



## **Scientific Report**

### **1. Executive Summary**

The workshop joined 17 leading scientists and seven young scientists from eight European countries and the United States. The participants represented various fields of protistology, ranging from taxonomy to molecular ecology and biotechnology. The workshop programme included 19 oral presentations, organized in four thematic sessions followed by thematically related working group discussions on (i) 'Protistan systematics and identification', (ii) 'Detection of protistan abundance, activity and diversity in soil', (iii) 'Protists as bioindicators' and (iv) 'Applied and industrial protistology'. A plenary session was devoted to a synthesis of working group results and the planning of joint future activities. A welcome reception, a conference dinner and an excursion to a field study site of scientific interest and an ancient mine of touristic interest completed the workshop programme and gave ample opportunity for informal discussions. The proposed budget was sufficient to cover the expenses for the organization of the workshop and traveling and accommodation of most participants. Some participants covered their own costs.

There was general agreement on the high technical quality of the talks and the 'freshness' and novelty of the results presented. The main goal of the workshop of joining disciplines was matched as several workshop participants, although active in related fields, met indeed for the first time. Countable outcome of the workshop were the commitments (i) to submit a joint proposal for an ESF network in 'Applied and Environmental Protistology' in November 2002 (see attached document), with the goal to consolidate the collaboration and to extend it beyond the workshop participants, (ii) to use the network to prepare ESF and or EU research proposals, (iii) to co-ordinate research by identifying and using common sampling sites, and (iv) to organize medium-term a 'European School for Protistology'.



## 2. Scientific content of the event

Four sessions of oral presentations covered different fields of protistology:

- A. Taxonomy and diversity of protists (four talks)
- B. Application of protists as bioindicators and in biotechnology (five talks)
- C. Protistan ecology (five talks)
- D. Molecular analysis of protistan communities (five talks)

**Session A** covered various aspects of protistan taxonomy and diversity. W. Foissner presented detailed evidence that conservation efforts are needed for protists as at least some protists have a restricted biogeographic distribution. S. Karpov presented an overview of the taxonomy of Cercomonads including the recent introduction of new genera. He proposed a combined investigation of molecular physiology and cytoskeleton structure description for future taxonomic work. F. Ekelund presented a mathematical model to describe the dynamics of ciliate populations during the decomposition of fresh organic material. One important outcome of the model was that soil ciliates may be adapted to the unstable soil environment by internally governed encystment. G. Novarino presented indications for higher flagellate species richness in contaminated aquifers. Three types of flagellates with respect to bacterivory could be distinguished.

**Session B** was devoted to the application of protists. E. Shubert pointed out that algae are particularly well adapted to acidic, saline, and metal rich soils and that non-motile coccoid algae are good indicators of highly acidic, metal rich soils. P. Mäder presented a study on microorganisms as indicators for soil fertility. Three case studies showed that soil microbial biomass and enzyme activities were good indicators for long-term farming system effects with the metabolic quotient showing a strong correlation with soil microbial functional diversity. E. Mitchell reported the use of testate amoebae as indicators in wetland ecosystems on various time and spatial scales. J. Hackstein added information from the comparably well studied diversity of rumen ciliates. A molecular approach to study their enormous biodiversity and efforts to keep e.g. the sequence information and cryo preserved organisms was presented. T. Kiy presented examples for the biotechnological exploitation of protists, the most prominent being the production and recent market launch of docosahexaenoic acid (DHA), a food additive with multiple health effects.

**Session C** focused on protistan ecology in various ecosystems. B. Griffiths introduced into the structure and function of foodwebs in soil, before giving examples for how food webs are affected by environmental changes and loss of biodiversity. M. Bonkowski presented evidence for more complex influences of protists on plants than previously assumed. An example is the stimulation of plant growth via promotion of rhizosphere bacteria. J. Schwarz presented work on the influence of rice field ciliate communities on methane emission and microbial communities. Clear ciliate community succession patterns were found and size-selective grazing led to reduced variability of bacterial biovolumes. J. Parry pointed out that protists play an important ecological role in maintaining biofilm communities in exponential growth via grazing and that surface-associated communities can be considered as hot-spots of microbial activity. J. Boenigk focused on the grazing behavior and substrate selectivity of protists. Discriminatory mechanisms in flagellates were presented whereas the absence of selection was shown for ciliates.



**Session D** was devoted to the investigation of protist communities with molecular methods. D. Moreira set the scene by introducing into the eukaryotic microbial diversity in aquatic environments. The enormous impact of molecular analyses on the progress of ecological and phylogenetic research was pointed out. A. Chatzinotas presented the application of (i) 18S rDNA sequence analysis in PAH- contaminated soil, (ii) of fingerprinting methods for high throughput screening of soil, and (iii) of oligonucleotide probing of distinct protistan groups. M. Pélandakis presented work on the global distribution of pathogenic *Naegleria* species. An unexpected variability within species was found. M. Horn gave an overview of recent method developments for in situ identification and characterization of protists. This includes the application of chip-techniques for elucidating the genetic potential of yet uncultured species. H. Arndt gave an overview of his research into the functional diversity of heterotrophic flagellates with an emphasis on community structure and feeding strategies in aquatic environments.

### **Working groups on**

'Protistan systematics and identification'  
'Detection of protistan abundance, activity and diversity in soil'  
'Protists as bioindicators' and  
'Applied and industrial protistology'

resulted in lively discussions, the results of which are summarized in Section 4.



### 3. Final Programme

#### Thursday, 10<sup>th</sup> October 2002

12.30 – 13.40 *Arrival and Registration*

- **Official opening**  
*Hauke Harms, Convenor*

- **Presentation of the European Science Foundation and LESC**  
*Hui Wang, ESF*

#### **Session A**

*Chairman: Gianfranco Novarino*

14.00 – 14.40 **Soil Protozoa: Conservation issues**  
*Wilhelm Foissner, Salzburg*

14.40 – 15.10 **Diversity of Cercomonads**  
*Serguei Karpov, St. Petersburg*

15.10 – 15.40 **Activity of soil protozoa, and its measurement**  
*Flemming Ekelund, Copenhagen*

15.40 – 16.10 **Diversity of groundwater protists in relation to their ecological role**  
*Gianfranco Novarino, London*

16.10 – 16.30 *Coffee Break*

#### **Session B**

*Chairman: Serguei Karpov*

16.30 – 17.00 **Algae as indicators of highly acidic and metal rich soils**  
*Elliot Shubert, London*

17.00 – 17.30 **Microorganisms as indicators for the fertility of soils**  
*Paul Mäder, Frick*

17.30 – 18.00 **What can protists tell us at community level in wetland ecosystems?**  
*Edward Mitchell, Anchorage*

18.00 – 18.30 **The molecular diversity of rumen ciliates: Implications for the global biodiversity of intestinal ciliates and potential biotechnology applications**  
*Johannes Hackstein, Nijmegen*

18.30 – 19.00 **Biotechnology of protists**  
*Thomas Kiy, Frankfurt*

- *Reception at conference location*



## Friday, 11<sup>th</sup> October 2002

### **Session C**

*Chairman Michael Bonkowski*

- 9.00 – 9.30            **Foodwebs in soils**  
*Bryan Griffiths, Dundee*
- 9.30 – 10.00        **Protozoa and plant growth: The microbial loop in soil revisited**  
*Michael Bonkowski, Darmstadt*
- 10.00 – 10.30       **Ciliates in anoxic rice field soil**  
*Julian Schwarz, Marburg*
- 10.30 – 11.00       *Coffee Break*
- 11.00 – 11.30       **Intra- and interspecific variability in protist bacterivory: Significance of selected environmental factors**  
*Jens Boenigk, Mondsee*
- 11.30 – 12.00       **Protozoan participation in biofilm dynamics**  
*Jackie Parry, Lancaster*
- 12.00 – 13.30       *Lunch*

### **Session D**

*Chairman: Hartmut Arndt*

- 13.30 – 14.00       **Molecular ecology and the discovery of a huge hidden diversity of protists**  
*David Moreira, Paris*
- 14.00 – 14.30       **Molecular eukaryotic diversity in polluted soils**  
*Antonis Chatzinotas, Lausanne*
- 14.30 – 15.00       **Molecular markers for the free-living amoeba Naegleria: Identification and biodiversity**  
*Michel Pélandakis, Lyon*
- 15.00 – 15.30       *Coffee Break*
- 15.30 – 16.00       **In situ identification and characterization of protists and their bacterial endosymbionts: From FISH to genomics and DNA microarrays**  
*Matthias Horn, München*
- 16.00 – 16.30       **Biodiversity of heterotrophic nanoprotists: Species identity using biochip technology and mechanisms of dispersion**  
*Hartmut Arndt, Köln*
- 16.30 – 17.00       *Coffee Break*



17.00 – 19.00

Working group 1. **Protistan systematics and identification**  
*Wilhelm Foissner and David Moreira*

Working group 2. **How do we best detect protistan abundance, activity and diversity in soil?**  
*Flemming Ekelund*

- *Conference Dinner in the Restaurant: Café Romand*

## **Saturday, 12<sup>th</sup> October 2002**

9.15 – 11.15

Working group 3. **Use of protists as bioindicators**  
*Bryan Griffiths*

Working group 4. **Applied and industrial protistology**  
*Thomas Kiy*

11.15 – 11.45

*Coffee Break*

11.45 – 13.15

**Synthesis of working group results**  
*Hauke Harms*

13.15 – 14.00

*Lunch (Sandwiches)*

14.00 – 19.00

**Excursion to the Val de Travers**

- *visit of the ancient asphalt mines of La Presta*

- *visit of peat-bogs studied in the frame of the European project 'RECIPE'*



## 4. Assessment of the Results

The workshop gave a broad overview of the state of the art in the various disciplines of applied and environmental protistology. Not unexpectedly, it became visible during the workshop that European scientists in environmental protistology are currently not organised in a way that would allow them to meet the scientific challenges. There was general agreement about the needs (i) to make protists and protist communities in their natural habitats accessible to molecular biological analysis, (ii) to preserve classical morphological and taxonomical knowledge and to link it to molecular data, (iii) to look for environmental and industrial applications of protists in order to create economic interest in these organisms and (iv) to put great effort into the attraction and formation of young protistologists. The successful market launch of docosahexaenoic acid (DHA) produced by protists (as presented by T. Kiy) has proven that detailed investigation and exploitation of protists will yield new material for biotechnological applications. Towards this goal special emphasis has to be laid on promoting contacts to biotechnological companies, culture collections and other projects focusing on the biotechnological potential of protists, such as the “European Rumen Ciliate Culture Collection” (ERCULE).

Combining the expertise of traditionally separate disciplines such as taxonomy and ecology on the one side, and molecular biology and genetics on the other side is urgently needed and will enable European scientists to develop a critical mass and become pioneers and leaders in the field of applied and environmental protistology. The workshop participants agreed on applying for an ESF network in 'Applied and Environmental Protistology'. This network aims at stimulating collaborative programmes and helping to cross-communicate ideas and different aspects of this research direction. It appears that the relative negligence of soil protists originates primarily from the historic difficulty of their manipulation and investigation. Joining experts from the field of taxonomy and molecular phylogeny will result in the development of simpler, less demanding and more objective methods for the identification, cultivation and genetic manipulation of protists. Investigations on the ecology and evolutionary relationships of soil protists are expected to benefit from these methods in the same way as bacterial ecology did. Also, there was general agreement that molecular methods will allow and stimulate researchers not experienced in protistology to work on this group of organism. One outcome of the workshop was the commitment to organise a practical course in ciliate identification in the end of 2003 directed by Prof. Foissner at the University of Salzburg/Austria.



## 5. Statistical Information on Participants

### Represented countries/number of participants

Germany	/ 6
Switzerland	/ 5
United Kingdom	/ 4
France	/ 3
Austria	/ 2
Denmark	/ 1
Russia	/ 1
The Netherlands	/ 1
U.S.A.	/ 1

### Age of participants / number

< 30	/ 2
30 - 39	/ 8
40 - 49	/ 10
50 - 59	/ 4
> 60	/ 0

### Male / Female

21 / 3





## 6. Final List of Participants

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