



EPCN  
European Pond Conservation Network

23-25 February  
2006

# Conservation of pond biodiversity

Toulouse  
FRANCE

## in a changing European Landscape



# ABSTRACT BOOK



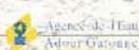
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Pond Conservation  
For Life in Fresh Waters

# Conservation of pond biodiversity in a changing European Landscape

## Toulouse, France, 23 – 25 February 2006

CNRS-CEMES Campus, 29 rue Jeanne Marvig, 31400 Toulouse

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- **R. Céréghino**, University Paul Sabatier & CNRS, Toulouse, France
- **B. Sajaloli**, Pôle Relais Mares et Mouillères de France, France
- **B. Oertli, S. Angélibert**, University of Applied Sciences of Western Switzerland, Geneva.
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## **WELCOME**

Welcome to the 2<sup>nd</sup> Workshop of the European Pond Conservation Network (EPCN). EPCN meetings provide opportunity to learn about and discuss science, education, and management issues related to ponds throughout Europe. Contributions are expected to yield a multi-disciplinary framework on how to maintain ponds and the biodiversity they host, in a landscape subjected to a wide array of potential stressors such as intensification/abandonment of agriculture, socio-economical pressures, climate change.

The official language of the workshop is English.

## **MEETING SITE**

The workshop, lunches, and coffee breaks will take place at the **CNRS-CEMES research campus** located **29 rue Jeanne Marvig, Toulouse**, a green place south-east of the city center, close to University Paul Sabatier. The building will be identified by signs and advertisements.

A special shuttle ("**EPCN bus**") will be organized between hotels (Wilson square – departure time 7:45 – 8:00) and the meeting site (rue Jeanne Marvig) during the three days. If for any reason you don't take the Workshop bus, you have the possibility to take the city bus N°24 Rue d'Alsace Lorraine (Alsace Lorraine street), direction "Rangueil Cité U", and to stop at "Bonnat". Wilson square also has a taxi station. The meeting building is about 200 m from this stop, and will be indicated by signs.

## **GENERAL INFORMATION**

### **Registration on Wednesday 22<sup>nd</sup> and Thursday 23<sup>rd</sup>.**

Registration will start on Wednesday 22<sup>nd</sup> from 17:00 to 19:30 in the hall of Hotel Le Capitole (10 rue Rivals, Toulouse) - A cocktail will be offered in the hotel hall.

Registration will go on the following day (Thursday 23<sup>rd</sup>, morning) in the hall of the meeting site building. Participants will receive their delegate packs when they will be registered.

### **Badge**

The personal badge you will receive is your entrance ticket to all conference sessions and receptions – remember to wear it during the workshop period.

### **Meals**

Lunches and dinners, from Thursday 23<sup>rd</sup> to Saturday 25<sup>th</sup>-noon, are included in the registration fees. Lunches will be served at the CNRS-CEMES campus restaurant, nearby the meeting room.

Dinners will be taken in the city center, a few minutes walk from the hotels area. A reception will be given at the Town Hall on Thursday 23<sup>rd</sup>, followed by a dinner in a nearby restaurant (Restaurant Le Gascon, 9 rue des Jacobins, Toulouse). The congress dinner will be on Friday 24<sup>th</sup> (Restaurant Les Caves de la Maréchale, 3 rue Jules Chalande, Toulouse). South-Western France boasts the oldest culinary art in France – we hope that you will enjoy our selection of restaurants.

### **Accommodation**

Accommodation is not included in the registration fees. We have suggested a list of affordable hotels in the historical center of Toulouse, all located nearby Wilson Square (departure and arrival of the workshop bus, city buses and taxi station), and nearby the Town Hall.

## **INFORMATION FOR ORAL AND POSTER PRESENTATIONS**

### **Oral presentation**

Please pay special attention to the timing of your talk: your presentation should not be longer than 15 minutes. After your oral presentation, 5 minutes will be devoted to discussions with the audience (questions).

We ask participant to prepare their slideshow using Microsoft PowerPoint® (ppt format). Save your file in a PC-compatible standard, on a USB drive or a CD-ROM. You will transfer your file to the meeting room computer at the beginning of each session and/or during coffee breaks.

## **Poster Presentation**

The dimensions of posters should not exceed 90 x 120 cm (about A0 format) at a maximum. Posterboards will be available in the hall of the meeting building. The posterboards will be grouped by topics (1, 2, 3). Posters should be set up on the arrival of the delegates (Thursday morning), and should remain until the end of the workshop.

During the special Poster Session on Friday, we require authors to be ready to make a 2-5 minutes presentation (stressing the main points of their poster) when participants may wish to view and discuss their works.

## **Oral and poster presentations relate to the following topics :**

### **Topic 1. Understanding pond ecology**

- Ponds as biodiversity reservoirs – geographic and temporal patterns
- Hydrology and temporary pool ecology
- Ponds as research tools – hypothesis testing
- Threats and human-induced changes

### **Topic 2. Added values of ponds**

- Functional role of ponds within the landscape – catchment
- Ecosystem services, biological indicators
- Social & economic use, historical & patrimonial value

### **Topic 3. Management of ponds, policy and education**

- Practical tools for management and monitoring
- Political importance, law in different countries
- Importance of ponds in ecological networks, EU habitat directive
- Ponds as educational tools in nature conservation

## **INTERNET ACCESS**

For e-mail and internet access, computers will be available near the workshop room.

## PROGRAMME

### Wednesday 22 February

17:00 – 19:30 Registration and cocktail at Hotel Le Capitole (10 rue Rivals, Toulouse)

### Thursday 23 February

8:30 Registration (meeting building, CNRS-CEMES Campus, 29 rue Jeanne Marvig, Toulouse)

9:15 Opening ceremony

#### Topic 1. Chair : B. Oertli

9:30 **Biggs J, Williams P & Whitfield M.**

Catchment scale patterns in aquatic biodiversity: the contribution made by ponds

9:50 **Briers R, Williams P, Whitfield M, Walker D & Biggs J.**

Rare and common components of species richness patterns in pond invertebrate communities

10:10 **Boix D, Sala J, Gascón S, Martinoy M, Gifre J, Brucet B, Badosa A, López-Flores R & Quintana X.D.**

Composition and richness of crustaceans and insects of Mediterranean ponds (NE Iberian peninsula)

10:30 **Jeffries M.**

Climate tracking by pond invertebrates

10:50 Coffee break & posters

#### Topic 2. Chair : X.D. Quintana

11:25 **Oertli B, Indermuehle N, Hinden H & Stoll A.**

Macroinvertebrate assemblages in the high alpine ponds of the Swiss national park (Cirque of Macun) and evaluation of their potential as indicators of global changes

11:45 **Della Bella V & Mancini L.**

The use of Diatoms as biological indicators of water quality of ponds as recommended by the Water Framework Directive 2000/60/EC

12:05 **Maletzky A, Goldschmid A, Kyek M, & Mikulicek P.**

Crested newts (*Triturus cristatus*-superspecies) as indicators for the quality of pond networks in Salzburg, Austria

12:25 **Davies B, Thompson S, Biggs J & Lee J.**

The relative catchment sizes of five waterbody types in a lowland agricultural landscape in the UK: How ponds are the most effective waterbodies to protect

12:45 **LUNCH** (Campus restaurant)

#### Topic 3. Chair : B. Sajaloli

14:00 **Weatherby A, Biggs J, Williams P, Nicolet P, Whitfield M & Aquilina R.**

The UK National Pond Monitoring Network

14:20 **Lacomba I & Sancho V.**

Restoration of Priority Habitats for Amphibians. A LIFE-Nature project on Valencian Community (East Spain)

14:40 **Biggs J.**

Presentation of the European Pond Conservation Network (EPCN)

15:30 **Working Groups**

WG1 : Pond manifesto (coordination : R. Céréghino)

WG2 : EPCN funding and activities (coordination : J. Biggs)

17:30 End (workshop bus to city center)

18:15 Reception at Town Hall (1 Place du Capitole, Toulouse)

19:30 Restaurant (Le Gascon, 9 rue des Jacobins, Toulouse)

Friday 24 February

**Topic 2. Chair : J. Biggs**

- 9:00 **Ruggiero A, Céréghino R, Figuerola J, Marty P, Angélibert S.**  
Artificial ponds support human activities and promote biodiversity: agriculture and odonates in SW France
- 9:20 **Declerck S, De Bie T, Brendonck L, De Meester L & Martens K**  
Habitat characteristics of small ponds in an agricultural landscape: associations with land-use patterns and practices
- 9:40 **De Bie T, Declerck S, Martens K, De Meester L & Brendonck L.**  
Zooplankton community structure of farmland ponds in relation with land use and pond characteristics
- 10:00 **Louette G, Declerck S & De Meester L.**  
Succession in zooplankton communities of newly created pools
- 10:20 Coffee break & posters

**Topic 1. Chair : L. Brendonck**

- 11:00 **Cayrou J, Céréghino R, Ruggiero A, Marty P, Angélibert S.**  
Ontogenetic succession and the functional organisation of pond invertebrate communities: an empirical study
- 11:20 **Gascón S, Boix D, Sala J & Quintana X.D.**  
Relation between macroinvertebrate life strategies and habitat traits in Mediterranean salt marsh ponds (Empordà wetlands, NE Iberian Peninsula)
- 11:40 **Frisch D & Green A.J.**  
Copepods come in first: rapid colonisation of newly built ponds
- 12:00 **De Meester L, Duvivier C, Van Damme C & Louette G.**  
Genetic composition of resident populations influences establishment success of immigrant species
- 12:30 **LUNCH** (Campus restaurant)
- 14:00 **Poster Session**

**Topic 1. Chair : P. Grillas**

- 15:00 **De Roeck E, Waterkeyn A, Vanschoenwinkel B, Raitt L, Xu Y & Brendonck L.**  
Relation between hydroperiod and invertebrates in temporary wetlands.
- 15:20 **Bagella S, Farris E, Filigheddu R & Pisanu S.**  
Spatial and temporal variability of plant biodiversity in Mediterranean temporary ponds in different landscapes
- 15:40 **Tavernini S & Rossetti G.**  
Zooplankton communities of nine mountain temporary pools: a two-year study
- 16:00 **Working Group**  
WG3: Joint research programs (coordination : B. Oertli)
- 18:00 End (workshop bus to hotels)
- 20:00 Congress dinner (Restaurant Les Caves de la Maréchale, 3 rue Jules Chalande, Toulouse)

<b>Saturday 25 February</b>
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**Topic 3. Chair : S. Angélibert**

- 9:00 **Sajaloli B.**  
Pond loss and uses in the Parisian basin : historical perspectives
- 9:20 **Williams P, Biggs J & Whitfield M.**  
Creating new ponds: principles and practice
- 9:40 **Kyek M, Maletzky A.**  
Pond conservation in Salzburg, Austria: policy, practical examples and problems from the amphibian's point of view
- 10:00 **Nicolet P, Williams P, Whitfield M & Biggs J.**  
The ecological basis for pond management: a synthesis and update of pond management myths
- 10:20 Coffee break

**Topic 1. Chair : R. Céréghino**

- 11:00 **Kaletka T, Berger G & Augustin J.**  
Kettle holes in young moraine landscapes of Northeast Germany - distribution, typology, pollution and conservation aspects
- 11:20 **Angélibert S, Whitfield M, Williams P & Biggs J.**  
The impact of anthropogenic stresses on macroinvertebrate assemblages: a comparison of minimally impaired and variably degraded ponds in the United Kingdom
- 11:40 **Organizing & Scientific Committee**  
Minute from the workshop  
Students' prizes  
Cloturing Ceremony
- 12:30 **LUNCH** (Buffet)
- 13:30 Bus to Toulouse center

## WORKING GROUPS

### **WG1 : Pond Manifesto - Thursday 23 February, 15:30** (coordinated by R. Céréghino)

- Presentation of what has been written on items 1 – 5 derived from 1<sup>st</sup> Workshop in Geneva
- Editing and reviewing of texts
- Writing of a 1-page Introduction
  
- Deliverable : “The Pond Manifesto”, a 10 – 15 pages document, authored by “The European Pond Conservation Network” (the list of contributors’ names will be mentioned at the end of the document). The Pond Manifesto will be published as :
  - A peer-reviewed paper in Ann Limnol – Int J Lim
  - A booklet version, with colour illustrations

### **WG2 : EPCN funding, management and activities - Thursday 23 February, 15:30**

(coordinated by J. Biggs)

- Presentation by Jeremy Biggs of expected structure
- Coordination, activities that could be done with existing persons
- What could be done with funds ?
  
- Deliverable : Outline for LIFE PROJECT application in 2007

### **WG3 : Joint Research Programs – Friday 24 February, 16:00** (coordinated by B. Oertli)

- Presentation of a potential list of applications
- Selection of 2-3 relevant calls for proposals
- Sub-groups elaborate the outline of future applications
  
- Deliverable :
  - 1 leader per future application
  - 1 list of persons involved per application
  - Identify and assign tasks to elaborate application during the months after workshop

## LIST OF CONTRIBUTIONS

\*O = Oral communication, P = Poster presentation

	O / P*	Page
<b>Angélibert S, Whitfield M, Williams P &amp; Biggs J.</b> The impact of anthropogenic stresses on macroinvertebrate assemblages: a comparison of minimally impaired and variably degraded ponds in the United Kingdom	O	12
<b>Bagella S, Farris E, Filigheddu R &amp; Pisanu S.</b> Spatial and temporal variability of plant biodiversity in Mediterranean temporary ponds in different landscapes	O	13
<b>Bazzanti M, Grezzi F &amp; Della Bella V.</b> Chironomids (Diptera) of temporary and permanent ponds in Central Italy: a neglected invertebrate group in pond ecology	P	14
<b>Biggs J, Williams P &amp; Whitfield M.</b> Catchment scale patterns in aquatic biodiversity: the contribution made by ponds	O	15
<b>Boix D, Sala J, Gascón S, Martinoy M, Gifre J, Brucet B, Badosa A, López-Flores R &amp; Quintana X.D.</b> Composition and richness of crustaceans and insects of Mediterranean ponds (NE Iberian peninsula)	O	16
<b>Boven L, De Meester L, Stoks R &amp; Brendonck L.</b> Temporal and spatial dynamics of temporary pools and their branchiopod communities: a case study in Hungary	P	17
<b>Briers R, Williams P, Whitfield M, Walker D &amp; Biggs J.</b> Rare and common components of species richness patterns in pond invertebrate communities	O	18
<b>Brucet S, Compte J, Boix D, López-Flores R, Badosa A &amp; Quintana X.D.</b> Does intraspecific competition influence zooplankton assemblage structure in Mediterranean coastal marshes ?	P	19
<b>Carchini G, Della Bella V, Solimini A.G &amp; Bazzanti M.</b> Relationships between the presence of Odonata species and environmental characteristics in lowland ponds of central Italy.	P	20
<b>Cayrou J, Céréghino R, Ruggiero A, Marty P, Angélibert S.</b> Ontogenetic succession and the functional organisation of pond invertebrate communities: an empirical study	O	21
<b>Davies B, Thompson S, Biggs J &amp; Lee J.</b> The relative catchment sizes of five waterbody types in a lowland agricultural landscape in the UK: How ponds are the most effective waterbodies to protect	O	22
<b>De Bie T, Declerck S, Martens K, De Meester L &amp; Brendonck L.</b> Zooplankton community structure of farmland ponds in relation with land use and pond characteristics.	O	23
<b>De Meester L, Duvivier C, Van Damme C &amp; Louette G.</b> Genetic composition of resident populations influences establishment success of immigrant species	O	24
<b>De Roeck E, Waterkeyn A, Vanschoenwinkel B, Raitt L, Xu Y &amp; Brendonck L.</b> Relation between hydroperiod and invertebrates in temporary wetlands.	O	25
<b>De Roeck E, Waterkeyn A, Vanschoenwinkel B, Verhoest N, Raitt L, Xu Y &amp; Brendonck L.</b> Condition of temporary wetlands in the Darling region (Western Cape, South Africa).	P	26
<b>Declerck S, De Bie T, Brendonck L, De Meester L &amp; Martens K</b> Habitat characteristics of small ponds in an agricultural landscape: associations with land-use patterns and practices	O	27
<b>Della Bella V &amp; Mancini L.</b> The use of Diatoms as biological indicators of water quality of ponds as recommended by the Water Framework Directive 2000/60/EC	O	28

<b>Della Bella V, Bazzanti M, Dowgiallo M.G &amp; Iberite M.</b> Macrophyte diversity and physico-chemical characteristics of Tyrrhenian coast ponds in central Italy: implications for conservation	<b>P</b>	29
<b>Demeter L.</b> Spatial patterns of temporary pond and large branchiopod distribution in Romania	<b>P</b>	30
<b>Frisch D &amp; Green A.J.</b> Copepods come in first: rapid colonisation of newly built ponds	<b>O</b>	31
<b>Gascón S, Boix D, Sala J &amp; Quintana X.D.</b> Relation between macroinvertebrate life strategies and habitat traits in Mediterranean salt marsh ponds (Empordà wetlands, NE Iberian Peninsula)	<b>O</b>	32
<b>Hollinshead J, De Bie T &amp; Declerck S.</b> Origins, Ecology and social significance of the Tommellen Pond complex near Hasselt, Belgium	<b>P</b>	33
<b>Hollinshead J, Hull A.</b> A web and GIS based <i>Triturus cristatus</i> (Great Crested Newt) site Inventory in North West England, UK	<b>P</b>	34
<b>Indermuehle N &amp; Oertli B.</b> Pond biodiversity assessment: how to implement a standardized method through practitioners (case study in Geneva, CH)	<b>P</b>	35
<b>Jeffries M.</b> Climate tracking by pond invertebrates	<b>O</b>	36
<b>Jocqué M, Riddoch B, Timms B &amp; Brendonck L.</b> Freshwater rock pool communities; build on environmental variables, shaped by biotic interactions	<b>P</b>	37
<b>Kalettko T &amp; Rudat C.</b> Hydrogeomorphic types of glacially created kettle holes in Northeast Germany	<b>P</b>	38
<b>Kalettko T, Berger G &amp; Augustin J.</b> Kettle holes in young moraine landscapes of Northeast Germany - distribution, typology, pollution and conservation aspects	<b>O</b>	39
<b>Kyek M, Maletzky A.</b> Pond conservation in Salzburg, Austria: policy, practical examples and problems from the amphibian's point of view	<b>O</b>	40
<b>Lacomba I &amp; Sancho V.</b> Restoration of Priority Habitats for Amphibians. A LIFE-Nature project on Valencian Community (East Spain)	<b>O</b>	41
<b>Louette G, Declerck S &amp; De Meester L.</b> Succession in zooplankton communities of newly created pools	<b>O</b>	42
<b>Lugliè A, Mariani M.A, Padedda B.M, Bagella S &amp; Sechi N.</b> Microalgal assemblages and environmental conditions in Mediterranean temporary ponds: first data from Sardinia (Italy)	<b>P</b>	43
<b>Maletzky A, Goldschmid A, Kyek M, &amp; Mikulicek P.</b> Crested newts ( <i>Triturus cristatus</i> -superspecies) as indicators for the quality of pond networks in Salzburg, Austria	<b>O</b>	44
<b>Mandrillon A.L &amp; Saglio P.</b> Herbicide exposure affects the learned chemical recognition of an invasive predator in common toad tadpoles ( <i>Bufo bufo</i> )	<b>P</b>	45
<b>Manel S, Martin R &amp; Miaud C</b> Tracking the role of landscape fragmentation on genetic structure in amphibian breeding in pond archipelago	<b>P</b>	46
<b>Marty P, Angélibert S, Ruggiero A, Giani N.</b> Feeding ecology and resources partitioning in sympatric populations of <i>Triturus marmoratus</i> and <i>Triturus helveticus</i> during their aquatic phase	<b>P</b>	47
<b>Menetrey N, Oertli B, Sartori M, Wagner A.</b> Water quality: are mayflies (Ephemeroptera) good bioindicators for ponds?	<b>P</b>	48
<b>Murton K &amp; Slater F</b> Phenological change in Common British Amphibians	<b>P</b>	49
<b>Nicolet P, Williams P, Whitfield M &amp; Biggs J.</b> The ecological basis for pond management: a synthesis and update of pond management myths	<b>O</b>	50
<b>Oertli B, Indermuehle N, Hinden H &amp; Stoll A.</b> Macroinvertebrate assemblages in the high alpine ponds of the Swiss national	<b>O</b>	51

park (Cirque of Macun) and evaluation of their potential as indicators of global changes		
<b>Orzechowska A &amp; Szyperek U</b> Habitat diversity for avifauna of small mid-field reservoirs in the Olsztyn Lakeland	<b>P</b>	52
<b>Pöckl R, Schabetsberger R</b> Plankton communities of the Weitmoos: A comparison of selected ponds in different developmental stages	<b>P</b>	53
<b>Rhazi L, Grillas P, Charpentier A, Rhazi A, Leclainche N, Titolet D, Desnouhes L, Duborper E &amp; El Khyari D</b> Causes for inter-annual instability of a rare annual species of Mediterranean temporary pools : <i>Elatine brochonii</i> Clav. (Elatinaceae)	<b>P</b>	54
<b>Rhazi L, Grillas P, Rhazi M, Titolet D &amp; El Khyari D</b> Richness and inter-annual dynamics of vegetation in unstable environment : the Moroccan temporary pools	<b>P</b>	55
<b>Ruggiero A, Céréghino R, Azemar F, Marty P, Angélibert S.</b> Habitat heterogeneity sustains the most productive invertebrate predators: evidences from ponds	<b>P</b>	56
<b>Ruggiero A, Céréghino R, Figuerola J, Marty P, Angélibert S.</b> Artificial ponds support human activities and promote biodiversity: agriculture and odonates in SW France	<b>O</b>	57
<b>Sager L.</b> Measuring the trophic status of ponds: relations between the summer rate of primary productivity and the physico-chemistry of the water	<b>P</b>	58
<b>Sahuquillo M, Poquet J.M, Rueda J &amp; Miracle M.R.</b> Macroinvertebrate biodiversity in coastal Mediterranean wetlands	<b>P</b>	59
<b>Sajaloli B.</b> Pond loss and uses in the parisian basin : historical perspectives	<b>O</b>	60
<b>Sala J, Font J, Gascón S &amp; Boix D.</b> Proposal of additional criteria for conservation purposes of the Mediterranean temporary ponds	<b>P</b>	61
<b>Sancho V &amp; Lacomba I.</b> Looking for an integrated pond management in Valencia	<b>P</b>	62
<b>Solimini A.G, Bazzanti M, Ruggiero A &amp; Carchini G.</b> Developing an index of biological integrity based on macroinvertebrates for mountain ponds of central Italy	<b>P</b>	63
<b>Sychra J &amp; Adámek Z.</b> Contribution to the sampling methods for the monitoring of phytophilous macroinvertebrates in pond littoral	<b>P</b>	64
<b>Tavernini S &amp; Rossetti G.</b> Zooplankton communities of nine mountain temporary pools: a two-year study	<b>O</b>	65
<b>Weatherby A, Biggs J, Williams P, Nicolet P, Whitfield M &amp; Aquilina R.</b> The UK National Pond Monitoring Network	<b>O</b>	66
<b>Williams P, Biggs J &amp; Whitfield M.</b> Creating new ponds: principles and practice	<b>O</b>	67

# **ABSTRACTS**

## **The impact of anthropogenic stresses on macroinvertebrate assemblages: a comparison of minimally impaired and variably degraded ponds in the United Kingdom**

Sandrine Angélibert<sup>1,3\*</sup>, Mericia Whitfield<sup>2</sup>, Penny Williams<sup>2</sup>, Jeremy Biggs<sup>2</sup>

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Small standing waters (ponds) are subject to a wide variety of anthropogenic stresses including those caused by diffuse agricultural pollution (nutrients, sediments, biocides), urban runoff (organic and inorganic pollutants) and biological impacts (excessive access by livestock, overstocking with fish and waterfowl). Here we assess the effect of these stresses by comparing the macroinvertebrates assemblages of minimally impaired and variably degraded ponds (n=266). The minimally impaired ponds (n=133) were located in areas of semi-natural landuse across England and Wales. The variably degraded ponds (n=133) were located in more intensively managed landscapes exposed to a variety of anthropogenic stresses associated with rural and urban land management. The main questions addressed in this study were: 1) are there differences in term of species richness, conservation value and percentage of rare species? 2) if yes, which faunal groups are more affected? and 3) do the species assemblages allow the discrimination of unimpaired and impaired ponds? First, we show that minimally impaired ponds have both higher total species richness and conservation values than impaired ponds. However, only four groups of fauna (Odonata, Coleoptera, Trichoptera and Megaloptera) had significantly higher species richness in unimpaired ponds than in impaired ponds. Then, we used Self-Organizing Maps (SOMs or neural networks) to investigate whether species assemblages allowed minimally impaired and variably degraded ponds to be discriminated. We tested this hypothesis on five groups: Odonata, Coleoptera, Heteroptera, Trichoptera and Mollusca. Our results indicated that SOM based on Odonata species assemblage data was most effective in discriminating unimpaired and impaired ponds. Overall, the study allows the impact of impairment on macroinvertebrate biodiversity to be quantified and indicates that the use of Odonata as surrogate taxa for the assessment of pond quality may be an efficient approach.

Keywords: impairment, macroinvertebrate, dragonfly, pollution, ponds.

## **Spatial and temporal variability of plant biodiversity in Mediterranean temporary ponds in different landscapes**

Simonetta Bagella<sup>1\*</sup>, Emmanuele Farris<sup>1</sup>, Rossella Filigheddu<sup>1</sup> & Stefania Pisanu<sup>1</sup>

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Mediterranean temporary ponds are among the most biologically and biogeographically interesting habitats in the Mediterranean bioclimatic region. Despite their importance there remain major gaps in the knowledge and understanding of their ecology and they are little, if at all, considered in Protected Area Network planning. The objective of the current study is to identify spatial and temporal patterns of plant biodiversity useful to give a contribution in understanding ponds, in defining strategic conservation goals and in the creation of a network for their conservation. The sampling areas are located in Sardinia and adjacent islands, a core Mediterranean area for which information on these habitats is exceptionally scarce, in different landscapes identified according with bioclimatic belts and geological substrata in both protected and unprotected areas. Plant species presence/absence and abundance were monitored along permanent transects of quadrats. The samplings were repeated throughout the year. The relevant physical-chemical parameters were also sampled in each site. Spatial units were identified at two different scales: belts (inside ponds) and ponds. Comparisons among assemblages were carried out through univariate and multivariate analysis in and among landscape units. Alpha diversity (species richness and evenness) was assessed to each assemblage. Beta diversity was described using Whittaker's formula re-expressed in terms of matching/dismatching components. Rare species or those unique to an assemblage were then listed. A conservation value of each assemblage was assessed on the base of diversity indices values and presence of rare or threatened species. Through MDS analysis aggregate of similar assemblages were identified and relations with abiotic factors and time were checked. The preliminary results point out a wide range of assemblages and different levels of biodiversity. This heterogeneity must be taken into account to ensure that all types of ponds were protected, with priority to those considered as hotspots for ponds biodiversity.

Keywords: biodiversity, conservation, hotspots, macrophytes, Sardinia

## **Chironomids (Diptera) of temporary and permanent ponds in Central Italy: a neglected invertebrate group in pond ecology**

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Due their ubiquity and the numerous species present in all freshwater ecosystems, chironomids are known to be good potential bioindicators of trophic state or other types of natural or anthropogenic stress. In spite of this, in most limno-ecological studies, they generally have been considered at family, subfamily or tribe level because of the difficulties of specific or generic identification of larvae. We report here the relationships between chironomid community structure and environmental parameters of 21 astatic ponds in Central Italy. In March, May and June 2002 we conducted a quali-quantitative study on chironomids of 13 temporary and 8 permanent ponds in four protected areas along the central Italian coast near Rome. A total of 40 taxa (species, species groups and genera) was collected during the study. Chironomids well discriminated the two pond types, with permanent ponds showing higher species richness and densities, due to their larger size, lower nutrient contents, more oxygenated and transparent waters, and greater macrophyte species richness than temporary ones. Moreover, some species showed a clear preference for different mesohabitats (i.e. Orthoclaadiinae, and particularly *Corynoneura scutellata*, for macrophyte beds and the species of *Chironomus* for central sediments). On the whole, the results indicated that chironomids alone seem to offer a good synthesis in describing ecological pond characteristics (i. e. wet phase duration, mesohabitat features) as well as the entire macroinvertebrate fauna.

Keywords: Diptera Chironomidae, Italy, mesohabitat, temporary and permanent ponds, wet phase duration

## **Catchment scale patterns in aquatic biodiversity: the contribution made by ponds**

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Until recently, surprisingly little has been known about the distribution of aquatic biodiversity at a landscape or catchment level. Thus, it has generally been assumed that larger freshwater habitats (rivers, lakes) were most important for aquatic biodiversity, and that smaller waterbodies, including ponds, were of less importance. Recent investigations by Pond Conservation on the comparative contribution to biodiversity made by different waterbody types (rivers, streams, lakes, ponds, ditches) in various parts of Europe have allowed this question to be addressed for the first time. These studies have shown that, although large lakes and rivers have high site (alpha) diversity ponds consistently support a high proportion of aquatic plant and macroinvertebrates species found at a regional level (gamma diversity), typically in excess of 50% of the total number of species. Factors which may contribute to causing this pattern are explored. The implications for the protection of freshwater biota are discussed. Particularly in the light of the Water Framework Directive, which has as its objective the protection of all surface waters, it is clear that considerably more attention should be given to the protection of small water bodies.

Keywords: Catchment, biodiversity, macrophytes, macroinvertebrates, ponds.

## Composition and richness of crustaceans and insects of Mediterranean ponds (NE Iberian peninsula)

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Composition and richness of crustaceans (Branchiopoda, Copepoda, Ostracoda and Malacostraca) and some insect groups (Ephemeroptera, Odonata, Heteroptera and Coleoptera) have been obtained for 99 ponds in Catalunya (NE Iberian peninsula). These ponds are classified according to their salinity and permanence in 4 groups: permanent saline waters, temporary saline waters, permanent fresh waters and temporary fresh waters. In relation to the composition, salinity can be associated to the proportion of crustaceans versus insects, and permanence to the singularity. Thus, saline ponds have a higher proportion of crustaceans, and freshwater ponds have a higher proportion of insects. On the other hand, temporary freshwater ponds have the highest singularity (41.3%). Some species can be associated to each pond type. Thus, *Daphnia curvirostris*, *Heterocypris incongruens* and *Hesperocorixa moesta* are species associated to temporary freshwater ponds; *Gammarus aequicauda*, *Calanipeda aquaedulcis* and *Lekanesphaera hookeri* to permanent and temporary saline ponds; and *Daphnia pulex*, *Acanthocyclops robustus* and *Cloeon inscriptum* to permanent freshwater ponds. In the same way, main taxonomic groups can also be associated to each pond type. For example, Coleoptera, Malacostraca and Cladocera have been associated to temporary freshwater ponds, permanent and temporary saline ponds and permanent freshwater ponds, respectively. The pond type with the highest species richness is not the same if we use the accumulative richness or the richness per visit. Temporary freshwater ponds have the highest richness per visit, while permanent freshwater ponds present the highest accumulative richness. Moreover, species richness per visit is significantly different in relation to salinity but not to water permanence. Relationships between trophic variables (ammonium, nitrite, nitrate, phosphate, total nitrogen and phosphorus, and chlorophyll-a) and species richness for each pond type were analysed. Different patterns were observed in these relationships: in temporary saline waters crustacean richness was negatively correlated to several trophic variables, whereas in permanent fresh waters insect richness was positively correlated to chlorophyll-a.

Keywords: salinity, singularity, species richness, taxonomic composition, water permanence

## **Temporal and spatial dynamics of temporary pools and their branchiopod communities: a case study in Hungary**

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Temporary pools are very suitable systems to study fundamental ecological processes. The specific physical and chemical conditions of temporary aquatic habitats, their high temporal and geographic variability and the often unpredictable character require specific adaptations of the biota to survive. The length of the aquatic phase is an important variable, affecting not only the physical and chemical environment, but also the biological community. With our study, we first want to investigate to what extent the distributional patterns of the branchiopod community can be linked to variation in the physical and chemical habitat characteristics in hydrologically different pools. Later, we want to study the relative importance of biotic interactions between keystone species of temporary pools (large branchiopods, cladocerans, odonate larvae) in explaining observed patterns of community structure over a hydrological gradient. In the spring of 2005, a survey of 36 temporary pools in and around the Kiskunság National Park (Hungary) was conducted. The pools were located in 3 different regions and their hydroperiod ranged from 7 to more than 18 weeks. Each habitat was sampled, at different times from the start of the aquatic phase until the pools were dry. The survey included the monitoring of the most important habitat characteristics (depth, surface, turbidity, vegetation, chlorophyll a, temperature, conductivity, oxygen...) and the sampling of the macrozooplankton and large branchiopod community. The temporal dynamics of the physical and chemical characteristics over a whole inundation cycle are described and we compared physical and chemical characteristics of pools with different hydroperiod and geographical location. Observations on the species composition and diversity of the branchiopod communities in the different pools are reported.

**Keywords:** branchiopod community, geographical location, hydroperiod, physical and chemical characteristics, temporary pools

## **Rare and common components of species richness patterns in pond invertebrate communities**

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Spatial variation in species richness is an emergent property of the overlap of species' ranges. The relative contribution of rare (i.e. restricted distribution) versus common (wide distribution) species in determining spatial patterns in richness is not well established. Here we address this issue using data on macroinvertebrate species in ponds at regional (Oxfordshire, UK) and national (UK-wide) spatial scales. Species richness patterns are predominantly driven by the distribution of common species, with similar patterns evident for all taxonomic groups considered. The implications of these results for conservation strategies are considered.

Keywords: commonness, invertebrates, rarity, spatial pattern, species richness

## **Does intraspecific competition influence zooplankton assemblage structure in Mediterranean coastal marshes ?**

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In this study we assess the influence of intraspecific competition in structuring zooplankton assemblages in Mediterranean coastal marshes. Six species (two calanoid, two cyclopoid and two *Daphnia* spp.) were selected: only situations in which one of these species dominated were analysed. Copepods, which show trophic niche partitioning among stages were dominant in food-limited environments, probably because niche partitioning during development allows them to reduce intraspecific competition between adults and juveniles. *Daphnia* species were only dominant in lagoons with high productivity, probably due to the high trophic niche overlap between juveniles and adults which regulates their populations, restricting them to habitats or periods with high food availability. Our findings suggest that, in addition to the well-known effect of interspecific competition, predation and abiotic factors, intraspecific competition might also play an important role in structuring zooplankton assemblages.

Keywords: calanoid, cyclopoid, *Daphnia*, intraspecific competition, zooplankton

## Relationships between the presence of Odonata species and environmental characteristics in lowland ponds of central Italy.

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A set of 21 ponds was sampled for Odonata larvae three times during spring 2002. At same time 17 environmental variables, including area, wet phase duration, total nitrogen and phosphorus, aquatic macrophytes and land use, were assessed. A total of 16 odonate species belonging to Lestidae, Coenagrionidae, Aeshnidae and Libellulidae families were recorded, while the total species in each pond varied from zero to seven. The relationships among species presence and environmental variables were studied by simple and multiple correlation and by Canonical Correspondence Analysis (CCA). The results showed that several environmental variables were correlated with each other. Furthermore, permanent ponds were larger, deeper, had more macrophyte species, were more covered by the macrophytes and had lower concentrations of nitrogen and phosphorus than temporary ponds. The number of odonate species was correlated with environmental variables linked with the permanent status of the pond, such as depth, area, number of macrophyte species (positively) and nitrogen concentration (negatively). The multiple regression analysis showed that the number of odonate species was affected by number of macrophyte species, and secondarily by the type of pond (permanent or temporary). However, the pond type appeared to be interchangeable with depth, area and nitrogen concentration. In the CCA analysis odonate species presence was linked with a few environmental variables, showing a tendency of the Odonata to avoid pond with higher nitrogen concentrations except *Lestes barbarus*, a typical species of temporary water in central Italy. At the same time, the majority of species were linked with higher wet phase duration and, less, with the higher number of macrophyte species.

Keywords: lowland, macrophyte, Odonata, permanent, pond, temporary,

## **Ontogenetic succession and the functional organisation of pond invertebrate communities: an empirical study**

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We hypothesized that pond invertebrates could undergo an "ontogenetic succession", with ponds sheltering different associated species and life histories traits according to their stage of natural succession. To test this hypothesis and to derive patterns fitted with a broader understanding of the pond/community dynamics, we selected three ponds representing three stages of natural succession and we studied between-ponds variations in the combinations of species traits rather than species compositions *per se*. Taxa biomasses and production were monthly recorded in the 3 ponds over 1 year. Species traits were described using a fuzzy-coding method and a simultaneous analysis of the two matrices (co-inertia analysis) was used to investigate changes of biological traits combinations. Biomass and secondary production increased from the early to the late pond stage, and were usually higher in vegetal than in muddy mesohabitats. Among 26 biological traits, 9 were significantly correlated to the distribution of samples: adult size, number of generations per year, life cycle duration, adult longevity, number of eggs, dispersal mode, dispersal capability, and the ingested food type. Our ponds-invertebrates system satisfied the three criteria (directionality, continuity and non-seasonality) for the recognition of a successional pattern. Accordingly, we detected a shift from *r* to *K* selection of life history traits of pond invertebrates. Our results suggest that mesohabitat changes within the ponds during their "ontogeny" might force the termination of former functional interactions by influencing their associated fauna. Consequently, this succession might override the attractiveness that the ponds could have for some species in the area.

Keywords : biological traits, biomass, life history, macroinvertebrates, production, succession

## **The relative catchment sizes of five waterbody types in a lowland agricultural landscape in the UK: How ponds are the most effective waterbodies to protect**

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Agricultural areas now occupy about a quarter of the land surface of the earth and are widely recognised as having caused major impacts on the water environment, particularly through diffuse pollution. An approach increasingly adopted to combat such impacts is catchment management, which has also been encouraged by legislation such as the Water Framework Directive. These management initiatives have traditionally been targeted at river catchment units, which are thought to provide effective natural boundaries. However, they are a simplification of reality and ignore the range of waterbody types within the landscape, particularly the catchments of smaller waterbodies, e.g. ponds, streams and ditches. In reality, a landscape is comprised of a patchwork of catchments of varying sizes belonging to a wide range of waterbody types. We used a geographical information system to model the size of catchments of five different types of waterbody (ponds, rivers, streams, ditches and lakes) within an area of lowland landscape in Southern England. The traditional river catchments covered the largest area, with the smallest catchments belonging to ponds. This has major implications for the success and economic value of catchment management with rivers requiring a much larger area to be managed resulting in much higher costs than for ponds. Additionally, ponds have been found to contribute highly to regional biodiversity, indicating that their protection requires higher priority than is currently received. Their small catchment sizes mean they are often well-protected from sources of surface water pollution. In contrast, the more extensive river catchments often contain large areas of pollutant-generating intensively managed land associated with reduced ecological quality. These findings show that it is both desirable and possible to provide ponds with high levels of protection from anthropogenic stresses by deintensifying their catchments. In contrast, widely adopted river catchment management techniques (e.g. buffer strips, arable to grass conversion) influence only a small part of the total catchment area, require considerable resources and vary in their effectiveness. Therefore, it is much more cost-effective to protect the catchments of small waterbodies.

Keywords: catchment; cost-effectiveness; GIS; management

## **Zooplankton community structure of farmland ponds in relation with land use and pond characteristics.**

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Understanding how small aquatic ecosystems are altered by agricultural activities is crucial for the development of strategies for their conservation. We here present the results of a large scale survey to investigate to what extent regional (e.g. land use, regional species richness) and local factors (e.g. physical and chemical characteristics, morphometric variables and age of ponds) explain structure and diversity of zooplankton communities in ponds. We sampled the zooplankton communities of a total of 126 ponds (mean size 0.026 ha) distributed all over Belgium and according to a design of 42 different clusters of three ponds each. Within each cluster we selected ponds according to different intensity levels of use of the surrounding land: intensive agriculture, extensive land use, and relatively natural environment (mostly protected area). Special care was taken to only apply land use as selection criterion, and not the aspects of the ponds themselves (e.g. macrophyte cover, water transparency). Similar to the general pond characteristics (see contribution of Declerck S. et al.), biomass and genus composition of the cladoceran communities were also associated with the intensity of agricultural activities. Furthermore, cladoceran species composition was related with pond age. The increase of species richness with age can be due to the gradual colonisation and accumulation of species or to gradually changing habitat characteristics (e.g. the development of aquatic vegetation and the presence of predators).

Keywords: Diversity, Land use, Pond age, Pond community, Zooplankton

## **Genetic composition of resident populations influences establishment success of immigrant species**

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If local competitive interactions may impact community assembly, it is conceivable that genetic composition of resident strong interactors may influence establishment success of immigrant species. We tested this idea conducting an outdoor container experiment in which we manipulated the genetic composition (source population) of the water flea *Daphnia magna* and monitored establishment success of immigrant zooplankton species of the regional species pool. We show that establishment success is not only affected by habitat conditions (presence/absence of macrophytes and fish) but also by source population of the resident *Daphnia*. This implies that genetic composition of resident populations, and thus micro-evolution, may impact community assembly.

Keywords: community assembly, establishment success, genetic diversity, micro-evolution, zooplankton

## **Relation between hydroperiod and invertebrates in temporary wetlands.**

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Temporary wetlands are an ecologically and economically important aquatic habitat type. All over the world they are very sensitive to land use, climate change, pollution and interference in their hydrology. One of the factors affecting the occurrence and species composition of macro invertebrates and large branchiopods (the flag ship species) in temporary systems is the hydroperiod (duration of the wet phase). With this study we reveal and discuss the effect of hydroperiod on the large branchiopod and macro invertebrate community structure by surveying hydrologically different classes of a total of 58 temporary wetlands in the Western Cape, South Africa. The consequences of our findings to conservation management of these invaluable and sensitive ecosystems are discussed.

Keywords: hydroperiod, large branchiopods, macro invertebrates, South Africa, temporary wetlands

## Condition of temporary wetlands in the Darling region (Western Cape, South Africa).

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Temporary wetlands are an important aquatic habitat type in the Western Cape, South Africa. These systems not only have a function in the landscape (e.g. purification, buffer against erosion), they are generally also important for regional diversity and offer feeding grounds for migratory birds and drinking water for cattle. Temporary wetlands are very sensitive to land use changes, as caused by agriculture activities and urbanisation. With this study we wanted to reveal the current situation of temporary wetlands in the Darling region, an extensive agricultural area. The current condition of the ephemeral wetlands was assessed first quantitatively, by using remote sensing for detecting numbers and sizes of the respective water bodies by classification of a Landsat image of July 2000. In addition, we studied the diversity, distribution and population sizes of large branchiopods (Crustacea), the flag ship species of temporary wetlands, by sampling 27 wetlands ranging from short-lived to semi-permanent systems. In the region of Darling we detected a relatively large density of 0.4 (temporary and permanent) wetlands per km<sup>2</sup>. Most wetlands had a surface of less than one hectare. Due to the limited resolution of the studied satellite image (30x30 m), small wetlands were missed and the current count should be considered an underestimation. A limited number of large branchiopod populations (14 in total) with often small population sizes were found for each of the three species collected (*Streptocephalus dendyi*, *S. purcelli*, *Leptestheria rubidgei*). Our results suggest that despite the intense agriculture activities in the Darling area, still a reasonable density of wetlands remains. Judged from the small numbers of healthy large branchiopod populations, however, the quality seems to be impoverished. Further negative impact is to be expected due to mass abstraction of groundwater, altering the hydroperiod of these sensitive surface water bodies.

Keywords: large branchiopods, remote sensing, South Africa, temporary wetlands, wetland classification

## **Habitat characteristics of small ponds in an agricultural landscape: associations with land-use patterns and practices.**

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Land use practices can strongly affect the ecological integrity of water bodies via multiple processes that operate at different spatial scales. This has extensively been demonstrated for river systems and is increasingly evident for lakes. Land use effects on small pools have so far hardly been studied despite their relative abundance and important contribution to regional biodiversity. Pools are different from lakes and rivers in many aspects and can therefore be expected to be affected by land use via other mechanisms at other scales. In this study we present data of a large scale survey on 126 pools distributed over the entire territory of Belgium (surface area: 30.000 km<sup>2</sup>). We measured a set of variables reflecting different aspects of pool ecological integrity. We related this dataset with land use variables assessed for different spatial scales, ranging from the pool edge to 32 km<sup>2</sup> circular areas. According to RDA-analysis, trampling by cattle and percentage cover of nearby crop land were associated with increased values of turbidity related variables. Conversely, pools with high surrounding forest cover tended to better approach the clear water state, possibly reflecting less intensive land use practices within land use categories. Multiple regression analysis demonstrated a negative effect of trampling and crop land on habitat complexity related variables. Effects of crop lands and forest were strongest at the local scale (<200 m radius) which contrasts with earlier findings on river systems and indicates that adverse external influences can most efficiently be mitigated at the local scale.

Keywords: Crop culture, Biotope complexity, Land use, Ponds, Trampling

## **The use of Diatoms as biological indicators of water quality of ponds as recommended by the Water Framework Directive 2000/60/EC**

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Diatoms are good environmental indicators and are one of the key groups of organisms recommended by the Water Framework Directive (W.F.D.) for the identification of ecological quality gradients on surface water. Diatoms have a worldwide distribution, represent one of the main components of phytoplankton and phyto-benthos in aquatic ecosystems and respond quickly to changes of environmental conditions and to anthropogenic pressures. The biodiversity of diatoms is a valuable tool for the monitoring water quality in general and for the evaluation of the trophic status or more specific phenomena. For several years they have been used as bioindicators for running waters in different European countries. The implementation of the W.F.D. requires a Diatom-based classification of all types of water bodies. Therefore the knowledge on Diatom species ecology and distribution must be extended also in standing waters in order to provide useful hints for the identification of reference communities. We presented here the first results of an ongoing study started in 2005 on the use of benthic Diatom communities for the biomonitoring of ponds. We investigated the Diatom community and selected environmental variables (pH, salinity, conductivity and nutrients) of freshwater and brackish ponds along the coast North of Rome. The advantages of using diatoms as a biological indicator group are outlined, the methods and main findings of the study are presented, and the implications for coastal ponds management are discussed.

**Key words:** Bacillariophyceae, benthic algae, biomonitoring, freshwater and brackish ponds, indexes

## Macrophyte diversity and physico-chemical characteristics of Tyrrhenian coast ponds in central Italy: implications for conservation

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Awareness of pond conservation value as biodiversity resource is growing all over Europe. Notwithstanding ponds, particularly those that are temporary, are still neglected in Italy. This study investigated the physico-chemical characteristics and macrophyte communities of 8 permanent and 13 temporary ponds along the Tyrrhenian coast near Rome, with the aim of filling a gap in the ecological knowledge and the conservation value of Mediterranean small still waters. Throughout the study period (March, May and June 2002), Principal Component Analysis performed on abiotic variables clearly discriminated temporary ponds, smaller and more eutrophic, from permanent ponds, larger and with higher pH and oxygen concentration. A total of 73 macrophyte taxa were collected in all study ponds. Temporary waters hosted a smaller number of plant species than permanent ones. Besides hydroperiod length, the main environmental factors positively influencing the number of plant species in ponds were, depth, surface area, phosphorus content, silt and clay percentages in sediments, while nitrogen concentration in the water and sand fraction percentages in the sediments negatively influenced species richness. Moreover, the Non-metric Multidimensional Scaling showed a high dissimilarity in the taxonomic composition of aquatic plants between temporary and permanent ponds. The former contained more annual fast-growing species (*Callitriche* spp. and *Ranunculus* spp.), while in the latter species with long life-cycles (i.e. *Potamogeton* spp.) were more abundant. This study suggests that both pond types could give an irreplaceable contribution to the conservation of aquatic plant diversity of these freshwater ecosystems.

Key words: hydroperiod, species richness, temporary and permanent ponds, wetland plants.

## **Spatial patterns of temporary pond and large branchiopod distribution in Romania**

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There are no studies of large branchiopod distribution in Romania since the 1950's. I investigated the distribution of temporary ponds and large branchiopods in eleven landscapes in Romania in 2004 and 2005. I found totally 13 species. Highest temporary pond densities were found in mountain basins, lowlands and high mountains. Largest species numbers were found in mountain basins (up to 8), lowest species numbers in the high mountains (1). The higher species number of mountain basins compared to lowlands is most probably due to different sampling effort. The intensity of human presence and its effect on pond existence and the intensity of land use surrounding ponds increases from the high mountains to mountain basins and to lowlands. Some species (*Chirocephalus diaphanus*, *Streptocephalus torvicornis*, *Branchipus schaefferi*, *Triops cancriformis*) survive in an intensive agricultural landscape while others are confined to natural ponds (*Chirocephalus shadini*, *Drepanosurus hankoi*). The study enlarged the known European distribution of *D. hankoi* and gives a first basis for large branchiopod conservation in Romania.

Keywords: habitat spatial patterns, habitat types, large branchiopods, pond landscapes, Romania

## **Copepods come in first: rapid colonisation of newly built ponds**

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The sequence in which new colonizers reach an empty habitat can be crucial for future development and species structure of communities. It is therefore important to assess species composition and abundance in the initial stages of habitat existence. The present study determines the arrival of colonizers in the first two weeks of pond existence under natural conditions in the field. Study ponds were created by removing > 30 cm of the top soil, thus extracting a possibly existing propagule bank. Cyclopoid copepods had arrived and dominated all of the seven study ponds within two weeks. Other taxa with very low abundance were monogonont rotifers in two and cladocerans in one pond. We suggest that speed of successful dispersal and dominance of certain cyclopoid copepods at early colonization is tightly connected to a combination of their ability to store sperm and of fast development. For climatic reasons, mediterranean ponds often last for only few weeks or months, and might favour the relative dominance of cyclopoid copepods over cladocerans in such shortlived habitats.

Keywords: colonization, overland dispersal, temporary pond, zooplankton

## **Relation between macroinvertebrate life strategies and habitat traits in Mediterranean salt marsh ponds (Empordà wetlands, NE Iberian Peninsula)**

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Monthly samples of macrobenthic fauna (> 1 mm) were collected during two consecutive hydroperiods (from November 1997 to July 1998 and from November 1998 to July 1999) from 6 ponds of the Empordà salt marshes (NE Iberian Peninsula). The basins had different water permanence (temporary, semi-permanent and permanent waters). Functional approaches of community dynamics often use functional groups, although several authors criticise the validity of these approaches. Thus, the convenience of grouping taxa in functional groups based on life strategies was studied, as well as the existence of temporal and spatial patterns for the whole community, and for each functional group. Organisms were grouped in five life strategies, according to their capacity to survive desiccation events, dispersion capability, and the necessity of water for their reproduction. Generalised additive models (GAM) have been used to test the validity of the study of the community dynamics by means of these life strategy groups. GAM results showed that species of the same group had similar response curves. Community composition seemed to be more related to water permanence than to intrannual (among seasons) and interannual (between hydroperiods) variability. On the other hand, some functional groups (according to life strategies) showed significant differences among season and water permanence, and between hydroperiods.

Keywords: brackish ponds, functional groups, life strategies, macrobenthic fauna, water permanence

## **Origins, Ecology and social significance of the Tommellen Pond complex near Hasselt, Belgium.**

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At Tommellen, Near Hasselt, Belgium an important wildlife site consists of over 117 ponds, plantation woodland and grassland. The ponds are fairly uniform morphologically, being in the main circular, and occurring in two basic sizes, the smaller around 5m diameter, and the larger around 8m in diameter, with depth 2 – 4m in the same proportion. They are of completely uniform age structure, having been created more or less simultaneously as the result of an air raid, which took place on April 8<sup>th</sup>. 1944. One hundred and ninety eight B-26 Marauder bombers, and 32 P-47 Thunderbolt fighter-bombers of the 9th USAAF attacked rail installations at Tommellen in preparation for the Normandy landings. The raid created a substantial crater field, some of which has survived as the pond complex. Despite the uniformity of morphology and age, ecologically these ponds display extreme variation, across the site and between neighbouring ponds, in both floral and faunal communities, which can only partially be explained by differences in size and hydroperiod. The site as a whole is notable for invertebrate species, particularly *Odonata*, and amphibian species richness and abundance. The local community appreciate the value of the site, which is now almost completely isolated by road and rail corridors, industrial and housing development. Older members of the community recognise the site as a link to their past and the experiences of the 1940's, remembering the event that created this valuable site. The importance of the historic and social dimension of pond conservation is emphasized by the role explanation of these aspects is playing in the campaign for statutory protection for the site.

Keywords: community, variation, air raid, Tommellen, historic

## **A web and GIS based *Triturus cristatus* (Great Crested Newt) site Inventory in North West England, UK**

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*Triturus cristatus*, or Great Crested Newt, is the most stringently protected amphibian species in the UK. Declining throughout its range, *T. cristatus* is locally common in North West England. The species is vulnerable to pond loss due to changes in agricultural practice and succession, since it is reliant on vegetated mid succession ponds and the availability of woodland and un- or semi improved grassland terrestrial habitat, for foraging and refugia. The species demands licencing of activities which will disturb or destroy the species or its aquatic habitat and rigorous mitigation measures where habitat is lost. Often, the presence of the species is only discovered at a development site once work has commenced, resulting in unnecessary ecological damage and, unexpected delay and expense for developers. The Site Inventory is to be a compilation of records from a wide variety of sources and has been developed for use by researchers, ecological consultants, planners and developers. It will map known *T. cristatus* breeding sites, noting details of population, dates and quality of survey, levels of protection afforded the site. Additionally, details of ponds located within home range and short distance dispersal distance of the breeding sites will be included, as well as dates and details of surveys showing negative results for *T. cristatus* presence. The inventory is to be kept as both a database and in GIS formats, and served via the web through the National Biodiversity Network Gateway and the MAGIC Land based data portal. It is hoped the methodology developed will be “rolled out” to the rest of the UK.

Keywords: GIS, methodology, protection, site inventory, *Triturus cristatus*

## **Pond biodiversity assessment: how to implement a standardized method through practitioners (case study in Geneva, CH)**

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Nature conservation managers and environmental consultancies often have to perform biodiversity assessments for conservation and monitoring purposes. Standardized and economic tools designed for routine biodiversity assessment have thus been produced. Nevertheless, many of these methods are rather fitted to fundamental research and are unadapted to practitioners, among others for financial reasons or lack of specific knowledge and equipment. Moreover, sampling bears many uncertainties, as listed for example by Sutherland in his *twenty commonest censusing sins* (Sutherland 1996). The problems which can arise during the implementation of a method point out the necessity of knowledge transfer between fundamental and applied science. In the current study, a standardized method for sampling and assessing the biodiversity in ponds (PLOCH, Oertli *et al.* 2005) is therefore tested by an environmental consultancy with regard to its suitability for practitioners. A recently created pond in Geneva was sampled during 2005 using the method cited above. Problems and difficulties encountered by the practitioners throughout the assessment were identified and addressed and suggestions were drawn up in order to optimize the implementation of the method. It is shown that many presumably trivial steps of the assessment have to be explicitly defined to ensure the quality and reproducibility of the results.

Keywords: biodiversity assessment, environmental consultancy, knowledge transfer, monitoring, PLOCH-method

## Climate tracking by pond invertebrates

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Pond invertebrates are affected by and respond to influences at a range of scales. Many species show fine-grained responses to microhabitat, food availability or enemies, which can determine the establishment or extinction of a species within a pond. Larger scale factors, such as the spatial array of ponds over a landscape or temporal variations of pond hydrology between years, are also likely to affect distributions, given the evidence from shorter-term studies of invertebrate associations with adjacent terrestrial habitat or responses to local drought-flood regimes. Data from a decade of monitoring small, temporary ponds in Northumberland, north east England, will be used to explore the relationships between individual species, metacommunities and the regional climate, characterised by the North Atlantic Oscillation. The ponds and their fauna have experienced diverse local hydrology, including summers when all the study ponds dried and other years when none did and winters when all ponds flooded together and other years when none did. The analyses incorporate these very site-specific hydrological data, larger-scale regional weather data and the global scale North Atlantic Oscillation to identify dominant influences. The North Atlantic Oscillation appears to be a robust predictor of the varying distributions for many species. If invertebrates are tracking global scale climate systems at a landscape scale strategies for the conservation of ponds will have to incorporate adaptation to global climate change.

Keywords: climate change, invertebrates, temporary ponds

## **Freshwater rock pool communities; build on environmental variables, shaped by biotic interactions**

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Community ecologists traditionally are interested in the relative contribution of the abiotic environmental variables and biotic interactions to shape a community. Previous studies striving to unravel the dominant variables explaining community structure in ephemeral pools often were limited in gradients or numbers of replicas. In a dataset of 100 freshwater rock pools differing widely in size on two rocky outcrops in Western Australia, we assessed the structuring factors for the entire community and subgroups of organisms. The impact of the predictability of the rock pool communities is discussed.

Keywords: biotic interaction, community structure, environmental variable, rock pool, temporary

## **Hydrogeomorphic types of glacially created kettle holes in Northeast Germany**

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Glacially created kettle holes are typical small (< 1 ha) lentic waters or wetlands respectively within internal catchments in young moraine landscapes. In Northeast Germany, kettle holes are high distributed, mostly within arable land. They are characterised by strong varying water levels and a high potential for structural and species diversity. However, kettle holes are subject to pollution, drainage and structural reduction due to intensive land use practices. Actually kettle holes in general are protected by nature conservation law, but strategies for conservation and management are not specific enough. Therefore, the objective is to characterize different kettle hole types by hydrological and morphological features. That's the basis to create an decision support system including ecological assessment of kettle hole types with respect to selection of suitable type dependent and independent conservation and management measures. In 3 regions of agricultural landscape in Northeast Germany we investigated features of 268 kettle holes (water regime, depth, area, form, shore width and slope) as well as of their catchments (area, slope). By statistical analysis of data sets of 144 kettle holes we defined hydrogeomorphic kettle hole types and described their typical functions and species, especially of the vegetation. The basic types are "silted kettle holes" and "water bearing kettle holes". Basic subtypes of the latter type are "storage type", "shore bursting type" and "puddle type". Furthermore, we found differences in distribution of kettle hole types depending on landscape relief.

Keywords: hydrogeomorphic types, kettle holes, young moraine

## **Kettle holes in young moraine landscapes of Northeast Germany - distribution, typology, pollution and conservation aspects**

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Glacially created kettle holes are small lentic waters or wetlands respectively in young moraine landscapes. In Northeast Germany, kettle holes are high distributed, mostly within arable land. Kettle holes have a high potential for structural and species diversity, but they are still subject to pollution, drainage and structural reduction due to intensive land use practices. Kettle holes are protected by nature conservation law, but there is a lack in specific strategies for conservation and management of kettle holes. The objective is to characterise the distribution, typology and pollution of kettle holes with respect to the development of specific measures for conservation and management of kettle hole types in agricultural landscapes. In our studies, we investigated kettle holes in Northeast Germany at different scales (investigation area level up to Northeast Germany). Matter loading effects by agricultural land use on sediments, water quality, emission of climate relevant gases and macrophytes were detected at selected kettle holes. Typology for hydrogeomorphic kettle hole types was developed by statistical analysis of morphological and hydrological features of 144 kettle holes. Distribution of kettle holes in Northeast Germany was estimated by GIS based on terrestrial mapping of kettle holes in the investigation areas. On that basics, a concept of a decision support system was developed to derive suitable measures for conservation and management of both, kettle hole in general and kettle hole types. The effect of set aside areas at the margins of kettle holes on amphibians and vegetation was tested.

Keywords: conservation, distribution, kettle holes, pollution, young moraine

## **Pond conservation in Salzburg, Austria: policy, practical examples and problems from the amphibian's point of view**

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The province of Salzburg, Austria, consists of a variety of habitats with a vertical range between 380 and 3600 m a.s.l. Hence there is a great variety of pond types facing many different threats. Especially in the lowland areas of the North and the inner alpine river valleys the number of ponds has become low due to intensive anthropogenic pressure and land use. Most of the remaining ponds are artificial and often densely stocked with fish and waterfowl. Eleven out of 13 amphibians species that occur in Salzburg rely on ponds and puddles as breeding habitats. They are excellent indicators for the quality of pond networks, being easy to detect, and dependent on the existence of breeding ponds, as well as corridors for seasonal migration and dispersal. Though amphibian species and most of their aquatic habitats in Salzburg are strictly protected by law, all occurring species are on the Red List, with population numbers significantly declining in large parts of the province. Destruction and isolation of ponds, migration barriers and landscape fragmentation are the main reasons for this development. Until now the measures taken by the federal government represent no systematic approach for the conservation, but only a patchwork of small projects. In the upcoming years the focus must lie on the creation of pond networks including new artificial ponds as well as the restoration of old ponds and the parallel development of migration corridors. The aim of this presentation is to give insights to (i) the current situation of pond conservation in Salzburg, (ii) the planning of artificial ponds that may contain high amphibian diversity, (iii) examples of completed projects and the monitoring of these new habitats, (iv) educational efforts, (v) an outlook for future activities.

Keywords: Amphibia, Austria, conservation, management, pond networks

## **Restoration of Priority Habitats for Amphibians. A LIFE-Nature project on Valencian Community (East Spain)**

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Small freshwater bodies of the Valencia Region inland are disappearing owing to the abandonment of traditional management practices. These habitats are crucial for the conservation of amphibians as well as different plant and animal species. To correct this situation, a LIFE-Nature project has been recently approved in Valencian Community for the period 2005-2008 (LIFE05 NAT/E/000060). The objectives of the project are: 1) To create a network of 55 small freshwater bodies of special interest to amphibians within the Natura 2000 sites in the Valencia Region, 2) to ensure their permanence through the elimination of present impacts and potential threats and the protection of the most relevant examples, and 3) to develop a management methodology for the different types of freshwater habitats which could be transposed to the mediterranean scale. To achieve these goals the project will involve two layers of management actions differing on the type of work and degree of intervention and a set of initiatives focused on the dissemination and drawing up of conclusions and protocols: 1) Establishment of a network of 55 small freshwater bodies and development of a geographic information system to allow their monitoring, 2) development of Action Plans for two endangered amphibian species, 3) monitoring of the limnology and of the plant and amphibian communities, 4) propagation of plant taxa for the restoration of helophytic and hydrophytic plant communities, 5) eradication of alien invasive animal species, 6) fitting of sites with explanatory and awareness raising boards, 7) restoration of the original morphology of water bodies, water inputs and functionality, 8) control of erosion and sedimentation processes, cleaning and digging out of ponds, 9) regulation of accessibility and development of wise use practices, and 10) dissemination, awareness-raising, synthesis and transposition of results.

Keywords: amphibians, conservation, restoration, mediterranean temporary ponds.

## Succession in zooplankton communities of newly created pools

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Ponds and pools are generally considered to be valuable landscape elements which harbor often rare and endangered species. Due to their distinctive species composition they often contribute substantially to the regional biodiversity of an area. However, during the last decennia, ponds and pools are rapidly disappearing because of the intensification of agricultural activities. In addition, the ecological quality of these small aquatic habitats suffers from severe eutrophication and pollution. In Flanders (Belgium), numerous new pools are (re)created by governmental and private agencies in order to provide suitable habitat to endangered amphibian species. Such initiatives form a unique opportunity to investigate the colonization rate and succession in newly assembled zooplankton communities. We monitored 25 newly created pools scattered over Flanders during a three year period. New habitats were bimonthly sampled for environmental and biotic characteristics. Pools were very rapidly (after a few months) colonized by several cladoceran zooplankton species. During the entire colonization survey, 23 different cladoceran species were observed in at least one of the pools. Only three of these species (*Daphnia obtusa*, *Chydorus sphaericus* and *Simocephalus vetulus*) appeared and became dominant in the majority of the pools. Ten other species, which were observed to arrive during the first year, were not able to maintain their populations throughout the entire study period. During community assembly, relative frequencies of the different species changed over time, with a consistent pattern of succession over the entire set of pools. A possible explanation for this change in relative species dominance may be dedicated to differences in arrival time between species as no significant differences in environmental characteristics were observed among the 3 subsequent years.

Keywords: colonization, dispersal, new pools, succession, zooplankton

## **Microalgal assemblages and environmental conditions in Mediterranean temporary ponds: first data from Sardinia (Italy)**

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The study on macrophytes of Mediterranean temporary ponds started in Sardinia (Italy) in 2004 has extended in 2005 to the suspended microalgal assemblages, physicochemical parameters and nutrients to improve the knowledge of them and understand their ecology. The 14 studied ponds were selected according to their bioclimatic characters and geological substrate. The samples were collected monthly from April to June. The number of samplings varied from 1 (in 5 ponds) to 2 (5) to 3 (4) depending on the temporariness of the ponds. The cell densities of microphytes varied from about 10<sup>5</sup> cells l<sup>-1</sup> up to more than 50x10<sup>6</sup> cells l<sup>-1</sup>. Any clear and common trend of the density dynamics was not observed. Chlorophyceae and Bacillariophyceae were the main algal classes for both the expressed density values and species number. Occasionally, Cryptophyceae and Euglenophyceae were dominant. The ponds shared most of the observed microalgal species and Cyanobacteria, even though a few species was detected only in a restricted number of ponds or samplings. Biodiversity was evaluated by Shannon's index and ranged from 0.824 to 3.490. Conductibility was between 500 to 1000  $\mu$ S cm<sup>-1</sup> in about 60% of the samples. Lower and higher values were observed in 30% and 7% of the cases, respectively. pH normally ranged from 7 to 8 units. It was lower in 7% of the samples (minimum of 6.6) and higher in 6% (maximum of 10.3). Total nitrogen and phosphorus always showed high concentrations (>30 mg P m<sup>-3</sup>, >1000 mg N m<sup>-3</sup>). An increasing trend in values was revealed compared to the time, probably as an effect of the reduction of water volume in the ponds. The results of microalgae and environmental parameters are discussed to characterise and divide the ponds into different ecological types with regard to the presence or abundance of macrophytes, too.

Keywords: Mediterranean temporary ponds, Sardinian ponds, phytoplankton, microalgae, biodiversity.

## **Crested newts (*Triturus cristatus*-superspecies) as indicators for the quality of pond networks in Salzburg, Austria**

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Crested newts (*Triturus cristatus*- superspecies) are excellent indicator species for the functioning of pond networks. Their high requirements concerning size, depth, structure and exposition of breeding ponds lead to the fact, that these ponds contain a high diversity of amphibian species and other pond dwelling organisms. They are biodiversity reservoirs in a landscape that is underlying high anthropogenic pressure. During the years 2004 and 2005, Crested newt (*Triturus cristatus*, *T. carnifex*) populations were surveyed in the province of Salzburg. Historical and current distribution data were collected and compared and a total number of 350 ponds were visited several times. Amphibian diversity, as well as pond characteristics and the habitat settings were assessed. A large decline from 78 localities recorded between 1916 and 2003 to only 24 (18 breeding populations) in 2005 was found. Genetic variation of 144 individuals from 15 populations was analysed using 7 polymorphic microsatellite loci to obtain information about gene flow and allelic richness. The destruction or manipulation (e.g. by fish insertion) of many natural ponds, as well as the fragmentation of terrestrial habitats are the main reasons for this scenario. The increasingly isolated populations face genetic poverty and inbreeding phenomena. On the basis of these data the state of preservation of selected pond networks was evaluated. Strategies for improvement were developed, focussing on both aquatic habitats and migration corridors.

**Keywords:** Amphibia, Austria, genetic variation, habitat requirements, *Triturus cristatus* superspecies

## Herbicide exposure affects the learned chemical recognition of an invasive predator in common toad tadpoles (*Bufo bufo*)

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Many larval amphibians live in ponds where visual cues are limited and where water-borne chemicals represent the most efficient cues to assess the predation risk. Amphibian larvae can recognize and respond to chemical cues from native predators at the first confrontation. Conversely, this identification generally fails when larvae are confronted with recently introduced or invasive predators. In that case, the chemical recognition of the predators can result from a Pavlovian conditioning. In the common toad (*Bufo bufo*), we have recently shown that tadpoles can learn to respond to chemical cues from a starved invasive predator, the Turkish crayfish (*Astacus leptodactylus*), through a prior association between the chemical stimuli from this predator and chemical alarm stimuli from injured conspecific tadpoles (Mandrillon and Saglio, Arch. Hydrobiol., In press). The objective of the present laboratory study was to examine the vulnerability of this learning process to an herbicide contamination. Groups of common toad tadpoles were chemically exposed to tadpole-fed Turkish crayfish and to amitrole, a commonly used herbicide, at four concentrations (0.01, 0.1, 1 and 10 mg.L<sup>-1</sup>). It was predicted that a pre-exposure to tadpole-fed crayfish would allow the tadpoles to make the learning association between predator's odour and chemical alarm cues from injured conspecifics. We found that tadpoles previously exposed to tadpole-fed crayfish in control water, or in water contaminated with 0.01 mg.L<sup>-1</sup> of amitrole were the only groups to show an antipredator behavioural response when first confronted with chemical stimuli from a starved crayfish. Conversely, that learned recognition of the predator's specific odour did not operate in groups of tadpoles exposed to 0.1, 1 and 10 mg.L<sup>-1</sup> of amitrole. >From a conservation perspective, deleterious effects of pesticides on the acquired chemical recognition of invasive predators could represent a serious threat for the survival of amphibian populations.

Keywords: Amitrole, *Astacus leptodactylus*, *Bufo bufo*, chemical signals, predator recognition.

## Tracking the role of landscape fragmentation on genetic structure in amphibian breeding in pond archipelago

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Amphibians reproduce in water bodies such as ponds and are suitable model to infer the role of landscape structure on (meta)population genetic structure. Using microsatellites as genetic markers, we analysed the genetic structure of the Common frog *Rana temporaria* that breed in 11 ponds (from 1 to 10 km away for each other). Population structure was assessed by several methods considering successively individual and sampling sites levels (Assignment tests, correlations  $F_{st}$ /geographic distances). Geographic distances in the landscape were described as movement costs i.e. taking into account frog movement ability in the different habitat types (quantified from radiotracking studies), and mortality risk related to road traffic. We also applied a Bayesian approach at the breeding site level, to determine which combination of sampling sites is best supported by the data, and the current rate of dispersal between the breeding population.

The results are discussed in term of impact of landscape use on genetic structure of animal colonizing pond archipelago, and statistical methods to understand functioning (e.g. intersite dispersal) of metapopulation.

Keywords: Amphibian, Bayesian statistics, Genetic structure, Metapopulation, Microsatellites.

## Feeding ecology and resources partitioning in sympatric populations of *Triturus marmoratus* and *Triturus helveticus* during their aquatic phase

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The populations of *Triturus marmoratus* and *Triturus helveticus* of two rocky ponds (700 m apart) in south-western France were monitored during 2002. In this area, adult newts enter the water in November, start reproducing in February and usually leave the ponds site in June. We decided to study the feeding ecology of *T. marmoratus*, *T. helveticus* from February to June, since the presence of both species in the same breeding site is at its maximum during this period. We thus analysed the gut contents of adults and oldest stage larvae on a monthly basis, while we monitored their distribution among the micro-habitats present on a weekly basis. Horizontal and vertical newt distribution was assessed using hand netting and funnel traps respectively. Each trapped newt was measured and released. Gut content was collected by a flushing method. In total, 104 (46 males, 48 females and 10 larvae) and 119 (54 males, 53 females and 12 larvae) gut contents of *T. marmoratus* and *T. helveticus* respectively were analysed. Newts were found to exploit a large variety of prey (3751 individual preys grouped in 60 prey items), mainly zooplankton, aquatic insects and amphibian eggs. The number of preys/stomach varied in time, this variation differs between species, and between sexes for *T. marmoratus*. Feeding niche breadth increases with time in both species and this increase seems to be greater for the *T. marmoratus*. In fact *T. marmoratus* seems to change its feeding strategy being a specialist at the beginning of the aquatic phase and becoming a heterogeneous generalist at the end. Feeding niche overlap was relatively low for adults (Schoener index  $Co < 0.45$ ) which did not use the same prey size category. It was high for larvae (Schoener index  $Co > 0.9$ ) but a temporal and spatial partitioning probably avoided any hypothetical competition between the two species. These feeding, spatial and temporal segregations are likely to contribute to maintaining the two populations.

Keywords: Diet, prey selection, amphibians, trophic niche, competition, marbled newt, palmate newt

## Water quality: are mayflies (Ephemeroptera) good bioindicators for ponds?

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Ephemeroptera larvae are worldwide recognized for being sensitive to aquatic pollution in running waters. Most of the biological water quality assessment methods developed over the years for streams incorporate Ephemeroptera taxa (see for example the RIVPACS methods, the EU project STAR, the EPT indices; the EPA's rapid bioassessment protocols; and the french IBGN). Mayflies inhabiting lentic waters, like lakes and ponds, have been poorly used in biomonitoring programs, although we could assume they can also adequately integrate some aspects of water quality in such environments. For this purpose, a better understanding of the distribution of mayflies in lentic habitats and of the relations of species presence with environmental conditions are needed. Within this framework, 104 Swiss ponds were sampled. Mayflies were found to be present in 76 ponds. Of the 11 families (and 85 species) of Ephemeroptera present in Switzerland, 12 species from five families were identified in our study area. These were: *Baetis rhodani*, *Baetis alpinus*, *Caenis horaria*, *Caenis luctuosa*, *Caenis robusta*, *Centroptilum luteolum*, *Cloeon dipterum*, *Cloeon simile*, *Ephemera danica*, *Habrophlebia fusca*, *Habrophlebia lauta* and *Siphonurus aestivalis*. This list includes both lentic and lotic species, the latter ones being related to the presence of tributaries. The dominating lentic species are *Cloeon dipterum* (observed in 71 ponds) and *Caenis horaria* (34 ponds). Amongst the 12 sampled species, 4 are mentioned in the red list of threatened species for Switzerland: *Centroptilum luteolum* *Cloeon simile*, *Ephemera danica* (all three potentially endangered) and *Siphonurus aestivalis* (endangered). One of the species is a new finding for Switzerland: *Habrophlebia fusca*. Another one was observed in Graubünden for the first time: *Habrophlebia lauta*. When present, Ephemeroptera communities are composed of only a few taxa (mean species number = 1.9 and mean family number = 1.6). 33 ponds include only one family, in most cases (31 ponds) the family Baetidae. 41 ponds include two families, with Baetidae present in all cases. Therefore Baetidae appears as the most common mayfly family to be found in Swiss ponds. The ponds without Ephemeroptera mainly include those situated at an altitude over 1410 m or with hypertrophic conditions (six ponds). The relation between the Ephemeroptera presence in the ponds and the trophic level is investigated. The evaluation of Ephemeroptera as bioindicator of ponds is discussed, and a new metric is proposed for inclusion in rapid bioassessments methods.

Keywords : Ephemeroptera, bioindication, water quality

## Phenological change in Common British Amphibians

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The timing of events or 'phenology' in the amphibian life cycle is largely driven by environmental cues such as moisture and temperature. Research has found that amphibians in temperate regions such as the UK appear to be responding to milder winters and warmer early spring temperatures. The warmer temperatures being experienced in recent years may result from human induced climate change. Data on phenological change in amphibians is limited since most studies are short term and causal relationships are difficult to establish in field work. However, newt migrations to 'Llysdinam Pond' in mid Wales have been studied for the past 30 years providing a long-term data set. Drift fencing with pitfall traps are checked daily for amphibian captures providing information on numbers arriving to and leaving from the pond and the timing of migrations throughout the year. The most common amphibians at Llysdinam pond are the palmate newt, *Triturus helveticus* (~2500 arrived in 2005) and the smooth newt, *T. vulgaris* (~800 arrived in 2005). There have been changes in the timing of arrival within and between *Triturus* species over the years. Milder spring temperatures have resulted in earlier arrivals of *Triturus* species, particularly of male palmate newts. Although, *Triturus* newts appear to be arriving at the pond earlier, studies on breeding behaviour (courtship and oviposition) will show whether they are breeding earlier too. The change in phenology may have consequences for the species concerned and for pond ecology. Some species may respond to climate change faster than others, resulting in an asynchrony in predator and prey peaks and important changes to the food chain within ponds. In addition to monitoring phenological change, the impact of temperature change on amphibians in pond mesocosms and in hibernation enclosures can further understanding of the effects of climate change on the pond habitat.

Keywords: asynchrony, breeding, climate change, phenology, *Triturus*,

## **The ecological basis for pond management: a synthesis and update of pond management myths**

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Managing ponds to improve their conservation value is a popular activity. However, the ecological literature contains very little information about the factors affecting the biodiversity value of ponds. Unfortunately, pond management activities often tend to try and create 'ideal', mid-successional ponds. The factors related to the conservation value of ponds were investigated using data on wetland plants and macroinvertebrates from national surveys of (i) minimally impaired ponds and (ii) degraded ponds. Results of correlations between biotic groups and physico-chemical variables show that the main factors related to the number of species and the occurrence of rarities in ponds were: areas, isolation, pH (and related variables) and the abundance of vegetation. A series of pond management myths commonly perpetuated by available literature do not seem to fit with the results of these analyses. Amongst them are (i) ponds must have deep water, (ii) ponds must not dry up, (iii) tree shade is damaging to ponds, and (iv) ponds will become choked with vegetation and therefore must be periodically dredged. These myths will be reviewed in the light of (i) the results of the national surveys presented above, and (ii) more anecdotal evidence gathered over the last two decades by Pond Conservation. This review emphasises the importance of ecological knowledge prior to undertaking pond management activities, and the value of a 'soft' approach to pond management. At the landscape level, each type of ponds contribute to regional diversity, and maintaining this variety should be the aim of management activities. Ultimately, the creation of ponds or pond complexes may be as beneficial for the maintenance of aquatic biodiversity as the management of existing ponds.

Keywords: pond management, plant diversity, macroinvertebrate diversity, landscape

## **Macroinvertebrate assemblages in the high alpine ponds of the Swiss national park (Cirque of Macun) and evaluation of their potential as indicators of global changes**

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High altitude freshwater ecosystems and their biocoenosis can be ideal sentinel systems to detect global changes. In particular, ponds communities are likely to be highly responsive to climate warming. For this reason, the Research Committee from the Swiss National Park has included ponds as part of the initiation of the long-term monitoring programme of the high alpine Macun cirque. This cirque covers 3.6 km<sup>2</sup>, has a mean altitude of 2660 masl, and includes a large hydrographic system composed of a stream network, 6 small lakes, and about 30 temporary or permanent ponds. One of the first step in the programme consisted in making an exhaustive inventory of the biodiversity of all waterbodies in the Macun circus, with an emphasis on macroinvertebrate assemblages. The results showed that pond assemblages had very low species richness, and were therefore clearly not species saturated. Assemblages were dominated by Chironomidae (Diptera). Coleoptera and Oligochaeta were also relatively well represented. Other groups, which are frequent in lowland ponds, had particularly poor species numbers (Trichoptera, Heteroptera) or were absent (Gastropoda, Odonata, Ephemeroptera). The assemblages showed a high degree of nestedness. No “major” environmental variable was related to community composition; nevertheless, two “minor” variables seemed to be of some importance: conductivity and the hydroperiod characteristics. Regional species richness (Macun cirque) was also very low, following local (pond) species richness trends. Finally, this study showed that many advantages for monitoring global changes can be gained through the investigation of pond macroinvertebrate assemblages. Above all, due to the relatively simple macroinvertebrate communities, investigations can be conducted at a relative low cost and; furthermore, the different scales of diversity can be assessed (sample, pond, Macun site, Swiss oriental Alps). In addition, the extensive knowledge of the geographical distribution of pond species in Switzerland, allows simulations of future expected changes to be carried out (richness, community composition).

Keywords: alpine ponds, biomonitoring, global changes, macroinvertebrates, species assemblages

## Habitat diversity for avifauna of small mid-field reservoirs in the Olsztyn Lakeland

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In the period of 1998-2000 breeding birds were observed on 183 mid-field reservoirs in the Olsztyn Lakeland (NE Poland). The main parameters to settle on the reservoirs were their size and the vegetation structure. Considering the share of plant communities forming the macrophytes emerging above water surface, the following groups of reservoirs were distinguished: "reed", "reed mace", "reed-reed mace", "sedge" and "floodplain" reservoirs. Each year, from April to July, 3 - 5 bird countings took place. Wetland bird species and species existing at the edges of reservoirs were counted. Nomadic, migratory as well as bird species within the distance of 100 m from the shoreline were noted, as well. A number of singing *Passeriformes* bird pairs was determined using the Enemer's method in the Tomiałojć modification (1968). The basic aim of the investigation was the recognition of breeding avifauna inhabiting mid-field reservoirs, habitat preferences of particular bird species as well as the classification of the reservoirs with regard to their attraction for birds. The results showed nesting of 52 bird species, including 29 species favoring the wetland environment and 23 species inhabited the shoreline zone of grey willow bushes and trees. Number of breeding bird species for a particular reservoir ranged from 1 to 19, with an average of 18.3. Amount of environmental factors influencing the total number of nesting bird species on the reservoirs ranged from 2 to 7 with the variability from 40 to 48%. The total number of species and the number of breeding pairs were statistically different in relation to the vegetation structure. The highest numbers of bird species and pairs were stated for the reservoirs of the reed and the reed-reed mace types. The lowest number of bird species appeared on the sedge and flood plain reservoirs where ground wetland flora dominated.

Keywords: avifauna, breeding birds, mid-field reservoirs

## **Plankton communities of the Weitmoos: A comparison of selected ponds in different developmental stages**

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The name "Weitmoos" originally referred to a peat-bog 25 km north of Salzburg, Austria, which developed from a glacier lake. Intensive peat mining activities starting in the middle of the 19th century led to an exposure of the subsoil throughout large areas. Soon after the mining had stopped in the 1990's, a mosaic of small ponds and large reed areas originated from the totally destroyed bog. As a consequence, a considerable number of rare and internationally preserved bird species found their breeding and feeding habitats there. This fact led to the nomination of the "Weitmoos" as a NATURA 2000 area. An initiative of LIFE allowed the realisation of structural measures in order to improve the quality of the habitat.

In the course of a diploma thesis, 13 ponds of different structures and developmental stages all over the bog were selected. Samples of plankton and other small aquatic animals were taken, measuring as well the fundamental abiotic factors like ph-value, water temperature, oxygen saturation and conductivity. Each pond was sampled three times between June and October 2005. The diversity within the plankton communities was analysed. Representing the basal part of a whole food web, changes within these communities can have considerable effects on larger animals, like birds. So, the results of this investigation are a first step for future monitoring efforts and may give us insight into the current and future development of the species diversity of this area.

Keywords: conservation, monitoring, Natura 2000, plankton communities, pond network

## Causes for inter-annual instability of a rare annual species of Mediterranean temporary pools : *Elatine brochonii* Clav. (Elatinaceae)

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*Elatine brochonii* is a rare species, found only in temporarily flooded habitats in S-France, Spain and Maghreb. The populations of *E. brochonii* have been studied in 2 temporary pools in Morocco during respectively 9 and 5 years along permanent transects. The abundance and spatial distribution of the seedbanks have been measured during 3 years by direct counts after sieving of the sediment. The impact of selected environmental factors on the germination of seeds, primary production and sexual reproduction were measured during several experiments.

The results of the field observations and experiments in controlled conditions suggest that the populations of *E. brochonii* are closely controlled by the environmental factors and especially hydrology. Shallow flooding enhance germination, water saturation of soil is necessary for the development of germlings and to the success of reproduction. However complete flooding increases the rate of mortality and prevents sexual reproduction. The spatial distribution of *E. brochonii* in the vegetation is restricted to a narrow strip along the outer edge of the pool although the distribution of the seedbank covers more extensive areas. This pattern suggests that the favourable years for that species are infrequent, restricted to the wettest years with extensive flooding of the pool. The lack of populations of *E. brochonii* in the centre of the pools could be explained by high rate of mortality caused by flooding and the failure of reproductive success in deeper water.

Keywords: *Elatine brochonii*, flooding, germination, inter-annual instability, Mediterranean temporary pool, Morocco.

## Richness and inter-annual dynamics of vegetation in unstable environment : the Moroccan temporary pools

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In Moroccan Cork oak forests numerous temporary pools (locally named « daya ») constitute very important sites for biodiversity. They shelter rare plant species which are restricted to this type of habitat. The vegetation in the Daya are impacted by high pressure resulting from man activities and especially domestic grazing and by large inter-annual rainfall fluctuations. The dynamics of vegetation has been studied during 9 successive years in one pool located in the Benslimane Forest (1997-2005) and during 5 years in 2 pools in the Mamora Forest (2001-2005). Three suites of species have been recognized for the analysis: species exclusive or characteristics of temporarily flooded pools, forest species and ubiquitous species. The results of the analysis of the dynamics of the vegetation revealed large inter-annual fluctuations in the abundance and spatial distribution of species. This dynamics was explained to a large extent by hydrological fluctuations. Climatic events of low frequency but high intensity (drought/flood) resulted in durable impact on the abundance of species from the 3 suites and on the relative abundance of perennials and annuals. Ubiquitous and forest species were more abundant during dry years while they receded during wet years. Different pattern were recognized among species in their spatial and temporal variations of their abundance. A group of rare species exclusive to temporary pools (*Damasonium stellatum*, *Pilularia minuta*, *Elatine brochonii*) was found with a high stability in space and a low frequency of occurrence in time

Keywords: adaptive strategy, inter-annual dynamics, temporary pool, Morocco, vegetation, richness,

## Habitat heterogeneity sustains the most productive invertebrate predators: evidences from ponds.

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Habitat-specific sampling was used to estimate the annual production (P) of macroinvertebrates in three ponds (A, B and C) located in south-western France. The dragonflies *Libellula depressa* (P = 1679 mg dry weight/m<sup>2</sup>/yr in pond A) and *Anax imperator* (P = 3713 and 3911 mg/m<sup>2</sup>/y in ponds B and C, respectively) were the most productive invertebrate predators. Production estimates and gut content analyses were used to quantify the prey ingestion of these predators. In pond A, the calculated prey ingestion indicated that *L. depressa* was supported by Ephemeroptera (44% = 1909 mg/m<sup>2</sup>/yr ingested), Chironomidae (33% = 1419 mg/m<sup>2</sup>/yr ingested) and Oligochaeta (19% = 814 mg/m<sup>2</sup>/yr ingested). In ponds B and C, *A. imperator* was primarily supported by *Cloeon dipterum* (91% = 8733 mg/m<sup>2</sup>/yr ingested and 94% = 9593 mg/m<sup>2</sup>/yr ingested) with zooplankton representing only 3% (i.e. 335 and 3279 mg/m<sup>2</sup>/yr ingested) of the ingestion flux in both cases. Muddy substrata, *Sphagnum* sp., *Chara* sp. and *Typha latifolia* were the main available habitats in the three ponds. Habitat heterogeneity increased from pond A (mud cover: 85-95% of the pond area) to pond C where *T. latifolia* and *Chara* sp. covered 100 % of the pond area. Our data indicate that the contribution of each habitat to the total prey production was necessary to sustain the most productive predators in all ponds.

Keywords: energy flow, food web, macroinvertebrates, secondary production, wetlands

## **Artificial ponds support human activities and promote biodiversity: agriculture and odonates in SW France**

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Recent studies considered domestic ponds as a medium to increase local species richness and to sustain regional biodiversity. Therefore, why not considering a compromise between the services they offer and an added value for biodiversity? We studied 37 ponds bored in an agricultural landscape of SW France in order to provide different types of services (fish reservoirs, ornament, cattle watering, duck farming). Without reference conditions in the area, the gamma diversity was used to assess the benefit of artificial ponds for aquatic life. Odonata were used as a surrogate taxa for the assessment of the biodiversity hosted by ponds. The 37 ponds captured 32 % of the regional species pool (i.e. 70 species), whereas the number of species per pond ranged from 0 to 12. The Self-Organizing Map (SOM, neural network) was used to classify the ponds according to their odonate assemblages, then General Linear Modelling (GLM) was used to specify the influence of environmental variables related to land use and pond characteristics on species richness. The SOM trained with species occurrences showed 6 clusters of ponds. The species assemblages could not be related to pond use, or to any other landscape or pond variable, suggesting that many factors contributed to realize a mosaic of habitats which in turn was attractive for species with different requirements. However, GLM yielded a positive correlation between species richness and pond area ( $p < 0.01$ ), and a negative correlation between species richness and the presence of ducks ( $p < 0.05$ ). Species richness could be primarily related to well-known ecological patterns (species-area effect) and not to particular use or landscape features. All ponds contributed to biodiversity in the area, while they offered support to human activities. Assessing the cost-benefit ratio of designing ponds for human activities could consider a positive added value for biodiversity.

Keywords : agriculture, artificial ponds, gamma diversity, Odonata, species-area relationship.

## **Measuring the trophic status of ponds: relations between the summer rate of primary productivity and the physico-chemistry of the water**

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The trophic status of ponds, required to identify reliable bioindicators of water quality, is optimally indicated by the primary productivity. This measure is time consuming and a physico-chemical surrogate valid for ponds would be very valuable. To study relationships between productivity and water physico-chemistry, we measured rates of periphytonic productivity during two month (June-July 2005) at two points of nine Swiss colinean ponds varying in concentrations of water nutrients. Productivity was determined by ignition of the periphyton accumulated on the inner side of transparent cubic plastic boxes covered on their open face by a net and placed 2-3 cm below the water surface. Submerged macrophytes presence in seven of the nine ponds was taken into account by locating points inside and outside stands. Three boxes per point were replaced every two weeks. Water physico-chemistry was measured and sampled at the deeper position during the previous winter and was also measured at each summer visit. Results show primarily a good reliability of the experimental design for measuring productivity in ponds. Overall, mean value of primary productivity is positively correlated to winter total nitrogen concentration (linear regression  $r^2=0.829$ ,  $p<0.001$ ). Productivity tends to vary along the season in most of the ponds but the relationship with nitrogen remains valid. For a given pond, rates measured inside stands of submerged macrophytes are nearly always lower than outside, according to the competition for resources. Additionally the subset of productivity measured outside of macrophytes gives a better correlation with nitrogen concentration than the other subset. However, in the two sites without submerged species, productivity differs also between points. Results allow using winter concentration of total nitrogen to determine the trophic status of colinean ponds which is also in accordance with results found with a flora trophic index.

Keywords: AFDW, alternative stable states, assessment, macrophytes

## **Macroinvertebrate biodiversity in coastal Mediterranean wetlands**

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Sediment and plant associated macroinvertebrates were sampled in six shallow water bodies in Mediterranean wetlands along the coast of Valencia region. Size of ponds, salinity and hydroperiod were variable. In spite of this disparity some results could be achieved:

1.- Sixty four taxa were recorded at species level, some of them endemics or uncommon species, evidencing the important contribution of these ponds to biodiversity.

2.- Correspondence analysis showed the macroinvertebrate assemblages responded to environmental variables, mainly: salinity, temporality and eutrophication. For example, brackish water fauna was dominated by crustaceans, while in freshwater oligochaeta and insects larvae were also abundant.

3.- Biological water quality indices were tested since these ponds are subject to different human impacts. Density of macroinvertebrates associated to plants, diversity, number of taxa, predators percentage, oligochaeta/chironomid ratio in sediment and percentage of sensible taxa (EOT) were useful but are dependent on pond typology.

This study shows the broad ecological variety of ponds found in these wetlands and their importance for biodiversity. Some spring ponds act as a permanent biological reservoir in fluctuant marshes with seasonal dryness. This must should be taken into account for both index quality application and for management strategies.

Indicators, macroinvertebrates, Mediterranean wetlands, salinity, spring pond

## **Pond loss and uses in the Parisian basin : historical perspectives**

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Sometimes described as *Palus domesticus*, ponds reflect the most familiar and narrow bonds between wetlands and local societies, which use them and tailor them. They were an omnipresent feature of the rural landscape beginning in the XIX<sup>th</sup> century up until the spread of water conveyance in the surrounding countryside, depending on the location, between 1930 and 1960. Thus, they have always been witness to the day-to-day history of the man's relation with nature. However, because of their ultra-domestic and contingent nature, their limited size, their number and their being so commonplace, as well as of their absence of land recognition, they defy a geo-historical analysis, which consolidates that of textual and iconographic files. Consequently, the documentation difficulty inherent in the intellectual grasp of these small wetlands results too often in outlining their history in reduced terms. Given that one precedes with an analytical and officious inventory of their uses without those being replaced in time and without comparing the rural areas to the other uses affecting the contiguous ponds, the ponds are perceived under general considerations. Such considerations relate to perceptions and policies as regards stagnant water coming from legal and regulatory bodies.

The purpose here is therefore to provide a foundation to the history of sowings, the uses and perceptions in three delimited geographical areas: (I) The Paris Basin, (II) The agricultural cantons of the Center (of France) marked by breeding, field cropping or the maintenance of mixed-farming, (III) The commune of Thimert to the borders of Beauce and Perche (Eure-et-Loir).

If the main stages of the use and the perception of these wetlands are found within these three geographical frameworks, this study makes it possible to specify the dynamic ones having led to the creation or the filling of the ponds. Moreover, it evaluates the influence of the factors that ensure their maintenance between two successive ranges of uses. Consequently, this history, far from being completed, provides an argument upon which to build a strategy of conservation for rural ponds which, for many of them, have become part of today's urban periphery.

Keywords: historical analysis, rural ponds, urban nature, policy

## Proposal of additional criteria for conservation purposes of the Mediterranean temporary ponds

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The importance of lentic aquatic ecosystems of the Mediterranean and their deterioration has given rise to concern. Temporary aquatic environments are those that are in the most precarious situation, as their condition has continued to deteriorate despite, in the case of the Mediterranean temporary ponds, the existence of preservation initiatives (European Directive 92/43/CEE). Although certain zoological and vegetation groups only inhabit temporary ponds, there has been a tendency to undervalue the fauna and flora of these waterbodies. The true importance of the flora of Mediterranean temporary aquatic environments has been revalued, and the need to protect and create these ecosystems for the conservation of the species that inhabit them has been noted. Mediterranean temporary ponds have been classified by the UE as a “priority habitat”, although they are only identified following restrictive vegetation criteria. This classification excludes some temporary waterbodies, which can have valuable elements of natural heritage. In order to obtain a better identification of the most interesting Mediterranean temporary ponds for conservation purposes, some faunal and floristic criteria are proposed in addition to those already existing in the UE directives (i.e. *Isoetion* alliance). These additional criteria could be the presence of large branchiopods, the suitability of the pond for amphibian reproduction, the species richness of aquatic coleopterans and heteropterans, the percentage of characteristic species of the *Isoetion* phytosociological alliance, the presence of charophytes, or the number of hydrophytic species.

Keywords: conservation, faunal criteria, floristic criteria, Habitats Directive, Mediterranean temporary ponds

## Looking for an integrated pond management in Valencia

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Water scarcity inland the Valencian Community (East Spain) represents a limiting factor for aquatic dwellers. So, presence of ponds, natural or artificial, and temporary pools may be determinant for its conservation, specially in the case of amphibians and many invertebrates. Ponds shelter all the amphibian species present in the Valencian Community: *Pleurodeles waltl*, *Pelobates cultripes*, *Discoglossus jeanneae*, *Alytes obstetricans*, *Pelodytes punctatus*, *Bufo bufo*, *Bufo calamita* and *Rana perezi*. Also noticeable is the presence of some rare aquatic invertebrates (Branchiopoda, Calanoida) and vegetation (*Marsilea strigosa*, *Isoetes velatum*).

In this preliminary report, the result of an intensive pond survey carried out along the Valencian Community is shown. The survey includes the result of applications filled by the Warden Service, fieldwork and cartographic revision. In the resulting inventory 4.609 ponds belonging to different typology has been identified: springs, artificial and natural ponds, etc. 900 of them being Mediterranean temporary pools, mainly human managed ponds after cattle use. The climate of the Valencian Community belongs to the Mediterranean type, nevertheless showing a relatively high diversity between the coastal zone and the inland mountains. So, a limiting factor for life development is the climatic water availability, so meaning the relationship between rainfall and potential evapotranspiration (PE). Under this point of view we can distinguish local climates varying from wet type (more than 800 mm/year rainfall) to arid type (less than 250 mm). The major of those 900 temporary ponds (93%) are placed in areas with a yearly rainfall mean between 400 and 700 mm. Also the 83% of them belong to areas with a PE below 80 cm. In order to establish future conservation guidelines through the implementation of a LIFE-Nature project (Restoration of priority habitats for amphibians), the correspondence between the identified pond network and the land protection tools, as well as the land ownership, is here considered. In this way, the situation of the selected ponds and the Nature Park network, Natura 2000 network, and Wetland Catalogue is shown.

Keywords: network, mediterranean temporary ponds, Valencia.

## Developing an index of biological integrity based on macroinvertebrates for mountain ponds of central Italy

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Most of the mountain areas in central Italy are protected by local and/or national authorities. Although the high conservation status, ponds of those areas are often affected by nutrient enrichment coming from the livestock reared in the watershed during snow free months. The lack of biological systems for the assessment of ecological quality specific for those pond types prevents an effective management of these natural resources. In this paper we develop an index based on macroinvertebrates sensible to the gradient of nutrient enrichment. With this aim, we selected 31 ponds with similar geomorphological characteristics and watershed use in protected areas of central Apennines. A rapid bioassessment protocol was adopted to collect and process benthic samples and key associated physical, chemical and biological variables during the summer growth season of 1998. We calculated several macroinvertebrate metrics based on selected and total taxa richness, functional groups and taxa tolerance. As expected, dissolved inorganic nitrogen (DIN, ranging from 0.47 to 11.24 mg L<sup>-1</sup>), chlorophyll *a* (CHLA, ranging from 2 to >500 µg L<sup>-1</sup>) and macrophyte coverage (ranging from none to 100% of pond area) were the main variables explaining the gradient of environmental degradation. A total of 64 macroinvertebrate genera was collected. Total taxa richness was positively correlated with macrophyte coverage and negatively correlated with DIN and CHLA. Also several other macroinvertebrate metrics responded to the same environmental gradient. Based on environmental variables, clear water, meso-eutrophic and macrophyte rich ponds were distinct from hyper-eutrophic, turbid and macrophyte free ponds. Overall, the taxonomic composition of the macroinvertebrate assemblage was different among the two pond types, as several taxa presence was clearly linked to aquatic vegetation (e.g. gastropods, ephemeropterans, some sub-families and tribes of chironomids). Advantages and limitations of the tested macroinvertebrate metrics are briefly discussed.

Keywords: Apennines, ecological integrity, macroinvertebrates, mountain ponds, rapid bioassessment.

## Contribution to the sampling methods for the monitoring of phytophilous macroinvertebrates in pond littoral

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Phytophilous macroinvertebrates are a very important item of pond ecosystems usually associated with both submersed and emergent reed and other macrophyte beds in the pond littoral. Quantity and diversity of these aquatic animals can largely indicate biological condition of pond. Especially the research of aquatic invertebrates of hard emergent macrophytes (*Phragmites australis*, *Typha* spp.), that creates typically pond littoral vegetation in the Central Europe, was still insufficient. The reason can be difficult and still disunited methods of sampling. The aim of the study was to attend to the method, which could joint technical sampler unpretentiousness, sampling simplicity and maximal quantitative accuracy. For these purposes, we developed a modified Gerking's frame box sampler with movable cutter (Gerking 1957) for sampling of animals in the littoral macrophyte beds and a new type of core sampler for collection of animals inhabiting the root zone of emergent plants. The comparative sampling (n = 5) using frame box sampler (25 \* 45 cm) and benthos handnet (25 \* 35 cm) on a comparable area was performed on the marginal area of reed bed and open water in the littoral of a carp pond. The sampling utilising the frame sampler was more labour demanding however it enabled the collection of non-freemoving animals (*Gastropoda*, *Oligochaeta*, larvae of *Chironomidae*). On the contrary, the actively moving invertebrates (*Ephemeroptera* nymphs, *Corixidae*) were less frequent in comparison with handnet. Both approaches provided collection of identical macroinvertebrate taxa. The modified frame box Gerking's sampler is a suitable sampling device for quantitative collection of phytophilous macroinvertebrates enabling their monitoring in the pond littoral.

Keywords: phytophilous macroinvertebrates, pond littoral, sampling methods.

## **Zooplankton communities of nine mountain temporary pools: a two-year study**

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In 2001 and 2002 nine temporary pools located in the Northern Apennines (Italy), at an altitude between 1596 m and 1733 m a.s.l., were visited during the ice-free season (May to October) in order to examine the structure of zooplankton communities. On the whole, 54 taxa were found (41 rotifers, 5 cladocerans, 6 copepods and 2 anostracans). In both years, zooplankton taxa varied markedly in their appearance time and persistence among habitats, and distinctive species assemblages were observed in pools with different hydroperiod. The aquatic phase length appeared to be the main factor influencing the structure of zooplankton communities. Data on zooplankton occurrence in the study area were compared with those available from hydrobiological studies carried out in neighbouring mountain districts to analyse the role of dispersal and other processes (e.g. competition) in shaping zooplankton communities. In spite of harsh environmental conditions (e.g. long winter ice cover, low water temperature, large distance from the colonisation source) which usually prevent alpine water bodies from hosting high species richness, the number of zooplankton taxa reported in this study and the presence of the endemic species *Chirocephalus ruffoi* (Crustacea, Anostraca) make evident the importance of these temporary pools as biodiversity hotspots.

Keywords: anostraca, dispersal, hydroperiod, temporary pools, zooplankton

## **The UK National Pond Monitoring Network**

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The United Kingdom National Pond Monitoring Network (NPMN) has been established as a partnership between government agencies and non-governmental organisations. It aims to promote collection of biological and environmental pond survey data using standard methods, to develop a national monitoring programme, to collate existing data, and to make pond data freely available through its website ([www.pondnetwork.org.uk](http://www.pondnetwork.org.uk)). To date over 50 organisations and over 500 individuals have been involved. We will describe the development of the NPMN, the data it can deliver and some of the projects being implemented through the Network.

Keywords: data, database, monitoring, survey, website

## Creating new ponds: principles and practice

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Ponds are unusual freshwater systems in that individual waterbodies are often relatively short lived, but in natural areas at least, the habitat is continually sustained by a wide variety of natural creation processes. Perhaps not surprisingly, many freshwater plants and animals are very well adapted to colonising such new sites and, given a good start, with careful design and siting, new man-made ponds can rapidly become very valuable waterbodies. Our information and experience from the last 15 years suggest that three factors have a key influence on the biodiversity of new ponds. They are: (i) good water quality, (ii) a wetland location, or good (indirect) links to other wetlands, and (iii) a varied mosaic design. In general, a new pond complex that combines any two of these factors will develop a valuable wildlife community. With all three, the pond community is likely to be outstanding. A site that we designed and monitored in the 1990's exemplifies the potential value of good pond creation schemes. Pinkhill Meadow is a 3 ha flood meadow next to the River Thames in Oxfordshire, UK. A mosaic of 40 ponds was created here in 1990-91, with waterbodies in the complex differing in size, permanence, underlying substrate and (good quality) water source. Monitoring data show that within the first 6 years, the complex was colonised naturally by c.20% of all Britain's wetland plant and larger invertebrate species. This included breeding records for 12 species of dragonfly, and a number of uncommon and Nationally Scarce plants and invertebrate species. Invertebrate species richness values in some individual ponds were in the top 2-3% of sites we have looked at in our national surveys, and better than the majority of ponds in UK nature reserves. Such results show that it is possible to rapidly create high value new pond sites and that, if they are carefully designed and put into corners of the countryside where it is convenient to keep them clean and unpolluted, new ponds have considerable potential to contribute to local and regional freshwater biodiversity.

Keywords: Colonisation, creation, macroinvertebrates, pond, wetland plants

## INDEX OF AUTHORS

	Pages
Adámek	64
Angélibert	12, 21, 47, 56, 57
Aquilina	66
Augustin	39
Azemar	56
Badosa	16, 19
Bagella	13, 43
Bazzanti	14, 20, 29, 63
Berger	39
Biggs	12, 15, 18, 22, 50, 66, 67
Boix	16, 19, 32, 61
Boven	17
Brendonck	17, 23, 25, 26, 27, 37
Briers	18
Brucet	16, 19
Carchini	20, 63
Cayrou	21
Céréghino	21, 56, 57
Charpentier	54
Compte	19
Davies	22
De Bie	23, 27, 33
De Meester	17, 23, 24, 27, 42
De Roeck	25, 26
Declerck	23, 27, 33, 42
Della Bella	14, 20, 28, 29
Demeter	30
Desnouhes	54
Dowgiallo	29
Duborper	54
Duvivier	24
El Khyari	54, 55
Farris	13
Figuerola	57
Filigheddu	13
Font	61
Frisch	31
Gascón	16, 32, 61
Giani	47
Gifre	16
Goldschmid	44
Green	31
Grezzi	14
Grillas	54, 55
Hinden	51
Hollinshead	33, 34

Hull	34
Iberite	29
Indermuehle	35, 51
Jeffries	36
Jocqué	37
Kaletka	38, 39
Kyek	40, 44
Lacomba	41, 62
Leclainche	54
Lee	22
López-Flores	16, 19
Louette	24, 42
Lugliè	43
Maletzky	40, 44
Mancini	28
Mandrillon	45
Manel	46
Mariani	43
Martens	23, 27
Martin	46
Martinoy	16
Marty	21, 47, 56, 57
Menetrey	48
Miaud	46
Mikulicek	44
Miracle	59
Murton	49
Nicolet	50, 66
Oertli	35, 48, 51
Orzechowska	52
Padedda	43
Pisanu	13
Pöckl	53
Poquet	59
Quintana	16, 19, 32
Raitt	25, 26
Rhazi A	54
Rhazi L	54, 55
Rhazi M	55
Riddoch	37
Rossetti	65
Rudat	38
Rueda	59
Ruggiero	21, 47, 56, 57, 63
Sager	58
Saglio	45
Sahuquillo	59
Sajaloli	60
Sala	16, 32, 61
Sancho	41, 62

Sartori	48
Schabetsberger	53
Sechi	43
Slater	49
Solimini	20, 63
Stoks	17
Stoll	51
Sychra	64
Szyperek	52
Tavernini	65
Thompson	22
Timms	37
Titolet	54, 55
Van Damme	24
Vanschoenwinkel	25, 26
Verhoest	26
Wagner	48
Walker	18
Waterkeyn	25, 26
Weatherby	66
Whitfield	12, 15, 18, 50, 66, 67
Williams	12, 15, 18, 50, 66, 67
Xu	25, 26