ExpeER

Distributed Infrastructure for EXPErimentation in Ecosystem Research

Grant Agreement Number: 262060

SEVENTH FRAMEWORK PROGRAMME

Capacities

Integrating activities: Networks of Research Infrastructures (RIs)

Theme: Environment and Earth Sciences

DELIVERABLE D 2.1

Deliverable title: Final report on parameters and standardised protocols, for external dissemination

Abstract: The adoption of a set of core parameters and standardised measurement protocols for ecosystem research is a prerequisite for harmonized measurements in every discipline. Here we describe the process by which ExpeER selected which protocols should be used for the project's training and dissemination programme.

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Dissemination level:

PU Public (must be available on the website)	**x**
PP Restricted to other programme participants (including the Commission Services)	
RE Restricted to a group specified by the consortium (including the Commission Services) (precise to whom it should be addressed)	
CO Confidential, only for members of the consortium (including the Commission Services)	

Table of Content

1. Executive summary

The compilation and comparison of research findings across European ecosystem research facilities is often hampered by non-harmonised and non-standard measurement protocols that limit comparability of datasets. Therefore the primary goal of WP2 is to harmonize measurement and sampling methods for a core set of environmental and ecosystem variables across the focal network of participating research sites, so as to allow findings to be compared and generalised. This was done by conceptualizing the way how to select some core parameters and by elaborating the methods how to measure them.

Parameters were chosen for training and development within ExpeER on the basis of the range of ecological integrity variables, priority given by the ExpeER community, and feedback from the first (internal) training course. The final set of parameters is :

1. Land Use Type (landscape analysis)
2. Leaf Area Index (grassland/forest)
3. Plant biomass (grassland/forest)
4. Soil macrofauna (QBS technique, bait lamina, litterbags)
5. Soil respiration (different techniques)
6. Soil organic matter (sampling and analysis)
7. Plant phenology

   and covered the issues of
8. Metadata for sampling, experiments and data management

At the time of writing, the set of protocols has been used for two training courses, one internal and an external course, with another external course to follow. The courses will be reported, and the final set of protocols, will be published in due course.

2. The purpose of this document

The objective of the ExpeER Infrastructure project is to enable integrated studies of the impacts of climate change, land use change and loss of biodiversity in terrestrial ecosystems through two major steps:

1. Bringing together the EXPEER Infrastructures to enable collaboration and integration of observational, experimental and modelling approaches in ecosystem research (in line with the concept developed in ANAEE);
2. Structuring existing network of ecosystem observational, monitoring and experimental sites across Europe (LTER-Europe).

Part of the challenge of integration of ecosystem research is to ensure compatibility of data collected at different infrastructures. At the moment, scientists may measure a range of ecosystem properties using slightly different methods, making data integration and analysis difficult. Therefore, the ExpeER project included Work Package 2, "Standardization of core variables and protocols". The primary objectives of this workpackage are:

- To select and standardise a set of core parameters/variables;
- To develop a nested set of common measurement protocols and standards for sites with different surveying capabilities and instrumentation levels;
- To facilitate adoption of these core parameters/variables by project partners and the wider community via training courses.

This document reports on the selection and standardisation of the core parameters and protocols. I also provides copies of the protocols themselves, but for reasons given below, these are live documents and may change somewhat during the remainder of the ExpeER project.

3. The challenge

Much ecological research has taken place at individual sites, using protocols that have been developed by individuals to suit their needs, capabilities and availability of instrumentation. Thus, different people can use slightly different measurables to record the same ecological processes, making data integration difficult. The idea of ExpeER was to introduce a processes to seek to harmonise these protocols across the sites that comprise the ExpeER infrastructure.

ExpeER is not the first programme that has sought to address this issue. In 1992, the UK Environmental Change Network (ECN)[1] established a set of protocols for recording physical, chemical and biodiversity variables consistently. This approach is now proving its worth, with papers now appearing that look at ecosystem trends at the national scale by integrating data across sites[2](Dick et al., 2011).

[1] http://www.ecn.ac.uk/

[2] DICK, J., ANDREWS, C., BEAUMONT, D. A., BENHAM, S., BROOKS, D. R., CORBETT, S., LLOYD, D., MCMILLAN, S., MONTEITH, D. T., PILGRIM, E. S., ROSE, R., SCOTT, A., SCOTT, T., SMITH, R. I., TAYLOR, C., TAYLOR, M., TURNER, A. & WATSON, H. 2011. A comparison of ecosystem services delivered by 11 long-term monitoring sites in the UK environmental change network. Environmetrics, 22, 639-648.

More recently, the US have established the National Ecological Observatory Network (NEON)[3]. NEON is "designed to gather and synthesize data on the impacts of climate change, land use change and invasive species on natural resources and biodiversity. Data will be collected from 106 sites (60 terrestrial, 36 aquatic and 10 aquatic experimental) across the U.S. (including Alaska, Hawaii and Puerto Rico) using instrument measurements and field sampling. The sites have been strategically selected to represent different regions of vegetation, landforms, climate, and ecosystem performance. NEON will combine site-based data with remotely sensed data and existing continental-scale data sets (e.g. satellite data) to provide a range of scaled data products that can be used to describe changes in the nation's ecosystem through space and time."[4] ExpeER seeks to contribute to this increasing standardisation of ecological data, working in co-ordination with another European project, EnvEurope[5], which seeks to integrate data from the broader network of the European Long Term Ecosystem Research (LTER) Network.

4. Approach for selection of parameters

We aimed to select around 10 ecological variables with which to work. We required the methods to be well tested, robust and widely applied; efficient in terms of information content and relevance to key ecosystem processes; and affordable in terms of time. We did not wish to select protocols for which data are already collected to uniform standards, e.g. meteorological data or data from flux towers.

We took an iterative approach to end up with a set of core variables requiring standardisation:

1. **Measurements at ExpeER sites**: A questionnaire was distributed to ExpeER partner sites to identify which parameters were being used across the ExpeER infrastracture. This was supplemented by visits by Les Firbank to the ExpeER ecotrons at London and Montpelier to discuss how to integrate protocols used in the field with those used in highly controlled environments
2. **Conceptual framework**: We developed a conceptual framework of ecological integrity, by extending previous work performed within the Life+ project ENVEurope which was established as common ground for justification of indicator selection (Table 1). The idea is the framework is used to identify the major processes and structures that a well balanced set of terrestrial ecosystem indicators should address; it also gives a list of high level ecological integrity indicators. This conceptual framework was accepted in both ExpeER and ENVEurope.
3. **Collection of parameters**: ExpeER partners were asked to select important parameters targeting at the high-level ecological integrity indicators for the terrestrial environment. This activity generated about 70 parameters for terrestrial systems.

[3] http://www.neoninc.org/
[4] http://www.neoninc.org/about/overview
[5] http://www.enveurope.eu/

Components I	Components II	Ecological integrity indicators
ECOSYSTEM STRUCTURES		
	Biotic diversity	Flora diversity
		Fauna diversity
		Within habitat structure
		Additional variables when indicated
	Abiotic heterogeneity	Soil
		Water
		Air
		Habitat
		Additional variables when indicated
ECOSYSTEM PROCESSES		
	Energy budget	Input
		Storage
		Output
		Other state variables when indicated
		Efficiency measures
	Matter budget	Input
		Storage
		Output
		Other state variables when indicated
		Efficiency measures
	Water budget	Input
		Storage
		Output
		Other state variables when indicated
		Efficiency measures

Table 1: Conceptual Framework of Ecological Integrity. This framework identifies the major ecological structures and processes that a well-balanced set of indicators should address, with suggested variables that should, ideally, be monitored.

4. **Prioritizing parameters (questionnaire)**: This long list was filtered according to feasibility and importance by UFZ and UNIVLEEDS. The result was a questionnaire with at least one measurable for each ecological integrity indicator. In order to enable a further selection of measurables, recipients were asked to select high priority indicators and measurables. This was sent to all ExpeER partners and 13 responded. The results were analysed in terms of

the rank order of priority given to the ecological integrity indicators, along with the highest priority measurable (Table 2).

Ecological Integrity Indicators	*Rank Order of Importance*	*Highest priority measurable*
Air	**1.00**	Basic climate of the site
Energy input	**1.00**	Radiation and agronomic inputs
Water output	**1.00**	Evapotranspiration
flora diversity	*4.00*	Species and functional diversity, higher plants
Soil	*4.00*	Soil physical characteristics
Energy storage	*4.00*	Biomass
Matter input	*4.00*	Deposition of main nutrients
Matter output	*4.00*	Significant matter export
Water storage	*4.00*	Soil moisture
Water	*10.00*	Soil moisture
Additional variables	11.00	Type and intensity of management
Energy output	11.00	Energy output

Table 2. Results of prioritization of ecological measurables by ExpeER partner organisations.

5. **Prioritizing parameters (group discussion)**: Results of 3. and 4. were presented at the first annual ExpeER meeting in Leipzig (21-23 February 2012). During the technical meeting of WP2 on 22 February the list of parameters was further condensed in group work in order to have a feasible set of parameters and corresponding methods to be developed for task T2.2. (Training and testing of protocols). These were the 10 selected parameters:
    - leaf area index
    - plant biomass
    - soil macrofauna
    - soil moisture
    - soil nutrients (NPS concentration)
    - soil organic matter
    - soil respiration
    - evapotranspiration
    - land use type
    - phenology.

5. Protocol development, testing and dissemination

The selected protocols were written in order to be tested and used for training and dissemination exercises. After each course, feedback was used to guide the further development and selection of the protocols. The training courses will be reported on in more detail elsewhere (Deliverable 2.2). IN summary, the programme of courses is as follows:

27-31 August 2012 ExpeER internal event to test protocols and rehearse forms of training: Rome. The parameters trained were:

1. Leaf Area Index (Forest, grassland)
2. Plant biomass (Forest, grassland)
3. Soil macrofauna (QBS technique, bait lamina, litterbags)
4. Soil organic matter (sampling and analysis)
5. Soil respiration (different techniques)
6. Evapotranspiration (sap flow, eddy covariance)
7. Land Use Type (landscape analysis)
8. Soil moisture (discussion only)
9. Plant phenology (discussion only)

20-24 May 2013 Full Training programme, Italy
26-20 August 2013 Full Training programme, Netherlands

Both training events were aimed at participants from beyond the ExpeER network. Following the experience and feedback from the 2012 courwse, evapotranspiration was dropped from the package of protocols, while the issue of data and metadata management was introduced. At the time of writing, the May training course has taken place, and the final set of protocols for the August training course is as follows:

9. Land Use Type (landscape analysis)
10. Leaf Area Index (grassland/forest)
11. Plant biomass (grassland/forest)
12. Soil macrofauna (QBS technique, bait lamina, litterbags)
13. Soil respiration (different techniques)
14. Soil organic matter (sampling and analysis)
15. Plant phenology

and covered the issues of

16. Metadata for sampling, experiments and data management

6. Next steps

At the time of writing (July 2013), the materials have been prepared for the final training course. The WP2 team shall report on the training courses in Deliverable D2.2 in Month 35. The protocols themselves are likely to be revised afterwards, taking into account feedback from course participants, and will be published as Deliverable 2.3 in Month 45.

7. Annex

Deliverable Check list

To be completed by Deliverable leader

	Check list	√	Comments
BEFORE	I have checked the due date and have planned completion in due time	x	Please inform project management team of any foreseen delays
	The title corresponds to the title in the DoW (Description of Work)	x	If not please inform project management team with justification
	The contents corresponds to the description in the DoW (Description of Work)	x	
	The dissemination level corresponds to that indicated in the DoW (Description of Work)	x	
	The contributors (authors) correspond to those indicated in the DoW (Description of Work)		
	The Table of Contents (ToC) has been validated with the WP Leader	x	Please validate the ToC with the WP leader before drafting the deliverable
	I am using the ExpeER deliverable template (title page, styles etc)	x	Can be found in the intranet
AFTER	The deliverable has been reviewed internally in my organization	x	Please ask colleagues to review the deliverable for its scientific content
	The deliverable has been reviewed by all contributors (authors)	x	Make sure all contributors have reviewed and approved the final version of the deliverable. You should leave sufficient time for this validation.
	I have done a spell check and had the English verified	x	Ask a colleague with a good level of English to review the language of the text and do a spell-check too.
	I have sent the final version to the WP Leader for approval	x	Please send the final validated draft to the Coordinator (project management team) & ExC for validation before the submission to the EC.