43/EEC in Greece.

Location: Greece, Sites of Community Importance (SCI) and locations outside the NATURA 2000 network.

Methods: More than 9000 plots have been sampled in Sites of Community Importance (SCI) and at locations outside the NATURA 2000 network. The assessment, at the plot level, was based on variables-criteria expressing the completeness and status of (i) structure and functions (including typical species), as well as (ii) the future trend and (iii) the future status of the habitat's structures and functions. Moreover, in the assessment process, the actual status, the future trend and the future status of the habitat area of occupancy per SCI was assessed for its sufficiency to allow for the habitat's mid-term conservation. Quantitative algorithms were applied in order to combine the sub-criteria for the final assessment of the conservation status at different spatial scales: (i) plot, (ii) reference European Environmental Agency (EEA) 10x10 km grid cell, (iii) SCI and (iv) national. The weight of the sub-criteria in the final output of the assessment of the conservation status is explored by means of MCAnalysis and the effectiveness of the methodological approach is evaluated. Finally, the spatial patterns of pressures/threats for selected habitats and habitat categories are investigated

Results-Conclusions: The outcome of the assessment is presented here, emphasizing at the priority habitat types. The analyses showed that the use of the algorithms succeeded to reduce the effect of subjective expert judgment and that the status and completeness of structure & functions (including typical species) played the major role in the assessment of the conservation status at the plot level. Moreover, complex spatial patterns of the intensity of pressure and threats have been revealed at the national level, when the complete data set is included in the analysis.

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KEYWORDS: PRESSURES AND THREATS, NATURA 2000, EVALUATION CRITERIA, SPATIAL PATTERN

## HABITAT COMPLEXES, A NEGLECTED PART OF THE EUNIS HABITATS CLASSIFICATION?

DOUGLAS EVANS

EUROPEAN TOPIC CENTRE ON BIOLOGICAL DIVERSITY

The EUNIS habitats classification is a hierarchical classification aimed to cover all habitats in Europe and has been developed since 1995 by the European Topic Centre on Biological Diversity and its predecessors. The first level of the classification has 10 groups of habitats together with 'X Habitat complexes'. Group X currently contains 30 'habitat complexes' although there are also some habitats which are complexes but not listed under 'X' such as 'D3.2 Aapa mires'.

Although this section has been present since the earliest editions of the classification it is poorly documented and other than mentions in descriptions of individual habitats, the only definition available is "At the larger scale, habitats can be grouped as 'habitat complexes', which are frequently-occurring combinations or mosaics of individual habitat types, usually occupying at least 10 ha, which may be inter-dependent. Estuaries, combining tidal water, mud flats, saltmarshes and other littoral habitats, are a good example" in Davies, Hill & Moss (2004).

Many habitats listed on Annex I of the EU Habitats Directive are landscapes rather than habitats *sensu stricto*, some are recognised as habitat complexes in EUNIS, for example estuaries, but many are not. These habitats could be better described by new habitat complexes than by the existing crosswalks. For example several river habitats are currently linked to their bankside vegetation with no mention of the waterbody itself. Similarly, some geoseries or catena may also be treated as habitat complexes.

As the classification is now being revised, a re-examination of this section is required and some clear criteria for recognising habitat complexes are needed. It is proposed that such criteria should make reference to scale and repeated patterns of distribution.

Davies, C. E., Moss, D., & Hill, M. O. (2004). EUNIS habitat classification revised 2004.

KEYWORDS: HABITAT COMPLEXES, HABITATS DIRECTIVE, NATURA 2000

## CONTRIBUTION OF LEGACY VEGETATION DATA TO NATURA 2000 MANAGEMENT PLANNING: CASE STUDY IN MOUNTAIN FORESTS OF THE BAVARIAN ALPS (GERMANY)

JÖRG EWALD[1], BARBARA MICHLER[1]

[1] FACULTY OF FORESTRY, HOCHSCHULE WEIHENSTEPHAN–TRIESDORF, UNIVERSITY OF APPLIED SCIENCES

Management planning and mapping of NATURA 2000 sites in the Alpine region is time-consuming and cost-intensive. Thus, 155,000 ha (37%) of the Bavarian Alps, two thirds covered by forest, have been designated. To support the planning process, 5,781 vegetation plots from the databases BERGWALD (GIVD EU-DE-002) and WINALP-Ecobase (EU-DE-003) were subjected to standardised analysis.

The following research questions had been raised by planners: How many forest plots are available for single N2000 sites? Does tree and understorey composition of plots meet the definitions of NATURA2000 habitat types? Which habitat types occur in specific N2000 sites? What is the gamma- (number of habitat types) and beta-diversity (species turnover within types) of N2000 sites? Which types harbour endangered plant species?

To achieve these goals, forest plots were separated from open habitats and assigned to N2000 sites by GIS. Expert knowledge, numerical ordination and classification were used to group plots and assign them to habitat types. Rarefaction was used to compare species richness of habitat types and NATURA 2000 sites.

As a result, 1,505 plots were assigned to 19 forest habitat types and 44 N2000-sites. The crucial role of analysing vegetation plots is illustrated by the example of interpreting habitat type 9140 "Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*" for which formal criteria of tree and herb layer composition were evaluated and specified.

Legacy vegetation data support management planning in providing detailed information on species and tree layer composition, which allows objective assignment. However, such procedures require access to plot databases and considerable analytical expertise.

KEYWORDS: CONSERVATION PLANNING, HABITAT TYPES, VEGETATION DATABASES

## VEGETATION SERIES OF SHEBENIK-JABLLANICË NATIONAL PARK (ALBANIA)

GIULIANO FANELLI[1], MICHELE DE SANCTIS[1], ERMELINDA GJETA[2], ALFRED MULLAJ[3], FABIO ATTORRE[1]

[1] "SAPIENZA" UNIVERSITY OF ROME (ITALY)
[2] UNIVERSITY "ALEKSANDER XHUVANI" OF ELBASAN (ALBANIA)
[3] UNIVERSITY OF TIRANA (ALBANIA)

Aims: In the frame of the IUCN project "Institutional Support to the Albanian Ministry of Environment, Forest and Water Administration for Sustainable Biodiversity Conservation and Use in Protected Areas" funded by the Italian Development Conservation the vegetation of the Shebenik-Jabllanicë National Park (SJNP) has been investigated.

Location: SJNP extends for 33.928 ha along the border with Macedonia. The biodiversity of the SJNP is a complex and dynamic result of several factors: the wide altitudinal range (300-2200m), and the land use that, combined with a high geological heterogeneity, topographical and climatic diversity, have determined a high diversity of vegetation communities.

Methods: To analyse this vegetation, we carried out 321 phytosociological relevés in May-August in 2012-2013. They were entered into a Turboveg database and analysed through multivariate technique using R.

Results: The analyses of the relevés allowed the identification of 73 plant communities grouped into 17 vegetation series. The vegetation series are correlated with altitudinal belt, aspect and geology. Among these interesting vegetation communities, most important habitat are serpentinicolous vegetation (*Sedum serpentini*, *Festucopsis serpentini*), Balkan *Sesleria coerulans* grasslands (*Alkanna scardica*, *Bornmuellera baldacci*, *Lilium albanicum*), alpine and oro-mediterranean heaths (*Genista hassertiana*, *Astragalus sirinicus*) *Pinus peuce* Balkanic woodlands, bogs (*Narthecium scardicum*, *Pinguicola albanica*) casmophytic communities on limestone peaks (*Moltkia petraea, Ramonda serbica*). Apart from these interesting communities, the diversity of woodland vegetation is striking, with, for instance 4 communities dominated by *Fagus sylvatica*. This high diversity of forest vegetation is comparable to that of the well studied Durmitor massif, which lies not far from the SJNP. Using all these information and through the photo interpretation we also realised a vegetation and habitat map of this area.

KEYWORDS: ALBANIA, MOUNTAINS, PHYTOSOCIOLOGY, VEGETATION MAPPING, VEGETATION SERIES

## ORGANIZATION AND METHODOLOGICAL PRINCIPLES FOR UPDATING THE INTERPRETATIONS OF THE HABITATS OF COMMUNITY INTEREST IN FRANCE

VINCENT GAUDILLAT

NATIONAL MUSEUM OF NATURAL HISTORY, SERVICE DU PATRIMOINE NATUREL, 36 RUE GEOFFROY SAINT-HILAIRE, CP 41, 75231 PARIS CEDEX 05, FRANCE

In the framework of implementation of the EU Habitats Directive, the French interpretation manuals "Cahiers d'habitats" were published (Bensettiti et al., 2001-2005). Their principal goal was to describe habitats of Community interest present in France. After more than 10 years of use and thanks to improved knowledge, we observed that many definitions of habitats are ambiguous or incomplete and therefore have to be clarified.

Thus, the French Ministry of Ecology entrusted the National Museum of Natural History with coordination of a national working group which mission is to update interpretation of terrestrial Habitats of Community interest. The group is composed of experts from all regions of France and of specialists on certain types of vegetation. These are mainly experts of the "Conservatoires Botaniques Nationaux" or researchers.

Problems related to interpretation have been identified for 89 among 129 vegetated habitats occurring in France (69%). These concern for example:

ambiguous definitions of some habitats in the Interpretation Manual of European Union Habitats EUR 28;

the variability of spatial scale of habitats;

overlapping habitats;

the differences in interpretation with neighbouring countries.

At the end of 2015, 60% of issues had been discussed and updated habitat interpretation had been proposed. Despite the heterogeneity of cases several methodological principles have been set up to tackle different aspects of the interpretation of habitats. Beside this work, the list of syntaxa characterizing each habitat is reviewed in the framework of program Prodrome of French vegetation (Bioret et al., 2013).

KEYWORDS: FRANCE, HABITATS DIRECTIVE, NATURA 2000

## RE-VISITING HISTORICAL SEMI-NATURAL GRASSLANDS TO ASSESS SHIFTS IN SPECIES COMPOSITION AND FUNCTIONAL TRAITS AND THEIR DRIVERS

ELEONORA GIARRIZZO[1], SABINA BURRASCANO[1], TOMMASO CHITI[2], FRANCESCO DE BELLO[3,4], JAN LEPS[3], LAURA ZAVATTERO[1], CARLO BLASI[1]

[1] DEPARTMENT OF ENVIRONMENTAL BIOLOGY, SAPIENZA UNIVERSITY OF ROME, ITALY
[2] DEPARTMENT FOR INNOVATION IN BIOLOGICAL, AGRO-FOOD AND FOREST SYSTEM (DIBAF), UNIVERSITY OF TUSCIA, ITALY
[3] DEPARTMENT OF BOTANY, UNIVERSITY OF SOUTH BOHEMIA, CZECH REPUBLIC
[4] INSTITUTE OF BOTANY, CZECH ACADEMY OF SCIENCES, CZECH REPUBLIC

Questions: To which extent semi-natural grassland plant species composition and functional traits changed in the last decades? Which are the main directions of change? Which environmental, management, and landscape features have determined these changes?
Location: Apennine chain, Italy.
Methods: In 2013-2014, we used a stratified random sampling design to revisit 132 semi-natural grasslands originally sampled between 1966 and 1992. The original plots were associated with detailed vegetation maps but their exact location was not available. Plots were divided in 17 groups based on study area and original community type. The extent of change in species composition and functional traits were estimated comparing each new plot with the species pool of the corresponding historical group. Species composition changes were calculated using Bray-Curtis coefficient, and shifts in functional traits were quantified as the differences in CWMs. These measures were used as response variables in mixed effects models including climate, topography, management and landscape metrics as explanatory variables.
Results: The greatest changes occurred in sites at low altitude, which had low slope values and a thick soil organic horizon. Functional traits shifted widely also in relation to management patterns, indeed grazing intensity was negatively related to the abundance of woody species. Whereas, a great abundance of species associated with frequent grazing disturbance was found at sites with higher values of soil salinity.
Conclusions: Apennine semi-natural grasslands have undergone substantial changes in species composition and functional traits during the last decades, either shifting towards woody communities or facing an increase in ruderal species. Through our work, we demonstrated the strength of re-visitation studies in detecting past vegetation changes, especially if they are associated with functional traits.

KEYWORDS: *BROMUS ERECTUS*, CALCAREOUS GRASSLANDS, HABITATS DIRECTIVE, HABITAT 6210(*), MULTI-TEMPORAL ANALYSIS, VEGETATION DYNAMICS

## MEDITERRANEAN WOODY SPECIES: ECOLOGY, POTENTIAL DISTRIBUTIONS AND VEGETATION PATTERNS

FLORIAN GOEDECKE[1], RALF JAHN[2], ERWIN BERGMEIER[1]

[1] ALBRECHT VON HALLER INSTITUTE OF PLANT SCIENCES, UNIVERSITY OF GÖTTINGEN, UNTERE KARSPÜLE 2, 37073 GOETTINGEN, GERMANY
[2] RÖSCHENHÖHE 8, 09603 GROßSCHIRMA, GERMANY

Questions: Precise species location data together with map-like datasets provide a sound basis for i) a revision of ecological characterisations and ii) for species distribution modelling. We ask the following: Which are the most important abiotic site conditions for woody species in the study area? Are similar requirements of species reflected in similar distribution patterns? How much do mapped vegetation units containing woody species match with the potential species distributions?
Location: The South Aegean island of Kriti (Crete).
Methods: A dataset of about 9800 precise coordinates of 46 woody species was used to extract site-based information on several abiotic parameters (geology, climate, geomorphology, etc.) in a Geographic Information System. The MaxEnt algorithm was used for the prediction of species distribution. The extent of mapped woody vegetation polygons in selected survey regions is compared with modelling data.
Results: For the Mediterranean woody species we display ecological profiles for the relevant abiotic factors, showing the variation of sites; ecologically similar species and abiotic correlations are highlighted. Results underline that many rare species are linked to harsh site conditions expressed in extreme values of i.e. annual mean temperature, heatload or topographic wetness index. Modelled potential distribution maps show realistic probabilities for species occurences in known areas. The maps predict a now validated population for the endemic tree *Zelkova abelicea*. Comparisons of mapped woody vegetation and modelled distributions reveal a good overlap and thus endorse the models.
Conclusion: A new quality of ecological niche spectra for Mediterranean woody species is presented. Results of species distribution mapping show clear patterns in accordance with expert knowledge, own field experience and field surveys.

KEYWORDS: SPECIES ECOLOGY, SITE CONDITIONS, ECOLOGICAL NICHE, SPECIES DISTRIBUTION MODELLING

## FOREST COMMUNITIES OF THE ARGÖZÜ VALLEY IN KIBRISCIK, BOLU (TURKEY)

NEVAL GÜNEŞ ÖZKAN[1], NECMI AKSOY[1], SÜLEYMAN ÇOBAN[2], SERDAR ASLAN[1]

[1] DUZCE UNIVERSITY, FACULTY OF FORESTRY, DEPARTMENT OF FOREST BOTANY, BECIYORUKLER, DUZCE, TURKEY
[2] ISTANBUL UNIVERSITY, FACULTY OF FORESTRY, DEPARTMENT OF SYLVICULTURE, BAHÇEKÖY, İSTANBUL, TURKEY

The object of this study is to analyse the forest vegetation of Argözü Valley in Kıbrıscık, Bolu (Turkey). Argözü Valley is situated on the southern slopes of Köroğlu Mountains. The research area is in Euxine province of Euro-Siberian Region. Volcanic with andesite characteristic rocks occur in the area. The climate of the region changes from less rainy Mediterranean to rainy Mediterranean type. Annual precipitation varies from 700 mm to 1200 mm depending on altitudinal zones and mean annual temperature is 11°C.

In this study, a total of 103 sample plots were taken from forest vegetation of the study area. Vegetation data were classified using TWINSPAN (Hill, 1979) under JUICE software and indirect ordination analysis were applied to the data.

As a result of classification and ordination following classification scheme was proposed:

QUERCO-FAGEA Fukarek-Fabijanik 1968
QUERCETEA PUBESCENTIS Doing Kraft ex Scamoni & H.Passarge 1959
QUERCO CERRIDIS-CARPINETALIA ORIENTALIS Akman, Barbero & Quezel 1980
CARPINO BETULI-ACERION HYRCANI Quezel, Barbero & Akman 1978
*Doronico orientale-Pinetum sylvestre*
*Abieto-Pinetum sylvestri*
QUERCION ANATOLICAE Akman, Barbero & Quezel 1979
*Querco-Pinetum*
*Juniperus oxycedrus-Pinetum nigrae*

Forest communities in the region are important in terms of endemic species they contain. On the other hand, transhumance and grazing activities are potential threats for these species. Forest communities with high endemism rate must be protected.

This study was supported by Scientific Research Project Coordination Unit of Duzce University, Project number: DÜBAP2012.02.02.117.

KEYWORDS: FOREST COMMUNITIES, ARGÖZÜ VALLEY (KIBRISCIK- BOLU- TÜRKIYE)

## HABITAT CONSERVATION STATUS: SCALE, REFERENCE AND PARAMETERS MATTER! A CASE STUDY CASE FROM ATLANTIC MARSHLANDS

PAULINE HERBERT[1], ANNE BONIS[1], NICOLAS ROSSIGNOL[1], JAN-BERNARD BOUZILLÉ[1]

[1] UMR ECOBIO, CNRS-UNIVERSITÉ RENNES I, OSU RENNES

Background and Question: Habitats conservation status needs to be evaluated and regularly reported to the European community. However, European guidelines remain poorly operational and thereafter large contrasts regarding methods, scale, data used and criteria exit amongst authors and countries, prevent efficient comparisons. The question also holds for the evaluation of management plans in protected areas. Regarding the criteria used to assess the conservation status of a habitat, it is now well recognized that species diversity is only one amongst several issues for conservation. However, how and how far the species richness or patrimonial values are related to other services is still poorly documented.

Location: These two questions have been addressed considering wet grasslands spread all along the French Atlantic coast. Subtle variations in elevation drive flooding regime and grazing may print heterogeneity within plant homogeneous units.

Methods: Facing such important issues, we developed a first investigation on how the spatial scale chosen for describing the habitats, and any related plant community diversity or/and heterogeneity, will impact the evaluation of the habitats. The typology (EUNIS, Natura 2000) used to approach vegetation diversity will also been discussed.

Result: We found that fine-grained spatial diversity in plant communities, i.e. heterogeneity, is of upmost importance for the species diversity and other conservation quality criteria (landscape quality and occurrence of hygrophilous species). This is only poorly accounted for by available Natura 2000 and EUNIS habitats' typology. The conservation status may change with the criteria which is considered and argued in favor of multi-parameters assessments taken into account a variety of ecosystem services. This work is also the opportunity to consider the reference data to which actual observations may be compare; the observed limitations bring strong support for up-dated national and European vegetation classification based on numerical analysis and large data set.

KEYWORDS: EVALUATION, CONSERVATION, HETEROGENEITY, DIVERSITY, ECOSYSTEM SERVICES

## ENDEMIC PLANTS IN RED LIST HABITATS OF EUROPE - ASSESSMENT AND FIRST RESULTS

CARSTEN HOBOHM[1], JAN JANSEN[2], ANIKA ZIEMER[1], JOOP SCHAMINEÉ[3], JOHN JANSSEN[3]

[1] UNIVERSITY OF FLENSBURG, D-24943 GERMANY
[2] PAN EN DEMETER ECOLOGISCH ADVIES, JONAGOLDSTRAAT 27, NL – 6515EM NIJMEGEN, THE NETHERLANDS
[3] ALTERRA WAGENINGEN PO BOX 47, 6700AA WAGENINGEN, THE NETHERLANDS

Question: Information about endemic species is an important tool in environmental policy. We are organizing a new database on endemic vascular plant species occurring in Red List habitats of Europe (Evaplant.E.Redlist). How can we use this database to support landscape and nature conservation management?

Location: Europe

Methods: We use international and national floras, web information and expert knowledge of the Red List project. For every taxon of a habitat type we estimate the range size; we distinguish taxa with a range smaller than 25,000 km$^2$, taxa that are endemic to the European Union (28 plus; including Norway, Switzerland etc.), taxa that are restricted to whole Europe, and non-endemics.

Results: The database comprises more than 10,500 taxon-habitat relationships. We analyse which and how many endemics appear in one, two or more habitat types. We can show in which regions and habitats endemic taxa are concentrated. We can compare distribution patterns of habitats and characteristic species. A secondary effect of our work is a calibration of the taxonomy. Botanists from many countries in Europe use different taxonomies. We identify synonymies, difficulties and contradictions of modern taxonomies across Europe.

Conclusion: Evaplant.E.Redlist can be used as a tool for information about endemic and non-endemic vascular plants in rare and threatened habitats of Europe. The analyses of the database might emphasize the meaning of endemism, increase the knowledge of the biogeography of endemic plants, and give additional information about habitats of the new European Red List.

KEYWORDS: ENDEMIC PLANTS, HABITATS, EUROPE, DATABASE

## COASTAL DUNE VEGETATION OF GEORGIA (THE CAUCASUS)

DMYTRO IAKUSHENKO[1], IZOLDA MATCHUTADZE[2], ALLA TOKARYUK[3], VOLODYMYR SOLOMAKHA[4], BULVULI BOLQVADZE[5]

[1] DEPARTMENT OF BOTANY AND ECOLOGY, FACULTY OF BIOLOGICAL SCIENCES, UNIVERSITY OF ZIELONA GÓRA, ZIELONA GÓRA, POLAND
[2] DEPARTMENT OF KOLKHETI MIRE AND WATER ECOSYSTEM CONSERVATION DEPARTMENT, INSTITUTE OF PHYTOPATHOLOGY AND BIOLOGY, BATUMI SHOTA RUSTAVELI STATE UNIVERSITY, BATUMI, GEORGIA
[3] DEPARTMENT OF BOTANY, YURIY FEDKOVYCH CHERNIVTSI NATIONAL UNIVERSITY, CHERNIVTSI, UKRAINE
[4] DEPARTMENT OF BOTANY, EDUCATIONAL AND SCIENTIFIC CENTRE «INSTITUTE OF BIOLOGY», TARAS SHEVCHENKO NATIONAL UNIVERSITY OF KYIV, KYIV, UKRAINE
[5] FACULTY OF NATURAL SCIENCES AND HEALTHY, BATUMI SHOTA RUSTAVELI STATE UNIVERSITY, BATUMI, GEORGIA

Aim: The coastal vegetation of Georgia has not previously been studied according to Braun-Blanquet approach. The aim of this research is to study the structure, species composition and diversity patterns of coastal plant communities, and to develop a phytosociological classification of the coastal dune and shoreline vegetation in the region.

Location and Methods: More than 50 phytosociological relevès were carried out and 3 transects were described in four sites (Anaklia, Kulevi, Poti, and Kobuleti) on the Black Sea coast of Georgia (the South Caucasus) in early July, 2015. TWINSPAN classification and Detrended Correspondence Analysis (DCA) were used for communities and main ecological patterns identification.

Results: Along a sequence on shores and dunes, 3 habitat types have been identified: 1) strands with annuals (*Cakile maritima* ssp. *euxina*, *Salsola tragus* etc.), 2) shifting coastal dunes with rhizomatous grasses (*Leymus racemosus* subsp. *sabulosus*), and 3) fixed coastal dunes dominated by perennial dicots (*Silene euxina*, *Cota tinctoria* ssp. *euxina*, *Stachys maritima* etc.). A syntaxonomical scheme of the coastal plant communities is proposed. Three plant associations of three classes (*Cakiletea maritimae* Tx. et Preising in Tx. ex Oberd. 1952, *Ammophiletea* Br.-Bl. et Tx. ex Westhoff et al. 1946, *Helichryso-Crucianelletea maritimae* Géhu et al. in Sissingh 1974) have been determined. Diagnostic species, distribution and ecological features of the coastal plant communities are discussed. The main threats caused by human activities are analyzed. Special attention is paid to the spread of the highly invasive species (*Cenchrus longispinus*, *Ambrosia artemisiifolia*, *Vitex rotundifolia* etc.).

Conclusion: The results obtained should improve the knowledge of coastal dune vegetation in the Black Sea and Mediterranean contexts.

KEYWORDS: COASTAL DUNES, VEGETATION, HABITATS, CLASSIFICATION, SYNTAXONOMY, INVASIVE SPECIES, BLACK SEA, GEORGIA

## HIERARCHICAL EXPERT SYSTEM FOR CLASSIFICATION OF THE CARPATHIAN AND PANNONIAN ROCKY STEPPES

MONIKA JANIŠOVÁ[1], MILAN CHYTRÝ[2], WOLFGANG WILLNER[3], GHEORGHE COLDEA[4], NORBERT BAUER[5], AND DATA CONTRIBUTORS

[1] INSTITUTE OF BOTANY, SLOVAK ACADEMY OF SCIENCES, ĎUMBIERSKA 1, SK-974 11 BANSKÁ BYSTICA, SLOVAKIA
[2] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, CZ-611 37 BRNO, CZECH REPUBLIC
[3] DEPARTMENT OF BOTANY AND BIODIVERSITY RESEARCH, UNIVERSITY OF VIENNA, RENNWEG 14, 1030 VIENNA, AUSTRIA
[4] INSTITUTUL DE CERCETĂRI BIOLOGICE CLUJ, STR. REPUBLICII 48, RO-400015 CLUJ-NAPOCA, ROMANIA
[5] DEPARTMENT OF BOTANY, HUNGARIAN NATURAL HISTORY MUSEUM, BAROSS U. 13, 1088 BUDAPEST, HUNGARY

Aims: To develop an electronic expert system for explicit identification of rocky steppes of the *Stipo pulcherrimae-Festucetalia* pallentis order at three hierarchical levels (association, alliance and order).

Location: Carpathian Mts, Pannonian Basin, and adjacent regions within ten countries (Austria, Czech Republic, Hungary, Poland, Croatia, Serbia, Romania, Slovakia, Slovenia, Ukraine)

Methods: A joint database containing 40,077 relevés of all grassland communities in the study area was used to select the target communities and typical relevés of individual associations. All associations and alliances traditionally classified within the *Stipo-Festucetalia* order were revised. New associations were searched for using semi-supervised K-means clustering. The approved syntaxa were reproduced by formal definitions based on species composition and cover.

Results: Out of 73 associations recognized in national surveys and by local experts 39 were approved and formally defined, which is 53%. Semi-supervised clustering did not contribute any new cluster to the resulting classification. The analyses confirmed eligibility of seven out of eight alliances classified traditionally within the studied order. Formal definitions were formulated also for the alliances and the *Stipo-Festucetalia* order. In total, 92% of the *Stipo-Festucetalia* relevés matched a definition of one of the seven orders and 47% of these relevés matched also at least one of the association definitions. Diagnostic species and distribution maps for all syntaxa were provided.

Conclusions: The developed expert system is a helpful tool in both grassland research and nature conservation. It can be further developed mainly by addition of data from the neighboring or less investigated regions.

Financial support: Grant VEGA 02/0027/15.

KEYWORDS: CLASSIFICATION, EXPERT SYSTEM, *STIPO PULCHERRIMAE-FESTUCETALIA PALLENTIS*, CARPATHIAN MTS, PANNONIAN BASIN

## MODELING VEGETATION TYPES IN EUROPE AT THE LAST GLACIAL MAXIMUM USING MODERN ANALOGUES FROM SIBERIA

VERONIKA JANSKÁ[1], BORJA JIMÉNEZ-ALFARO[2], MILAN CHYTRÝ[2], JAN DIVÍŠEK[1,2], OLEG ANENKHONOV[3], ANDREY KOROLYUK[4], NIKOLAI LASHCHINSKYI[5], MARTIN CULEK[1]

[1] DEPARTMENT OF GEOGRAPHY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, CZ-611 37 BRNO, CZECH REPUBLIC
[2] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, CZ-611 37 BRNO, CZECH REPUBLIC
[3] INSTITUTE OF GENERAL AND EXPERIMENTAL BIOLOGY, SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES, SAKHYANOVOY 6, RU-70047 ULAN-UDE, RUSSIA
[4] INSTITUTE OF GENERAL AND EXPERIMENTAL BIOLOGY, SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES, SAKHYANOVOY 6, RU-70047 ULAN-UDE, RUSSIA
[5] CENTRAL SIBERIAN BOTANICAL GARDEN, SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES, ZOLOTODOLINSKYA 101, RU-630090 NOVOSIBIRSK, RUSSIA

Questions: We test the ability of palaeoecological modeling for assessing the distribution of European vegetation during the Last Glacial Maximum (LGM) using occurrence data from Siberia, a region supposed to be a partial modern analogue of European glacial climates.

Location: Europe and Siberia

Methods: We use maximum entropy modelling to calibrate distribution models with 6 274 vegetation-plot records surveyed in Siberia and assigned to 22 vegetation types, and six bioclimatic variables at 4 km x 4 km grid resolution. The models with good performance according to statistical validation and expert-based evaluation were projected to the climatic conditions of Europe at the LGM.

Results: Distribution models for 18 vegetation types performed well in current Siberia. The patterns of paleoclimatic projections showed coincidences but also disagreements with the reconstructions based on pollen records and dynamic vegetation models. The most accurate models were provided for eastern and central Europe, while the models for western and southern Europe were only reliable for wetlands and steppe vegetation, respectively.

Conclusion: Although our results support the existence of climatic analogues between current Siberia and the LGM in Europe, modelling vegetation types in the warmest and wettest regions of LGM Europe would require using other regions as modern analogues. By considering the uncertainties of palaeovegetation distribution modeling, we demonstrate how this approach can add a value to the reconstruction of vegetation in the LGM.

KEYWORDS: EUROPE, LAST GLACIAL MAXIMUM, MODERN ANALOGUES, PALAEOECOLOGICAL RECONSTRUCTIONS, SPECIES DISTRIBUTION MODELLING

## RED LIST OF EUROPEAN HABITATS: PRELIMINARY RESULTS FOR TERRESTRIAL AND FRESHWATER HABITATS

JOHN JANSSEN[1], JOHN RODWELL[2], ANA NIETO, FLAVIA LANDUCCI, JAVIER LOIDI, AXEL SSYMANK, TEEMU TAHVANAINEN, MARCOS VALDERRABANO, ALICIA ACOSTA, MORA ARONSSON, GERTIE ARTS, FABIO ATTORRE, FRÉDÉRIC BIORET, RIENK-JAN BIJLSMA, CLAUDIA BIȚĂ-NICOLAE, JORGE CAPELO, ANDRAŽ ČARNI, MILAN CHYTRÝ, JÜRGEN DENGLER, PANAYOTIS DIMOPOULOS, FRANZ ESSL, HANS GARDFJELL, DANIELA GIGANTE, GIAMPIETRO GIUSSO DEL GALDO, MICHAL HAJEK, IDOIA BIURRUN, FLORIAN JANSEN, JAN JANSEN, ALEXIS MICKOLAJCZAK, JOSE MOLINA, ZSOLT MOLNAR, DAVID PATERNOSTER, AGNIESZKA PIERIK, BRIGITTE POULIN, BENOIT RENAUX, JOOP SCHAMINÉE, HEIKKI TOIVONEN, TIINA TONTERI, ROSSEN TZONEV, MILAN VALACHOVIČ, AND MANY MORE

[1] ALTERRA WAGENINGEN UR, P.O.BOX 47, 6700 AA WAGENINGEN NL, E-MAIL: JOHN.JANSSEN@WUR.NL
[2] ECOLOGICAL CONSULTANT, 7 DERWENT ROAD, LANCASTER, LA1 3ES, UNITED KINGDOM, UK, E-MAIL: JOHNRODWELL@TISCALI.CO.UK

In this presentation an overview is given on the European Red List of Habitats project that has been carried out during the last 2.5 year on behalf of the European Commission DG Environment. The project aims at providing a Red List assessment of all natural and semi-natural terrestrial, freshwater and marine habitats in the EU28 and beyond. The presentation is focused on terrestrial and freshwater habitats. The followed approach will be explained, including the applied typology (based on EUNIS), criteria and categories (based on IUCN guidelines), data sources and the organisation in seven expert groups (coastal habitats, freshwater types, mires and bogs, grasslands, heathland and scrub, forests, and sparsely vegetated habitats). In total for 235 terrestrial and freshwater habitats a red list assessment is carried out. An overview of preliminary results will be shown, and problems during the process will be discussed. The potential application of the Red List, also in relation to Annex 1 habitat types of the Habitats Directive, will be indicated.

KEYWORDS: BIODIVERSITY, EUROPE, NATURE CONSERVATION, RED LIST, HABITATS

## PREDICTIONS OF PRIMARY SUCCESSION PATHWAYS ON ALLUVIAL SEDIMENTS – POSSIBILITIES AND LIMITATIONS

MITJA KALIGARIČ[1], MAŠA IGNJATOVIĆ[1], DANI IVAJNŠIČ[2], SONJA ŠKORNIK[1]

[1] UNIVERSITY OF MARIBOR SLOMŠKOV TRG 15 2000 MARIBOR
[2] ECOLOGICAL ENGENEERING INSTITUTE LJUBLJANSKA 9 2000 MARIBOR

Aims: To document the spatiotemporal patterns of primary succession, based on 11 temporal windows from 1983 until 2014.
To illustrate the development of plant communities and the velocity and direction of spatial changes throughout the primary succession.
To verify the prediction model of the succession on the basis of the trends in the first fifteen years of succession.
Location: Alluvial stream deposits on an artificial Ledava Lake (Slovenia)
Methods: Vegetation mapping, spatial statistics in ArcGIS
Results: In 34 years, a pristine white-willow riparian forest developed. One half of the initially aquatic habitat became terrestrial, covered with different vegetation types. The frequency of change, studied on 11250 quadrats 10x10 m each (on a scale from "no change" to 8 changes) and the mean of change per habitat type (most of the habitats changed 2 to 3 times) revealed only one successional trajectory and deterministic pathway of succession. The "time since formation" of a terrestrial habitat shows that more than 20% of the lake was terrestrialised within in the first ten years. After twenty years of succession the terrestrialisation slowed down substantially and succession almost stopped down. If prediction models are made on the basis of trends during the first fifteen years of succession, the result of the model mismatch completely with the current situation.
Conclusion: The retrograde reconstruction of the successional pathways enabled us to verify the prediction models and to reveal limitations and traps of vegetation modelling of successional pathways, if all the environmental parameters are not all fully considered.

KEYWORDS: PRIMARY SUCCESSION, *SALICION ALBAE*, ALLUVIAL DEPOSITS, VEGETATION MODELLING

## AN OVERVIEW OF THE EUROPEAN GRAVEL BAR VEGETATION

VERONIKA KALNÍKOVÁ[1], MILAN CHYTRÝ[1], AND DATA CONTRIBUTORS

[1] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, CZ-61137 BRNO, CZECH REPUBLIC. E-MAIL: V.KALNIKOVA@SEZNAM.CZ, CHYTRY@SCI.MUNI.CZ

Vegetation surveys and vegetation classification have a long history in Europe but their results are inconsistent among countries. There are vegetation types which have been studied less than others and this is the case of the gravel bar vegetation. The gravel bars are features of braided rivers and are common along streams in temperate piedmont and mountain-valley areas of young and easily eroding mountains. The unique gravel-bar habitats with typical vegetation are found across the whole of Europe.

The aim of this EVA (European Vegetation Archive) project is to establish consistent vegetation system and standardize and formalize vegetation classification of the gravel bar vegetation across Europe. The dataset contains more than 5000 phytosociological relevés from the main mountains ranges of 23 European countries.

Data preparation required: 1) collecting all accessible phytosociological relevés from European national, regional or personal databases, from the literature and making new relevés in countries or regions where this vegetation has been rarely studied so far; 2) filtering suitable relevés which were really made only on gravel bars; 3) filling the missing information; e.g. about the location; 4) unifying species nomenclature.

Here we want to present the results of large-scale vegetation analyses, offer a new gravel bar vegetation classification system and show the pattern of distribution of this rare vegetation across the Europe.

KEYWORDS: BRAIDED RIVERS, CLASSIFICATION, EUROPEAN VEGETATION ARCHIVE, GRAVEL-BED RIVERS, MOUNTAIN RANGE, RIVER GRAVEL BARS, VEGETATION

## POTENTIAL DISTRIBUTION OF BEECH FORESTS COMMUNITIES IN GREECE: ASSEMBLING DIAGNOSTIC SPECIES POTENTIAL DISTRIBUTION

DIMITRIOS KASAMBALIS[1], SPYROS TSIFTSIS[1], IOANNIS TSIRIPIDIS[1]

[1] DEPARTMENT OF BOTANY, SCHOOL OF BIOLOGY, ARISTOTLE UNIVERSITY OF THESSALONIKI, GR-54124 GREECE

Questions: Estimation of the potential distribution of plant communities from that of their diagnostic species.

Location: Distribution area of beech (*Fagus sylvatica* s.l.) forests in Greece.

Methods: All the plant communities (16) of beech forests described up to now in Greece have been studied. Their diagnostic species were classified numerically on the basis of the community(-ies) they differentiate. From each group of diagnostic species, we selected a number of species (144) that exhibited high fidelity values to the communities they differentiate. We used occurrence data from various data bases for these species and a number of rasterized environmental variables in order to predict their spatial distribution by means of MAXENT algorithm (version 3.3). Habitat suitability values for each species were converted to presence/absence data and thus for each raster grid cell we calculated the species that were estimated to occur within them. The composition of each grid cell was compared by means of a similarity index with the 16 communities. As similarity index, a modified form of the Lennon et al. (2001) index for measuring beta diversity for presence/absence data was used. Plant communities were considered as present only in the gird cells where their similarity index with the composition of the grid cell was found significant by means of a randomization test.

Results-Conclusions: The predicted distribution of the communities presented a high agreement with their distribution as this has been recorded by field studies. However there are communities of which the potential distribution seems to be over-estimated. The method followed here allows the prediction of occurrence of more than one community per grid cell, the estimation of the distribution only of already described communities and it allows the individualistic estimation of species distribution, the prediction of occurrence of syntaxa of different rank and the use of different sources of species occurrence data.

KEYWORDS: DISTRIBUTION MODELING, PLANT COMMUNITIES, *FAGUS SYLVATICA* FORESTS

## LEADING ECOLOGICAL FACTORS OF SOUTH URAL STEPPE COMMUNITIES DIVERSITY

MARIYA LEBEDEVA[1], SERGEY YAMALOV[1]

[1] BOTANICAL GARDEN-INSTITUTE, UFA SCIENTIFIC CENTRE, RUSSIA ACADEMY OF SCIENCES, UFA

Questions: What are the leading factors defining diversity of steppes in the South Ural
Location: The South Ural region is an important botanical and geographical boundary between Europe and Asia. The steppes of region are rare communities considerably transformed by anthropogenic influence, mainly widespread on a slopes of ridges and small mountains and are less often dated for plains and terraces of river valleys.
Methods: Data set (437 relevés) was analyzed with application of the cluster analysis, as a distance measure the Euclidean distance is chosen, the group of objects is executed by "flexible Betta's" method (β>0,25). The environmental assessment of groups is carried out with Korolyuk ecological scales. To identify the communities arrangement in multidimensional space of environmental factors DCA-ordination is used.
Results: 11 clusters forming two isolated groups are allocated. The first group united the communities of steppes with domination of herbaceous species differing in high specific diversity and polydominance of structure. The second group included steppe communities with shrubs dominance (*Caragana frutex*, *Spirea crenata*, etc.), as well as dry feather grass steppes with dominance of *Stipa lessingiana*. This group differs in low specific diversity and the domination of one or two species.
The first DCA-ordination axis could be interpreted as moisture vector along which the identified clusters communities are arranged from the meadow steppes to dry steppes with *Stipa lessingiana* and their shrubby variants. There is the changing from communities on adult soils to the stony soils steppes with *Orostachys spinosa* along the second axis.
Communities ecological status assessment show that they are well differentiated on a factor of moisture and richness-salinity of the soil.
Conclusion: As investigation results, moisture and substratum rockiness can be interpreted as leading ecological factors of steppe communities organization in the South Ural.

KEYWORDS: STEPPE COMMUNITIES, SOUTH URALS, CLUSTER ANALYSIS, DCA-ORDINATION, ECOLOGICAL SCALE

## METAPOPULATION STRUCTURE OF HALOPHILOUS FLORA BASED ON LONG TERM PERMANENT PLOTS MONITORING

MARTA LIS[1], AGNIESZKA PIERNIK[1]

[1] NICOLAUS COPERNICUS UNIVERSITY, FACULTY OF BIOLOGY AND ENVIRONMENT PROTECTION, CHAIR OF GEOBOTANY AND LANDSCAPE PLANNING, LWOWSKA 1, 87-100 TORUŃ, POLAND

The research addressed the question: can halophilous flora on permanent research plots be a stable source of diaspores for neighbouring protected area? It was assumed that despite the renovations, during which research areas were being destroyed, metapopulation structure did not change.

Permanent plots are located under saline graduation towers in health resort Ciechocinek (central Poland) in the vicinity of a Natura 2000 area and reserve of halophytes. In the analysis of floristical and phytosociological composition data from the field work in 2015 and 2011 and data obtained from works of other authors from years 1988, 1990 and 2004 were included. The composition of plant populations and selected indicators characterising these metapopulations, e.g. life forms and Ellenberg indicator values were analysed. The statistical assessment has been done with Kruskal-Wallis test with Dunn's post-hoc comparisons.

The results indicate that the structure of the metapopulations is relatively stable, which confirms our hypothesis. The largest number of species with a high Ellenberg salinity indicator value was recorded at the permanent plots directly adjacent to the protected Natura 2000 site. Detailed analysis of those species in the period of 1988-2015 indicates that in fact only the cover of *Aster tripolium* and *Salicornia europaea* decreased. *A. tripolium* was noted only in period 1988-1991. *S. europaea* population decreased by 2011, and by 2015 there was a significant increase. The share of other species, i.e. *Spergularia salina*, *Puccinellia distans*, *Atriplex prostrata* ssp. *prostrata* var. *salina* increased in relation to 1988, and *Glaux maritima* was constant.

Based on the results it can be concluded that species metapopulation structure adjacent to the Natura 2000 area and reserve of halophytes is relatively stable and may support the protected area.

KEYWORDS: HALOPHYTES, INLAND SAT-MARSHES, SALINITY, ELLENBERG INDICATOR VALUES

## PATTERNS OF RANGE DENSITIES OF EUROPEAN TREES ACROSS TIME: PERSISTENCE VERSUS EXTINCTION

DONATELLA MAGRI*, FRANCESCO SPADA *, FEDERICO DI RITA*, EMILIANO AGRILLO * & MARCO MASSIMI *

* UNIVERSITY OF ROMA "LA SAPIENZA", DEPT. OF ENVIRONMENTAL BIOLOGY P.LE ALDO MORO, 5 00185 ROMA – ITALY (DONATELLA.MAGRI@UNIROMA1.IT)

Local extinction of living tree species in W Eurasia during the Quaternary is a well documented event. However, recolonisation patterns of trees after the last pleniglacial have been given much more focus than to evidence for Upper Pleistocene-Holocene retreat of species from formerly occupied areas. This neglect has negatively affected issues dealing with the modern assessment and the developmental history of present day zonal forest communities in Europe.

Modern ranges compared with reconstructed past distribution patterns at different times in the late Quaternary, show that a number of taxa (e.g., *Zelkova*, *Abies*, *Picea*, *Buxus,* and *Carpinus*) contracted their ranges or even gradually disappeared from the Italian peninsula and other S Mediterranean regions. This process, which is likely to be ongoing, is part of a well-known long-term trend towards extinction of tree taxa, affecting species richness in the arboreal vegetation in Europe compared to Asian or N American analogues, despite no clear evidence for increase of environmental suppressive forces at any subsequent glacial cycle. What we see today in tree ranges in southern Europe, hardly is the spatial result of spread, rather the result of a global retreat in the long run, as documented by pollen data. When past distributions are compared to modern ranges of species, sensitivity for local extirpation may be suggested by low density of refugial enclaves of trees at their modern range limits.

Here, sensitive areas for potential, local extinction of selected trees are outlined using geostatistical treatments of the low density, modern range belts, compared to late Quaternary spatial patterns and events of extinction at the European scale.

History as cumulative effects of past large scale events is therefore a major constrain in the reassessment of the coenology of modern zonal plant communities along with the climatic changes of the last glacial-interglacial cycle in Italy.

KEYWORDS: VEGETATION HISTORY, RANGE DYNAMICS, DISPERSAL, EXTINCTION

## ASSEMBLAGES, POTENTIAL DISTRIBUTION AND GENETIC DIVERSITY OF *AESCULUS HIPPOCASTANUM* IN GREECE: EXPLORING THE DIVERSITY PATTERNS OF A RELICT SPECIES

ANNA MASTROGIANNI[1], ANDREAS D. DROUZAS[1], ARISTOTELIS C. PAPAGEORGIOU[2], ACHILLEAS TSIROUKIS[3], IOANNIS TSIRIPIDIS[1]

[1] DEPARTMENT OF BOTANY, SCHOOL OF BIOLOGY, ARISTOTLE UNIVERSITY OF THESSALONIKI, GR-54124 THESSALONIKI, GREECE
[2] DEPARTMENT OF FORESTRY, ENVIRONMENT AND NATURAL RESOURCES, DEMOCRITUS UNIVERSITY OF THRACE, GR-68200 ORESTIADA, GREECE
[3] DEPARTMENT OF FORESTRY AND NATURAL ENVIRONMENT ADMINISTRATION, TEI OF THESSALY GR-41110 LARISA, GREECE

Background-Questions: *Aesculus hippocastanum* is a Tertiary relict species, whose distribution during Pleistocene has been restricted to the Balkan Peninsula. The species has nowadays a highly specialized niche characterized mainly by high moisture availability. The aim of the present study was to investigate the woody species assemblages in which *A. hippocastanum* occurs, its genetic diversity as well as its potential distribution (present and past). In this way we are trying to explore the factors that have determined the present geography of a relict species.
Location: The known distribution of *A. hippocastanum* in Greece.
Methods: Forty nine vegetation plots have been sampled for the investigation of the woody species assemblages of the species. The plots have been classified by the Fuzzy C-means method and analyzed using NMDS. The potential distribution of the species was predicted for the present environmental conditions as well as those of the Last Glacial Maximum (LGM) and the Mid-Holocene with MaxEnt 3.3.3k. The genetic diversity was investigated by sequencing the cpDNA regions *thnH-psbA* and *rbcL*, while the spatial genetic structure by using a MCMC simulation.
Results-Conclusions: Four distinct woody species assemblages have been identified and their differentiation may be attributed to both ecological and geographical factors. During the LGM, the distribution of *A. hippocastanum* appeared to be significantly restricted, while during the Mid-Holocene it was significantly expanded. Present potential distribution includes mainly areas around the scattered localities where the species has already been recorded. *A. hippocastanum* was characterized by high genetic diversity, while the cpDNA haplotypes were characterized by a distinct spatial pattern. Common differentiation patterns were observed between haplotypic diversity and known plant geographical differentiation in the study area.

KEYWORDS: *AESCULUS HIPPOCASTANUM*, DISTRIBUTION MODELLING, GENETIC DIVERSITY, PALAEODISTRIBUTION, WOODY ASSEMBLAGES

## THE ROLE OF MINOR PATCHES IN STREAMSIDE FOREST TYPE DIFFERENTIATION

DENIS MIRIN

SAINT-PETERSBURG STATE UNIVERSITY, RUSSIA

Spatial heterogeneity is a one of basic properties of plant communities. Patches which are representative for vegetation in the environment condition are occupy the most square of phytocoenosis usually. Minor patches can be formed in small specific elements of environment such as bed of stream or outliers of soil bedrock (the first is a mandatory element of streamside forests and the second is optional elements). Patches formed in sites of destruction such as uprooting, footpaths or other anthropogenic and zoogenic elements of structure, spots of erosion of soil surface are widespread in the surveyed forests. Epiphytic groups of bryophytes and lichens on the various tree species and epixylic vegetation on fallen logs with various stage of decomposition are very small but rather numerous elements of forest communities. Assignment of plant communities to one association should reflect their similarity in species composition, structure and environment. However similarity of background and minor (accessoric) patches of compared plant communities can be different while this minor elements of vegetation usually have less obligatory role in structure of plant community.

For analyses of similarity various elements of plant communities that belong to close plant associations we used a small part of a pool of streamside spruce forests sample plots descriptions which contain ground vegetation characteristics for each visually distinguished contour. These sample plots were described on the north-west of European part of Russia mainly in Leningrad region in the bottom of small stream valleys.

Variation of ground cover parameters of one type patches (bed of stream, alluvial banks of steambed, windfall hills and depressions) within one forest type is higher than variation of background cover. Similarity of averaged minor one-typed patches of different (but not contrast) forest types usually higher than similarity of background cover.

KEYWORDS: STREAMSIDE FOREST, *PICEETUM ULIGINOSO-MAGNOHERBOSUM*, *MELICO NUTANTIS-PICEETUM ABIETIS*, *CLIMACIO DENDROIDIS-PICEETUM ABIETIS*

## COMMUNITY STRUCTURE INFLUENCES DIVERSITY IN *Q. SUBER* WOODS

TIAGO MONTEIRO-HENRIQUES[1,2], FEDERICO FERNÁNDEZ-GONZALEZ[3], EMILIANO AGRILLO[4], OLIVIER ARGAGNON[5], BORJA JIMÉNEZ-ALFARO[6], NICOLA ALESSI[7], GUILLERMO CRESPO[3], CARLOS NETO[8]

[1] CENTRO DE ESTUDOS FLORESTAIS, INSTITUTO SUPERIOR DE AGRONOMIA, UNIVERSIDADE DE LISBOA, TAPADA DA AJUDA 1349-017 LISBOA, PORTUGAL
[2] CENTRO DE INVESTIGAÇÃO E DE TECNOLOGIAS AGRO-AMBIENTAIS E BIOLÓGICAS, UTAD, QUINTA DE PRADOS, APARTADO 1013, 5000-801 VILA REAL, PORTUGAL
[3] INSTITUTE OF ENVIRONMENTAL SCIENCES,UNIVERSITY OF CASTILLA-LA MANCHA,TOLEDO, E-45071 TOLEDO, SPAIN
[4] DEPARTMENT OF ENVIRONMENTAL BIOLOGY, SAPIENZA UNIVERSITY OF ROMA, L.GO CRISTINA DI SVEZIA, 24 00165 ROMA, ITALY
[5] CONSERVATOIRE BOTANIQUE NATIONAL MÉDITERRANÉEN DE PORQUEROLLES, ANTENNE LANGUEDOC-ROUSSILLON, PARC SCIENTIFIQUE AGROPOLIS - B7, 2214, BOULEVARD DE LA LIRONDE, 34980 MONTFERRIEZ SUR LEZ, FRANCE
[6] DEP. OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, CZ-611 37 BRNO, CZECH REPUBLIC
[7] FACULTY OF SCIENCE AND TECHNOLOGY, FREE UNIVERSITY OF BOZEN-BOLZANO, P.ZZA UNIVERSITÀ 5, I - 39100 BOZEN-BOLZANO, ITALY
[8] CENTRE OF GEOGRAPHICAL STUDIES, INSTITUTE OF GEOGRAPHY AND SPATIAL PLANNING, UNIVERSITY OF LISBON, ALAMEDA DA UNIVERSIDADE 1600-214, LISBOA, PORTUGAL

Questions: *Quercus suber* L. woods are rare, as most of them have been transformed into agricultural areas, pastureland, exotic forest plantations and agro-silvo-pastoral systems. The latter maintain a variable amount of tree cover, sometimes resembling the original forests, yet quite far from a veritable forest structure. Our aim was to study how community structure relates with diversity in *Q. suber* woods.

Location: Portugal, Spain, France, Italy and the Tyrrhenian great islands, covering adequately the European distribution of cork oak.

Methods: We analysed 1200 phytosociological relevé plots corresponding to woods dominated or co-dominated by *Q. suber*. We identified the plant life-forms of the occurring taxa and summed the percentage cover of each plant life-form in each plot. We studied diversity measures and woods structure along the gradient of tree cover using a moving-window of 500 relevés. A k-means cluster, on the physiognomic spectra of each relevé was also performed.

Results: We found that mean α-diversity (mean plot richness) increased with tree cover (reaching its maximum at 90 to 100% tree cover), and, conversely β- and γ-diversity decreased. The highest tree richness was apparent at 70 to 80% tree cover. Richest communities correspond to highly-structured woods, i.e. presenting high cover values in all perennial life-forms. K-means cluster reflected the general trends found in the moving-window showing some complementary patterns.

Conclusion: Highly-structured woods are locally the richest, however, those with lower tree cover, despite being locally poorer, encompass larger taxa pools, showing that other species are progressively entering the forest, but with a high turnover from plot to plot. Covering 1071 species and subspecies in our dataset, *Q. suber* woods are undoubtedly valuable in terms of their phytodiversity, but their multi-layered structure certainly boosts their importance far beyond.

KEYWORDS: *QUERCUS SUBER*, BIODIVERSITY, RICHNESS, FOREST STRUCTURE, PLANT LIFE-FORM

## ECOLOGICAL QUALITY CLASSIFICATION OF GREEK RIVERS FOR THE IMPLEMENTATION OF WFD 2000/60/EE: ESTABLISHING A NATIONAL MONITORING NETWORK OF AQUATIC MACROPHYTE ASSESSMENT

EVA PAPASTERGIADOU[1], GEORGIOS DIMITRELLOS[1], G. KERAMETSIDIS[1], KATERINA KOSTARA[1], K. KOUTELIDA[1], P. MANOLAKI[1], D. TSOUKALAS[1]

[1] DEPARTMENT OF BIOLOGY, UNIVERSITY OF PATRAS, UNIVERSITY CAMPUS RIO, PATRAS GR 26500 PATRAS, GREECE

Aims: The aim of the EU Water Framework Directive (WFD 2000/60) is to ensure sustainable management of water bodies. Aquatic macrophytes are one of the BQEs in the WFD for which status assessments must be defined in the entire EU territory. Current research investigates the potential development and application of a macrophyte based index for the ecological quality assessment of freshwaters in Greece.

Location & Methods: The national monitoring programme of ecological quality of Greek rivers started at the end of 2013. Almost 100 lowland river sites of IC types [RM1, RM2 and RM3] were seasonally surveyed. Field survey data were collected from the rivers basin area using MEDGIG standardized protocol. In each surveyed site physicochemical, geomorphological and macrophyte data, were collected and analyzed. Presence of about 70 species was estimated in field according to MEDGIG abundance scale. A series of metrics such as diversity indices, species richness and relative abundance were additionally calculated. Correlations were run to investigate the relationships between the biological metrics and the environmental parameters. Ordination analyses were further performed to identify the main environmental gradients and to discriminate macrophyte assemblages according to their preference for specific habitat characteristics and water quality properties.

Results: The applied assessment method classified the studied sites in different Ecological Status Classes [EQR class boundaries for H/G and G/M] in accordance to the pressure gradient. The results presented significant variations in macrophytes composition according to the water quality. Charophytes and bryophytes were confirmed to show a preference for clear and nutrient poor waters, while submerged species were mostly associated with meso-eutrophic sites. These results indicate that a macrophyte index could be useful tool for classifying ecological quality of highly seasonal rivers, attributed to human-induced stress gradients.

KEYWORDS: BIOLOGICAL QUALITY ELEMENTS (BQES), MACROPHYTES, MEDITERRANEAN GEOGRAPHICAL INTERCALIBRATION GROUP (MEDGIG), IBMRGR INDEX, ECOLOGICAL QUALITY

## TREES, FORESTS AND GRASSLANDS IN DRYLANDS: A NEW GLOBAL APPROACH FOR VEGETATION ANALYSIS

CHIARA PATRIARCA[1], A. SANCHEZ-PAUS DIAZ[1], M. REZENDE[1], S. RICCI[1], D. MANIATIS[2], A. BEY[1], M. GARZUGLIA[1], J.F. BASTIN[1], G. MARCHI[1], N. BERRAHMOUNI[1], M.E. ABRAHAM[3], K. ALOUI[4], A. ATESOGLU[5], F. ATTORRE[6], C. BASSULLU[1], L. GONZAGA GARCIA[7], A. GRAINGER[8], B. MAMANE[9], P. PATTERSON[10], I. SALCEDO[11], V. SURAPPAEVA[12], L. LAESTADIUS[13], T. WOLDEMARIAM[13], D. MOLLICONE[1]

[1]FAO FORESTRY DEPARTMENT, FOREST POLICY AND RESOURCES DIVISION, ROME, ITALY.; [2] ENVIRONMENTAL CHANGE INSTITUTE, SCHOOL OF GEOGRAPHY AND THE ENVIRONMENT, UNIVERSITY OF OXFORD, , UK; [3] INSTITUTO ARGENTINO DE INVESTIGACIONES DE ZONAS ARIDAS, MENDOZA, ARGENTINA. ; [4] INVENTAIRE ET EVALUATION, DIRECTION GÉNÉRALE DES FORÊTS, TUNIS, TUNISIA. [5] BARTIN UNIVERSITY, ANTALYA, TURKEY. ; [6] LA SAPIENZA UNIVERSITY, ROME, ITALY. ; [7]UNIVERSIDAD POLITÉCNICA DE MADRID, DEPARTMENT OF INGENIERÍA Y GESTIÓN FORESTAL Y AMBIENTAL, MADRID, SPAIN. ; [8]UNIVERSITY OF LEEDS, SCHOOL OF GEOGRAPHY, LEEDS, UK.; [9] CENTRE REGIONAL AGRHYMET, NIAMEY, NIGER.; [10] UNITED STATES FOREST SERVICE, UTAH, US. [11] SEMI ARID NATIONAL INSTITUTE, CAMPINA GRANDE, BRAZIL. ; [12] DEPARTMENT OF FOREST AND HUNTING INVENTORY OF KYRGYZSTAN, BISHKEK, KYRGYZSTAN.; [13] WORLD RESOURCES INSTITUTE, WASHINGTON DC, US.

Quantifying trees, forests and grasslands with remotely sensed data is a challenge for dryland ecosystems due to sparse vegetation, climate seasonality, and reflectance similarities between trees and shrubs. Previous studies based on the analysis of reflectance properties consistently failed to report detailed information about vegetation in drylands.

Here we present the potential of a new methodology based on probability sampling, visual interpretation techniques of very high spatial resolution satellite images and multi-temporal analysis of multi-spectral satellite data. This approach is based on the use of Collect Earth, an open-source software developed by FAO's Forestry Department, which relies on Google Earth, and Google Earth Engine to access and analyze the satellite data. FAO in collaboration with several research and governmental organization is conducting the first global assessment of Drylands as per United Nations Convention to Combat Desertification definition. Here, we illustrate the results obtained for the drylands area which fall under the Mediterranean biome as per Olson et al. 2001. In total 6.961 sampling plots have been assessed. Results reveal that trees are present in 37% of the plots of which only 47% is then classified as forest land. Furthermore 19% of the area outside forests has trees, mostly in settlement (with an average of 14 trees $ha^{-1}$) and cropland (with an average of 11 trees $ha^{-1}$). The assessment also provides an exhaustive description of the land use and land use changes from 2001 - 2014, finding that 2% of the forest land in the Drylands area with in the Mediterranean biome has been converted into a different land use from 2001 to 2014. In particular 1% of forest land has been converted to cropland and 0.9% to Grassland. The study also provides an estimation of the total number of trees, trees and shrubs in and outside forests, and of the percentage of other main land uses such as grassland, cropland, settlement etc., variables and indicators; overall seventy seven variables have been assessed. The results provide a new approach to evaluate land characteristics, based on quantitative estimates and indicators, including also the evaluations of the uncertainties. In the near future the data will be freely released under a Creative Commons license and could be considered as a baseline for any future Drylands land monitoring analysis.

KEYWORDS: DRYLANDS, MEDITERRANEAN, VHR SATELLITE IMAGES, LAND COVER AND LAND USE, COLLECT EARTH, FREE AND OPEN SOURCE SOFTWARE, OPEN DATA.

## IS MANAGEMENT A KEY FACTOR FOR STRUCTURE OF INLAND SALINE VEGETATION?

AGNIESZKA PIERNIK[1], PIOTR HULISZ[2], DARIUSZ KAMIŃSKI[1]

[1] FACULTY OF BIOLOGY AND ENVIRONMENT PROTECTION, NICOLAUS COPERNICUS UNIVERSITY, LWOWSKA 1, 87-100 TORUŃ, POLAND
[2] FACULTY OF EARTH SCIENCES, NICOLAUS COPERNICUS UNIVERSITY, UL. LWOWSKA 1, 87-100 TORUŃ, POLAND

The research was addressed to the question if management is a key factor for structure of inland saline vegetation. The fieldwork was carried out on natural saline meadows in two regions in central Poland – "Pyzdrskie meadows" (P) in Wielkopolska and saline meadows in the Zgłowiączka River valley (Z) in Kujawy. Soil salinity in those regions is caused by the saline ground waters and springs being in the contact with the Zechstein rock salt deposits.

The type of soils and the salinity level were determined. The vegetation of the abandoned sites was compared with still mowed one using the Braun-Blanquet approach. In addition, the mowing experiment was established on abandoned meadow in the Z site. The first part of that meadow was mowed once a year in July, the second part twice a year in June and in August and third part remained abandoned as a control. The salinity (expressed as $EC_e$) of the mineral-organic soils from the P site varied between 1.4 and 12.1 $dS \cdot m^{-1}$. While the organic soils from the Z site had the higher $EC_e$ values (5.1-17.9 $dS \cdot m^{-1}$). In some places where the field experiment was established (Z) the salinity was higher with the maximum of 28.2 $dS \cdot m^{-1}$.

The *Triglochino-Glaucetum maritimae* association dominated on both investigated sites. The results of phytosociological comparison demonstrated that the abandoned parts were overgrown by *Phragmites australis* where the share of this species was 2-4 times higher than on mown parts of the meadows. However, after two years the controlled mowing experiment demonstrated that mowing results in significantly lower cover of *P. australis* on both mown parts. In the part mown two times per year significantly higher species richness, diversity and evenness were noted. Furthermore, the cover of some halophytes was significantly higher.

The research was financially supported under two projects of Polish Committee for Scientific Research no 3 P04F 069 24 and 3 P04G 042 25.

KEYWORDS: HALOPHYTES, INLAND SALT MEADOWS, MOWING, SOIL SALINITY, CCA, VEGETATION-ENVIRONMENT RELATIONS

## VEGETATION COVER 47 YEARS AFTER LARGE-SCALE WINDSTORM: CASE STUDY IN LATVIA

LIGA PURINA[1], INGA STRAUPE[2], LIGA LIEPA[3], MARA ZADINA[4], ARIS JANSONS[5]

[1,4,5] LATVIAN STATE FOREST RESEARCH INSTITUTE "SILAVA"
[2,3] LATVIA UNIVERSITY OF AGRICULTURE, FOREST FACULTY

Wind is an important natural disturbance factor in a forest ecosystem. It creates gaps in a forest canopy, providing microenvironmental conditions, suitable for forest regeneration and affects the species composition of ground vegetation. Most of the studies analysing consequences of wind-storm have addressed short-term changes or influence the stand structure, but the aim of our study is to analyse ground-vegetation long time after windstorm in hemiboral forests. Data collection was carried out in the summer of 2014 in the north-western part of Latvia in five areas affected by the storm of 1967, where due to salvage-logging 200-400 m wide clearcuts were created. Sample plots (1×1 m) were placed in different distance from the edge of former clearcuts and projective cover of ground vegetation assessed using Braun-Blanquet method in *Myrtillosa mel.* forest type. Results reveal that in all sites species belonging to boreal, boreal-temperate and temperate biome were present, but their proportions varied between sites. In total 82 species of vascular plants were found, most frequent among them *Maianthemum bifolium* (L.) F.W.Schmidt (species characteristic to Norway spruce forests), *Vaccinium myrtillus* L. and *Vaccinium vitis-idaea* L. (associated with Scots pine forests) as well as *Molinia caerulea* (L.) Moench *and Deschampsia caespitosa* (L.) P.Beauv. (both characteristic to wet soils). Results suggest, that even 47 years after the storm microenvironmental conditions in the sites are not stable. Ellenberg's indicator values reveal, that most of the sites are in semi-shade, cool and moist conditions, placed on acidic, nitrogen-poor (in few sites – also nitrogen rich) soils.

KEYWORDS: GROUND-VEGETATION, WINDTHROW, NATURAL DISTURBANCE, PALUDIFICATION, NATURAL SUCCESSION

## PATTERNS OF *ISOETO-NANOJUNCETEA* COMMUNITIES IN IBERIAN PENINSULA

SÍLVIA RIBEIRO[1], VASCO SILVA[2], CARLA PINTO-CRUZ[3], JOSÉ CARLOS COSTA[1], MARIA DALILA ESPÍRITO-SANTO[1], JOSÉ ANTÓNIO MOLINA[4], ULRICH DEIL[5]

[1] LEAF- LINKING LANDSCAPE, ENVIRONMENT, AGRICULTURE AND FOOD, INSTITUTO SUPERIOR DE AGRONOMIA,TAPADA DA AJUDA, 1349-017 LISBON, PORTUGAL. SILVIA.SBENEDITA@GMAIL.COM
[2] CENTRE FOR APPLIED ECOLOGY PROF. BAETA NEVES, INSTITUTO SUPERIOR DE AGRONOMIA, UNIVERSIDADE DE LISBOA, TAPADA DA AJUDA, 1349-017 LISBON, PORTUGAL
[3] ESCOLA DE CIÊNCIAS E TECNOLOGIA, INSTITUTO DE CIÊNCIAS AGRÁRIAS E AMBIENTAIS MEDITERRÂNICAS, UNIVERSIDADE DE ÉVORA, NÚCLEO DA MITRA, 7002-554 ÉVORA, PORTUGAL
[4] DEPARTMENT OF PLANT BIOLOGY II, COMPLUTENSE UNIVERSITY OF MADRID, E-28040 MADRID, SPAIN
[5] FACULTY OF BIOLOGY, SCHÄNZLESTR. 1, 79104 FREIBURG, GERMANY

Questions: What are the main community types of *Isoteo–Nanojuncetea* class in the Iberian Peninsula? How does current phytosociological classification match with classified community types? Which are their main diagnostic species? Which communities correspond natural habitats listed under Habitats Directive?
Location: Iberian Peninsula (c.a. 582 000 Km$^2$).
Methods: An initial data set of 786 relevés assigned to the *Isoeto-Nanojuncetea* was compiled and analyzed with Modified TWINSPAN, checking crispness of classification. Plant community types were recognized and diagnostic species were obtained by fidelity through the coefficient *Phi*.
Results: The classification revealed a clear differentiation of *Isoetetalia* and *Nanocyperetalia* orders. We obtain 34 clusters which differentiate communities according to the moisture gradient and biogeographic factors. Seven alliances were clearly recognized: *Isoetion*, *Menthion cervinae*, *Agrostion pourretii* and *Cicendion* (from *Isoetalia*); *Nanocyperion flavescentis*, *Verbenion supinae* and *Lythrion tribacteat*i (from *Nanocyperetalia*). The *Cicendion* and *Lythrion tribacteati* are clearly separated from all the other alliances. Diagnostic species were obtained for the well-represented community types. Most of these communities correspond to habitats 3110, 3120, 3130 and 3170 priority habitat under the Habitat Directive.
Conclusions: Despite some groups of communities reveal some biogeographic separation, traditional classification of other communities could be simplified. We suggest the use of diagnostic species for clear differentiation between habitat types. Diagnostic species can be used to unequivocally identify natural habitat types in a practical way.

KEYWORDS: CLASSIFICATION, DIAGNOSTIC SPECIES, EPHEMERAL WETLANDS, HABITAT TYPES, SYNTAXONOMY

## LONG-TERM EFFECT OF WHOLE-TREE BIOMASS HARVESTING ON GROUND VEGETATION: A CASE STUDY IN LATVIA

LINDA ROBALTE[1], LIGA PURINA[1], ARIS JANSONS[1]

[1] LATVIAN STATE FOREST RESEARCH INSTITUTE "SILAVA"

At present, forest management is aiming to increase the production of biomass for energy purposes without disturbing other ecosystem functions and further regeneration. Most often a conventional harvesting method (CH), when tree residues are left on the site, is used. In this regard, the whole tree harvesting (WTH) technique has been applied to maximise yields. Still, there is insufficient information about the effect of WTH on ground vegetation, particularly in long-term.

In this study, we examined a 40-years old experimental stand of Scots pine that has regenerated after the WTH and area where the residuals were disposed (stump area). Ground cover vegetation was characterized along two 50 m long transects, 17 sampling plots (1× 1 m) were placed along each transect. The ground cover was determined by the Braun - Blanquet method. Vegetation by the same method was studied in a mature (119 years) and CH young (10 years) stand.

In the WTH area, the number of ground cover species was higher compared to stump area, CH young and mature forest stand (20.5, 13.0, 15.0 and 12.5, respectively). Shannon diversity indices (H') in the CH young stand and in stump area compared to WTH area and old forest, as suggested by higher (2.39 and 1.9 vs. 1.78 and 1.55, respectively). The dominant species in the WTH area was *Pleurozium schreberi* (54.32 %), which also formed a high percentage cover (28.65 %) in the mature forest. One of the most common species in the WTH area was *Lycopodium clavatum* (7.06 %) which are threatened species in Latvia. The differences in species composition between the territories were statistically significant (p-value < 0.05).

Hence, our results indicate that is no negative effect of WTH on the regeneration of the most common ground cover vegetation species in the nutrient-poor Scots pine sites. Still more data, including rare species and wither temporal resolution, is needed to generalize the conclusions.

KEYWORDS: WHOLE TREE HARVESTING, DRY SCOTS PINE FOREST, VEGETATION REGENERATION

## ENVIRONMENTAL DATA STANDARDS AND DESCRIPTIVE FRAMEWORKS FOR RELEVÉS, SYNTAXA AND HABITAT TYPES

JOHN S. RODWELL[1], MILAN CHYTRÝ[2], STEPHAN M. HENNEKENS[3], JOOP H.J. SCHAMINÉE[3], DATA PROVIDERS

[1] 7 DERWENT ROAD, LANCASTER, LA1 3ES, UK
[2] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, 611 37 BRNO, CZECH REPUBLIC
[3] ALTERRA WUR, P.O. BOX 47, 6700 AA, WAGENINGEN, THE NETHERLANDS

Aims: In research funded by the European Environment Agency, to review data sources, user-needs and database structures for the environmental parameters used for relevés and syntaxa; to provide recommendations for further development of a parameter framework; and to discuss the implications for standardised descriptions of syntaxa and habitats.

Methods: Through literature search and enquiries to database managers, vegetation science practitioners and environmental policy personnel, we reviewed current practice and standards for the recording of environmental data among EVS and EDGG members; in the Global Index of Vegetation Plot Databases, the European Vegetation Archive, sPlot, TURBOVEG-3 and EUNIS; and in the environmental terminology of the glossaries of the Palaearctic Habitat Classification, CORINE, EUNIS, the EuroVegChecklist and EIONET.

Results: Categories and standards for field recording of environmental data and encoding in databases vary widely; typologies and glossaries of environmental and ecological terms employed for describing syntaxa and habitats are numerous, inharmonious and confusing; and secondary environmental sources and platforms for interpretation of ecological patterns and processes vary in scope and quality.

Conclusions: Increased harmonisation of environmental typologies, categories and terminology in the recording and encoding of relevé data and structuring of databases would improve the understanding of environmental dependencies of vegetation types, the quality and utility of syntaxa and habitat definitions and the administration of nature protection policy.

KEYWORDS: ENVIRONMENTAL PARAMETERS, GLOSSARIES, DATABASES, CLASSIFICATION, RELEVES, SYNTAXA, HABITATS

# STRUCTURAL DIVERSITY, QUALITY AND DISTRIBUTION OF EUROPEAN UNION IMPORTANCE FOREST HABITATS WITHIN LANDS MANAGED BY THE LATVIA'S STATE FOREST

IEVA ROVE[1], JURIS ZARIŅŠ[2], DIĀNA MARGA[3], VIJA KREILE[4]

[1] SENIOR ENVIRONMENTAL EXPERT, M.SC.BIOL.
[2] FOREST DATA SOLUTIONS MANAGER, M.SC.BIOL
[3] ENVIRONMENTAL PLANNING SPECIALIST, M.SC.ENVSC.
[4] ENVIRONMENTAL EXPERT, M.SC.ENVSC.

This report emphasizes on the European Union importance forest habitat occurrence and quality within lands managed by the Latvijas valsts meži, as well as – modelling of possible future distribution of certain target habitat ecological groups using instruments of landscape – ecology.

With 3.8 million ha of forests or 56.9% of the territory, Latvia is among the most forested countries in Europe. The highest amount and diversity of nature values in Latvia occur in the State forest managed lands.

The vegetation of Northern Europe, including Latvia, is about 10 000 years young and formed in Holocene after the last glaciation. Species composition/plant communities have changed along with changes of the climate and quarter-geological processes. However, during the last millennia human impact on natural vegetation has increased significantly till the stage where most forests are artificial while looking natural.

Functional management of forests covers various aspects, the basis of long term sustainable development is to balance interests of nature conservation and economics. Since 2010, great attention has been dedicated to implement these aims.

Existing data - 1.62 million ha of forests, 220 000 ha other lands, shows quite high diversity of the European Union importance habitats. Until now, data on the European Union importance forest habitats are based on concrete mapping records. On the basis of mapped habitat structural quality and distribution data it is possible to analyse the distribution pattern according landscape regions and ecological requirements of certain forest habitat ecological groups.

Specific nature values will require special management measures, such as either non-intervention or active management, which in turn may consists on maintenance, improvement or restoration, or – in landscape – ecological approach, even facilitation of certain habitat types in certain forest massif or landscape region to support ecological network alive.

KEYWORDS: LATVIA, EU IMPORTANCE FOREST HABITAT, CONSERVATION, LANDSCAPE - ECOLOGICAL PLANNING, DISTRIBUTION

## POTENTIAL ONSET OF FEN-BOG TRANSITIONS IN NORTHERN FENS IN RESPONSE TO HYDROLOGICAL CHANGE

TEEMU TAHVANAINEN[1], TIMO KUMPULA[2] & KIMMO TOLONEN[1]

[1] DEPARTMENT OF ENVIRONMENTAL AND BIOLOGICAL SCIENCES, UNIVERSITY OF EASTERN FINLAND, FINLAND
[2] DEPARTMENT OF GEOGRAPHICAL AND HISTORICAL STUDIES, UNIVERSITY OF EASTERN FINLAND, FINLAND

The peat carbon pool of northern mires is to a great proportion formed by subfossil remains of *Sphagnum* mosses forming peat in raised bogs. On area basis, however, a great part of northern peatlands are fens, peatlands that lack the thick *Sphagnum* layer and are instead dominated by other mosses and sedges. Remarkably, fens prevail in north-boreal to subarctic regions, while bogs are more common in hemi-boreal to middle-boreal zones. In concordance to this pattern, the expected north-ward movement of climatic ecotones includes the prospect of development of northern fens into bogs. In this case, such a major ecotone shift is plausible because it conforms to the typical pattern of bog development, as most bogs have been fens in their early phases of development.

Several recent case studies have suggested that critical phases of the fen-bog transition (i.e. ombrotrophication) may take place in a rapid pace within few decades. It is demonstrated that *Sphagnum* mosses may proliferate to cover vast fen areas within just few decades after sufficient hydrological change in the catchment and similar responses may rise from predicted change of climatic moisture regime. Potential for rapid response is also observed in mire restoration areas, where *Sphagnum* mosses have well known capacity of ecosystem engineering, these plants not only inhabit acidic bogs but build their own acidic substrate facilitating development of bog plant communities and peat accumulation. Fen-bog transition represents a remarkable potential sink for atmospheric $CO_2$ and it would also act to reduce emissions of $CH_4$ that are characteristically higher in fens than in bogs. In the same time, a serious threat is generated to biodiversity of fens.

KEYWORDS: AAPA MIRES, PALSA MIRES, OMBROTROPHICATION, SUCCESSION, CLIMATE CHANGE

## LONG-TERM ABANDONMENT OF CROPLANDS IN THE SUB-MEDITERRANEAN CLIMATE DOES NOT LEAD PER SE TO THE RECOVERY OF THE SEMI-NATURAL HERB COMMUNITIES DEEMED WORTHY OF CONSERVATION IN THE EU HABITATS DIRECTIVE

FEDERICO MARIA TARDELLA[1], NATALIA TROIANI[2], LUCA MALATESTA[3], KARINA PIERMARTERI[3], NICOLA POSTIGLIONE[3], CARLO FERRARI[2], ANDREA CATORCI[1]

[1] SCHOOL OF BIOSCIENCES AND VETERINARY MEDICINE - UNIVERSITY OF CAMERINO, VIA PONTONI 5, CAMERINO, ITALY
[2] DEPARTMENT OF BIOLOGICAL, GEOLOGICAL AND ENVIRONMENTAL SCIENCES, BOTANIC GARDEN - UNIVERSITY OF BOLOGNA, VIA IRNERIO 42, BOLOGNA, ITALY
[3] SCHOOL OF ADVANCED STUDIES - UNIVERSITY OF CAMERINO, VIA LILI 55, CAMERINO, ITALY

Abandoned croplands can be considered a new category of "scattered elements" of mountain landscapes. To gain deeper understanding of the conservation status (*sensu* Directive 92/43/EEC) of abandoned cropland in the northern Apennines, we coupled the concepts of the social behavior type (SBT) and the functional assessment of plant communities. SBTs refer to behaviour and ecological attributes of species at a given observation level and allow the understanding of the plant community conservation status, while the functional approach may help in predicting changes of species composition along disturbance and stress gradients.

We found that topographic and soil conditions drive the species assemblage in pastures after crop abandonment, but long-term abandonment does not lead *per se* to the recovery of the semi-natural grassland communities deemed worthy of conservation in the EEC Directive. This was mainly due to the lack of appropriate disturbance regimes that allows the spread of dominant tall herbs, which, in turn, reduces the site suitability for subordinate plants. Moreover, their spread fosters the presence of elements such as ruderals and fringe species.

We conclude that, these abandoned croplands have a good potential to develop into Habitat of 92/43/EEC Directive but without appropriate management plans they will remain of low representativeness.

KEYWORDS: ABANDONMENT, CROPLAND, MANAGEMENT, GRASSLAND RECOVERY, PROTECTED HABITATS, ELLENBERG INDICATOR VALUES, PLANT FUNCTIONAL TRAITS, SOCIAL BEHAVIOUR TYPES

## SPECIES DIVERSITY AND COMMUNITY STRUCTURE OF MOUNTAIN PASTURES – A CASE STUDY FROM BALKAN RANGE

TSVETELINA TERZIYSKA[1], DESISLAVA SOPOTLIEVA[1], CAMILLA WELLSTEIN[2], ZITA ZIMMERMANN[3], GÁBOR SZABÓ[3] , JAMES TSAKALOS[4], IVA APOSTOLOVA[1], SÁNDOR BARTHA[3]

[1] INSTITUTE OF BIODIVERSITY AND ECOSYSTEM RESEARCH, BULGARIAN ACADEMY OF SCIENCES, 23, ACAD. G. BONCHEV STR., SOFIA, BULGARIA
[2] FREE UNIVERSITY OF BOZEN-BOLZANO (FUB), FACULTY OF SCIENCE AND TECHNOLOGY, BOLZANO, ITALY
[3] INSTITUTE OF ECOLOGY AND BOTANY HUNGARIAN ACADEMY OF SCIENCES CENTRE FOR ECOLOGICAL RESEARCH, H-2163 VÁCRÁTÓT, ALKOMÁNY U. 2-4, HUNGARY
[4] SCHOOL OF PLANT BIOLOGY, UNIVERSITY OF WESTERN AUSTRALIA, PERTH, AU

Background and Questions: A complex land use history of mountain pastures in the Central Balkan leads to structural community dynamics influencing species performance and species richness patterns. How does compositional diversity perform with scale? Which relationships exist between dominant species and the spatial organization of other community elements?
Location: Beklemeto region, Central Balkan National Park, above timberline, 1560-1700m altitude.
Methods: We established six environmentally similar sampling sites on six hilltops of the ridge. Within each site we sampled one *Nardus sticta*-rich and one *Vaccinium* spp.-rich community stands. In each stand, we recorded species cover (%) data in three 4x4m plots and species presence/absence data along 52m long transects of 5x5cm contiguous micro-quadrats. We tested the increase of *Nardus*- cover as driver of community composition. We calculated diversity indices for each 4x4m plot. As indicators for fine-scale heterogeneity, we estimated the maximum number of realized species combinations (maxNRC) and the maximum compositional diversity (maxCD) for every transect and the plot sizes at which they appear, by computerized merging of consequent 5x5cm quadrats.
Results: Dominants were inversely proportional in percentage cover (4x4m plots) and occurring frequencies (5x5cm plots). Diversity at 4x4 m plots was declining with increasing *Nardus*-cover. *Vaccinium*-dominated stands clearly showed higher diversity than *Nardus*-dominated ones according to diversity indices and maxCD. Two communities did not differ significantly in maxNRC, when dominants were excluded. MaxCD and maxNRC appeared at similar range of plot sizes in both community types.
Conclusion: Compositional diversity between communities can be attributed to the biotic effect of matrix species, given that the effect of abiotic constrains and species pool were kept quasi-constant within pair of community stands and across all sampling sites.

KEYWORDS: SPATIAL HETEROGENEITY, FINE-SCALE SAMPLING, COMPOSITIONAL DIVERSITY, DRIVERS OF COMMUNITY STRUCTURE

## APPLICATION OF ARTIFICIAL INTELLIGENCE IN VEGETATION CLASSIFICATION (AN OVERVIEW)

LUBOMÍR TICHÝ

DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, 611 37, BRNO, CZECH REPUBLIC

A continuously increasing need for exact vegetation classification procedures in the past decades has been enhanced by rapid testing and application of new algorithms which formalize expert knowledge of vegetation ecologists. Computer programs that are capable of learning from experience are generally termed 'artificial intelligence'. Their classification strategy differs from those programs that work with the data using an exactly defined method. In plot-based vegetation classification we can distinguish two basic types of artificial intelligence that have been applied to vegetation data so far: machine learning and expert system algorithms.

Artificial intelligence based programs have two basic components – interference engine and knowledge base. While interference engine is a general algorithm, the knowledge base is stand-alone expert information – in vegetation classification it is a set of *a priori* assigned plots or species combination rules. The knowledge base of machine learning techniques in vegetation classification predominantly consists of a set of *a priori* assigned plots (plot-based techniques). The human expert is only asked to decide which machine learning solution sufficiently fits to his/her personal experience. The full knowledge base of the expert systems is a digitized know-how of the expert, who must define all steps he took to make the decisions and define the exceptions. Therefore, expert systems are mainly related to *a priori* defined species combinations to sociological or functional groups (species-based techniques), which is easier for the definition of rules and clearer for their acceptance.

Algorithms of machine learning allow two forms of knowledge base – fixed as a source for supervised classification and flexible for identification of new clusters (semi-supervised classification). The interference engine may support hard or fuzzy clustering.

Both the above components of artificial intelligence are complementary and they are the only known classification techniques in vegetation science that can support spatially transferable vegetation classifications.

KEYWORDS: VEGETATION CLASSIFICATION, SUPERVISED MACHINE LEARNING, EXPERT SYSTEMS, KNOWLEDGE BASE

## GRASSLANDS IN THE SYSTEM OF THE BIODIVERSITY CONSERVATION OF THE TRADITIONAL AGRICULTURAL LANDSCAPE OF THE VALDAISKIY NATIONAL PARK (NOVGORODSKAYA OBLAST)

ARKADY TISHKOV[1], ELENA BELONOVSKAYA[1]

INSTITUTE OF GEOGRAPHY, RUSSIAN ACADEMY OF SCIENCES

Questions. Identification of the grasslands' role in the traditional agricultural landscape's conservation in the old made forest region of the European Russia.

Location. The territory of the Valdaiskiy National park is situated in the old developed region of the European Russia north-west, on the border of mixed coniferous-broad-leaved forests and southern taiga zones.

Methods. Terrestrial geobotanic investigations and remote sensing (Landsat 5) survey of the National Park Valdaiskiy was done.

Results and conclusions. As a result of ancient history of land use the nature and anthropogenic mosaic of the vegetation cover, common for the old agricultural landscapes, was revealed. The small contours of former arable lands, various types of grasslands, bogs, secondary and primary forests form the high diversity of habitats where the great amount of rare and endangered plant and animal species are met. Major of them are mentioned in the lists of species and habitats types to be protected in the Resolutions 6 and 4 of the Bern Convention. That's why the territory of the national park could be considered as the Area of Special Conservation Interest for the Emerald Network.

The Valdai region grasslands belong to the following habitat types of EUNIS classification: E3.4 Moist or wet eutrophic and mesotrophic grassland and E3.5 Moist or wet oligotrophic grassland. The secondary post forest meadows on the watersheds and slopes and flood plain meadows occupy 15,2% of the territory. For centuries they were used as hay lands and pastures. Long term development under anthropogenic pressure formed stable floristic composition and communities' structure of the grass communities. Nowadays the lack of agricultural pressure became the reason of the succession: the important for biodiversity conservation grasslands communities are changed by secondary low productive and poor with species forests.

Importance of the grasslands' conservation for the old agricultural landscape maintaining in the forest zone is showed. Possibilities and methods of compatibility and mutual benefit of the local villages' and protected area' land use types are discussed.

KEYWORDS: OLD DEVELOPED REGION, MEADOWS DIVERSITY, TRADITIONAL LAND USE, AREA OF SPECIAL CONSERVATION INTEREST, EMERALD NETWORK

## SPATIOTEMPORAL VEGETATION CLASSIFICATION ALGORITHM TO MAP THE SPREAD OF INVASIVE *ROBINIA PSEUDOACACIA*

MÁRTON TOLNAI[1], JÁNOS NAGY[1]

[1] INSTITUTE OF BOTANY AND ECOPHYSIOLOGY, SZENT ISTVAN UNIVERSITY

Satellite imagery based classification is routinely applied in regional scale vegetation mapping. While the classification methods and tools implemented into commonly used GIS software are good for visualize certain land cover types, these methods do not provide detailed results which enables vegetation mapping at species (or community) level.

The key in mapping the spatial spread of a certain plant species is the ability to distinguish it from the other species, which can be done by their spectral properties. However, the spectral difference between certain broadleaf species is not as obvious as the difference between broadleaf and coniferous species, hence broadleaf species are barely or non-distinguishable from each other by their spectral properties at the spectral resolution of Landsat TM, ETM+ and OLI sensors. Preliminary research has shown that the desired result is not achievable by the usage of an individual Landsat image as input therefore the available data have to be studied not just in geographic space but in time as well. To store the data into spatiotemporal database makes it possible to examine a species specific occurrence of phenological events during the growing season and phenological curves can be built up for each and every pixel. With our method *Robinia pseudoacacia* can be distinguished from other broadleaf species.

ESA (European Space Agency) has launched its new satellite mission Sentinel-2 in last year to improve the spatial, temporal and even spectral resolution of worldwide environment monitoring. Sentinel-2 data highly improve timeseries and combined usage with Landsat data creates the needed input for successful and precise spatiotemporal classification, which provide more detailed and better results than commonly used algorithms.

The presented algorithm is easily applicable for wide range of spatiotemporal vegetation studies.

KEYWORDS: SPATIOTEMPORAL, CLASSIFICATION, REMOTE SENSING, VEGETATION MAPPING

## HIGH-RANK SYNTAXA OF THE DRY GRASSLAND VEGETATION IN THE CENTRAL AND EASTERN BALKAN PENINSULA: A NEW SYNTHESIS BASED ON A LARGE PHYTOSOCIOLOGICAL DATABASE

KIRIL VASSILEV[1], MILAN CHYTRÝ[2], HRISTO PEDASHENKO[1], SVETLANA AĆIĆ[3], IVA APOSTOLOVA[1], ERWIN BERGMEIER[4], STEFFEN BOCH[5], ANDRAŽ ČARNI[6,13], RENATA ĆUŠTEREVSKA[7], ZORA DAJIĆ STEVANOVIĆ[3], GEORGIOS FOTIADIS[8], ANNA GANEVA[1], EVA KABAŠ[9], MITKO KOSTADINOVSKI[7], ELEZ KRASNIQI[10], MIRJANA KRSTIVOJEVIC CUK[11], DMITAR LAKUŠIĆ[9], VLADO MATEVSKI[7], RAYNA NACHEVA[1], CHRISOULA PIRINI[12], VESELIN SHIVAROV[1], DESISLAVA SOPOTLIEVA[1], YASEN STOYANOV[1], LUBOMÍR TICHÝ[2], SALZA PALPURINA[2], IOANNIS TSIRIPIDIS[12], MICHAEL VRAHNAKIS[8], JÜRGEN DENGLER[14,15]

[1] INSTITUTE OF BIODIVERSITY AND ECOSYSTEM RESEARCH, BULGARIAN ACADEMY OF SCIENCES,23 ACAD. G. BONCHEV STR., 1113 SOFIA, BULGARIA
[2] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, 2 KOTLARSKA, CZ-611 37 BRNO, CZECH REPUBLIC
[3] UNIVERSITY OF BELGRADE, FACULTY OF AGRICULTURE, NEMANJINA 6, 11080 BELGRADE-ZEMUN, SERBIA
[4] VEGETATION ANALYSIS & PLANT DIVERSITY, ALBRECHT VON HALLER INSTITUTE OF PLANT SCIENCES, UNIVERSITY OF GÖTTINGEN, UNTERE KARSPÜLE 2, D-37073 GOETTINGEN, GERMANY
[5] INSTITUTE OF PLANT SCIENCES AND BOTANICAL GARDEN, UNIVERSITY OF BERN, ALTENBERGRAIN 21, 3013 BERN, SWITZERLAND
[6] RESEARCH CENTER OF SLOVENIAN ACADEMY OF SCIENCE AND ARTS, NOVI TRG 2, 1000 LJYBLJANA, SLOVENIA
[7] INSTITUTE OF BIOLOGY, FACULTY OF NATURAL SCIENCES AND MATHEMATICS, UNIVERSITY OF SS. CYRIL AND METHODIUS, GAZI BABA BB, MK-1000 SKOPJE, REPUBLIC OF MACEDONIA
[8] DEPARTMENT OF FORESTRY & N.E.M., TEI OF CENTRAL GREECE, KARPENISSI, GR-36100, GREECE
[9] UNIV. OF BELGRADE, FACULTY OF BIOL., INSTITUTE OF BOTANY AND BOTANICAL GARDEN "JEVREMOVAC", TAKOVSKA 43, BELGRADE, SERBIA
[10] UNIVERSITY OF PRISTINA, FACULTY OF MATHEMATICAL-NATURAL SCIENCE, PRISTINA, KOSOVO
[11] UNIVERSITY OF NOVI SAD, FACULTY OF SCIENCE, DEPARTMENT OF BIOLOGY AND ECOLOGY, TRG DOSITEJA OBRADOVIĆA 2, NOVI SAD, SERBIA
[12] DEPARTMENT OF BOTANY, SCHOOL OF BIOLOGY, ARISTOTLE UNIVERSITY OF THESSALONIKI, GR-54124 GREECE
[13] UNIVERSITY OF NOVA GORICA, VIPAVSKA 13, 5000 NOVA GORICA, SLOVENIA
[14] PLANT ECOLOGY, BAYREUTH CENTER OF ECOLOGY AND ENVIRONMENTAL RESEARCH (BAYCEER); UNIVERSITY OF BAYREUTH, UNIVERSITÄTS STR. 30, 95447 BAYREUTH, GERMANY
[15] SYNTHESIS CENTRE (SDIV), GERMAN CENTRE FOR INTEGRATIVE BIODIVERSITY RESEARCH (IDIV) HALLE-JENA-LEIPZIG, DEUTSCHER PLATZ 5E , 04103 LEIPZIG, GERMANY

Questions: What are the major floristic and ecological gradients of the Balkan dry grassland vegetation and how could they best be reflected in a formal phytosociological classification?
Location: Bulgaria, Northern Greece, Republic of Macedonia, Kosovo and Serbia.
Methods: We compiled a comprehensive vegetation-plot database of dry grasslands from the study region (Balkan Dry Grassland Database; GIVD ID: EU-00-013), consisting of 8,348 relevés. Ultimately, we used those 7,178 relevés that were within the study area, sized between 15 and 100 m² and had a tree and shrub cover below 30%. We used the Expert System in Juice to extract dry grassland vegetation only (i.e. *Festuco-Brometea*, *Helichryso-Crucianelletea*, *Helianthemetea guttati*, *Koelerio-Corynephoretea* s.l., *Lygeo-Stipetea*, *Poetea bulbosae*, *Stipo-Agrostietea*, *Stipo-Trachynietea*), relying on a consensus list of class diagnostic species. The remaining 6,477 plots were further stratified using Heterogeneity Constrained Resampling (HCR) with a grid cell size of 15'× 25'. We applied TWINSPAN to the vascular plant data set to obtain a numerical classification. We compared the clusters of the TWINSPAN classification with described syntaxa, re-assigned a small fraction of plots to increase the floristic crispness of clusters and translated the result into a phytosociological classification scheme.
Results: We classified the dry grasslands to the upper syntaxonomic levels (class, order, alliance), determined sets of statistically validated diagnostic species for these as well as distribution maps.
Conclusions: We provide the first consistent, supra-national classification of dry grasslands on the Balkan Peninsula. Doing this we overcome the previous idiosyncrasies of national classifications and make a contribution to a future update of the EuroVegChecklist.

KEYWORDS: BALKANS, DRY GRASSLAND, ECOINFORMATICS, *FESTUCO-BROMETEA*, *HELIANTHEMETEA GUTTATI*, *KOELERIO-CORYNEPHORETEA*, PHYTOSOCIOLOGY, VEGETATION CLASSIFICATION

## MAPPING OF FINE-RESOLUTION PATTERNS OF VASCULAR PLANT SPECIES RICHNESS ACROSS EUROPEAN FORESTS

MARTIN VEČEŘA[1], MILAN CHYTRÝ[1], JAN DIVÍŠEK[1,2], ILONA KNOLLOVÁ[1], AND DATA CONTRIBUTORS

[1] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, BRNO, CZECH REPUBLIC
[2] DEPARTMENT OF GEOGRAPHY, MASARYK UNIVERSITY, BRNO, CZECH REPUBLIC

Many studies have been exploring species-richness patterns and their drivers at regional, continental and global scales. However, most of them have inferred the patterns from spatially generalized data based on atlases or inventories of large areas, which may significantly limit the accuracy of the results. In this study, we analysed total vascular plant species richness in forest vegetation across Europe using a large set of spatially referenced phytosociological relevés.

Our aims were: (1) to map species richness of vascular plants in European forests both for all forest types and separately for coniferous, deciduous broadleaf, and sclerophyllous forests; (2) to examine factors determining the species-richness patterns; (3) to create a fine-resolution predictive maps of vascular plant species richness in European forests.

We used over 100000 relevés of all forest types with plot sizes of 100–1000 $m^2$ selected from national or regional databases, most of them integrated in the European Vegetation Archive. The data set covers the area from Portugal in the west to Bulgaria in the east and from southern Sweden in the north to Sicily in the south. As possible drivers of the observed patterns, we considered selected climatic, topographical, soil-geological, landscape-structure, and historical factors. Data processing included: (1) data filtering (based on sampling date, location error, etc.); (2) linking the relevés with explanatory variables using GIS techniques; (3) calculating a predictive model using the Random Forest method; and (4) creating predictive maps of species richness.

Our results suggest that the richest forests (when all forests are considered together) occur in the mountainous regions with high proportion of calcareous bedrock and relatively high values of actual evapotranspiration, e.g. the Limestone Alps. In contrast, species-poor forests predominate in north-western Europe, e.g. on the British Isles.

KEYWORDS: SPECIES RICHNESS, VASCULAR PLANT, FOREST VEGETATION, FINE-RESOLUTION PATTERNS, EUROPE, RANDOM FORESTS, PREDICTIVE MAP, EUROPEAN VEGETATION ARCHIVE

## METHODOLOGY FOR ASSESSMENT AND MAPPING OF GRASSLAND ECOSYSTEMS CONDITION AND THEIR SERVICES IN BULGARIA

NIKOLAY VELEV[1], DESISLAVA SOPOTLIEVA[1], IVA APOSTOLOVA[1], VASSIL VASSILEV[2], HRISTO PEDASHENKO[1], YASEN STOYANOV[1], TSVETELINA TERZIYSKA[1], KIRIL VASSILEV[1]

[1] INSTITUTE OF BIODIVERSITY AND ECOSYSTEM RESEARCH, BULGARIAN ACADEMY OF SCIENCES, SOFIA, BULGARIA
[2] REMOTE SENSING APPLICATION CENTER (RESAC), SOFIA, BULGARIA

Aims: Building national methodology for mapping and assessment of Grassland ecosystems condition and services.
Location: Bulgaria.
Methods: Using relevant information sources for a practical step-by-step guidance to the process of: 1) assessing the biophysical condition of the Grassland ecosystems and 2) assessing the Grasslands potential to deliver ecosystem services. Data sources used to derive appropriate indicators were digital maps with component on land use/cover, national statistics and vegetation relevés. A substantial amount of information about the selected parameters is included in the national vegetation databases.
Results: The typology of Grassland ecosystems corresponds to the habitat types of EUNIS combined with the ecosystem classification of MAES (2013). Five grassland ecosystem types are proposed at country level: Dry grasslands, Mesic grasslands, Seasonally wet and wet grasslands, Alpine and subalpine grasslands, Inland salt steppes. Indicators and parameters for assessing the grassland Condition and Ecosystem Services are selected. Vector dataset is generated for representation of polygon features each of them containing information for each ecosystem type. The final database integrates the vector features with comprehensive table datasets allowing the users to perform various queries, analyses and specific thematic information on selected grassland types.
Conclusion: The proposed methodology is being now implemented in a project financed by the EEA Grants. The final product is intended to be used by Ministry of Environment and Waters, NGOs, stakeholders and scientific organizations who will to perform ecosystems' condition assessment and valuation of Ecosystem Services in Bulgaria.

KEYWORDS: BIOPHYSICAL EVALUATION, DATABASE, MAPS, VEGETATION

## CLASSIFICATION OF PONTIC-CASPIAN TRUE STEPPE VEGETATION: PRELIMINARY OVERVIEW

DENYS VYNOKUROV

M.G. KHOLODNY INSTITUTE OF BOTANY, NATIONAL ACADEMY OF SCIENCES OF UKRAINE

Recently, research of different types of vegetation using large datasets of relevés have gained particular importance. Broad-scale classification was carried out with Pontic-Caspian true steppe vegetation. For an analysis it was used our own relevés, as well as published and unpublished other authors' materials. The entire database includes 14940 relevés.

An analysis of the entire database was conducted using Modified TWINSPAN Classification. *Phi* coefficient was used for the determination of diagnostic species of obtained clusters. The analysis indicated that the entire data array was divided into four main groups of clusters.

The first most separated group combines exactly the Pontic-Caspian true steppe vegetation that we consider as a new order *Galatello villosae-Stipetalia lessingianae* ord. nov. prov. These communities are distributed towards the west from the Eastern part of Romania (Vama Veche region), through the Southern Moldavia, steppe zone of Ukraine and of Western part of Russian Federation up to Ural mountain range and to Ural river on the East. On the North its distribution is limited by the Forest-Steppe zone boundaries, but some communities can also occur in the latter area. Another groups represent respectively *Stipo pulcherrimae-Festucetalia pallentis* Pop 1968, *Festucetalia valesiacae* Soó 1947 and *Brachypodietalia pinnati* Korneck 1974.

Within the new order we distinguish 7 alliances which combine different ecological and geographical variants of the true steppe vegetation: Pontic bunchgrass steppes, forb-bunchgrass steppes, Caspian bunchgrass steppes, saline steppe vegetation, the vegetation of the limestone and granitic outcrops, and ruderalized steppe vegetation. Within these 7 alliances we distinguish 26 associations but in the future its syntaxonomy should be improved.

KEYWORDS: NUMERICAL ANALYSIS, *GALATELLO VILLOSAE-STIPETALIA LESSINGIANAE*, TRUE STEPPE VEGETATION, PONTIC-CASPIAN REGION

## LARGE VEGETATION DATABASE REVEALS CONTRASTING LEVELS OF INVASION ACROSS EUROPEAN WOODLANDS

VIKTORIA WAGNER[1], MILAN CHYTRÝ[1], ILONA KNOLLOVÁ[1], BORJA JIMÉNEZ-ALFARO[1], JAN PERGL[2], PETR PYŠEK[2,3], IDOIA BIURRUN[4], DATA CONTRIBUTORS

[1] DEPARTMENT OF BOTANY AND ZOOLOGY, MASARYK UNIVERSITY, KOTLÁŘSKÁ 2, CZ–611 37 BRNO, CZECH REPUBLIC
[2] INSTITUTE OF BOTANY CAS, ZÁMEK 1, CZ-252 43 PRŮHONICE, CZECH REPUBLIC
[3] DEPARTMENT OF ECOLOGY, FACULTY OF SCIENCE, CHARLES UNIVERSITY IN PRAGUE, VINIČNÁ 7, CZ-128 44 PRAHA 2, CZECH REPUBLIC; DEPARTMENT OF PLANT BIOLOGY AND ECOLOGY
[4] UNIVERSITY OF THE BASQUE COUNTRY UPV/EHU, P.O.BOX 644, BILBAO, SPAIN

Questions: The European Union considers the management of invasive alien plants a key objective of its biodiversity strategy. However, little is known about the levels of alien plant invasion across European vegetation types. We addressed to what extent EUNIS woodland habitat types differ in their levels of invasion by vascular plants.
Location: Europe
Methods: We created a dataset of 246,899 plots by combining records of the European Vegetation Archive (EVA) and regional databases. For every plot, we assigned a EUNIS habitat type by using a crosswalk based on phytosociological alliances and species composition. Information on species status (alien, native) and origin (e.g. intra-European taxa, extra-European taxa) was derived from multiple sources (incl. DAISIE, Euro+Med, GloNAF, and primary literature). Data were extensively filtered and only well-represented EUNIS types were included in the analysis. We calculated levels of invasion as the number of alien species divided by the total number of species in a plot.
Results: Our first results show that softwood riparian woodlands had the highest level of invasion (mean > 0.04); other riparian woodlands also reached high values (> 0.02). By comparison, coniferous forests tended to rank among the habitat types with the lowest levels of invasion.
Discussion: Our results suggest that woodlands with a high disturbance regime and nutrient flow are highly susceptible to alien plant invasion. Our next step is an in-depth analysis of the spatial and environmental drivers of alien plant invasions across European woodlands.

KEYWORDS: FORESTS, EUNIS HABITAT TYPES, EUROPEAN VEGETATION ARCHIVE, DAISIE, NON-NATIVE PLANTS

## SEMI-SUPERVISED CLASSIFICATION OF IRISH RIVER VEGETATION – A FIRST FOR IRELAND

LYNDA WEEKES[1,2], ÚNA FITZPATRICK[2], AND MARY KELLY-QUINN[1]

[1] SCHOOL OF BIOLOGY AND ENVIRONMENTAL SCIENCE, UNIVERSITY COLLEGE DUBLIN, DUBLIN 4, IRELAND
[2] NATIONAL BIODIVERSITY DATA CENTRE, WIT WEST CAMPUS, CARRIGANORE, WATERFORD, IRELAND.

Ireland does not currently have a comprehensive national phytosociological river vegetation classification system. Today, Ireland must rely on the definitions for the habitats protected under the EU Habitats Directive and Irish Fossitt habitat classification scheme that have only two categories for rivers; upland (FW1) and lowland (FW2). It is recognised that this falls well short of describing the varied river vegetation communities that exist. There is also a lack of river vegetation data in Ireland's National Vegetation Database to use for analysis and subsequently assign to existing syntaxonomic units.

The purpose of this research was to collate existing river vegetation plots in to a River Macrophyte Database (RMD) and to then to construct a phytosociological classification system for Irish rivers. The RMD today contains 2415 river vegetation plots and after a thorough screening of the plots, a little over 1500 plots were deemed suitable for analysis. There were challenges when carrying out analysis due to the heterogeneity of these data but it was decided that K-means through the programme JUICE was the most appropriate approach to take for analysis. Vegetation plots were assigned to syntaxonomic groups where possible, unrecognised groups were either considered to be transitional vegetation or proposed as new vegetation variants. Much of the lowland rivers were assigned to well-known riparian and aquatic syntaxa, whereas some of the upland streams were more akin to spring vegetation found in some European mountain regions. There is a comprehensive number of plots from high status rivers (those of high water quality) that can form a reference classification system for conservation and restorative work in the future.

KEYWORDS: RIVER VEGETATION, CLASSIFICATION, SYNTAXONOMY, REFERENCE VEGETATION, PHYTOSOCIOLOGY, IRELAND

## INTERPRETATING THE INTERPRETATION MANUAL OF EU HABITATS: A STORY OF CONFUSION

WOLFGANG WILLNER

VIENNA INSTITUTE FOR NATURE CONSERVATION & ANALYSES (VINCA), GIESSERGASSE 6/7, 1090 VIENNA, AUSTRIA;
DEPARTMENT OF BOTANY AND BIODIVERSITY RESEARCH, UNIVERSITY OF VIENNA, RENNWEG 14, 1030 VIENNA, AUSTRIA

Due to the federalistic structure of Austria, no uniform interpretation of the habitat types listed in Annex I of the Habitat Directive has been established. Moreover, Austria has borders with many other member states having their own national interpretations of the EU habitat types. This makes Austria a perfect laboratory for testing the applicability of the Interpretation Manual. After 20 years of observation we can conclude that it failed the test. In a short historical overview I will show how the original list of habitats became increasingly confusing with each round of enlargement of the European Union. I will discuss the habitat types with the most urgent need for clarification and I will give examples of the same vegetation unit being included in different habitat types in different member states. Moreover, I will discuss problems related to the difference between potential and actual vegetation that can not be solved on the basis of the Interpretation Manual. Finally, I will give some recommendations how a future edition of the Interpretation Manual should look like.

KEYWORDS: AUSTRIA, HABITAT DIRECTIVE, NATURA 2000

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