I. Revised manuals of pre-existing manuals
II. Manual with new harmonized methods

(Manual of harmonised methods for environmental indicators across different ecosystems)

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Authors	*Mark Frenzel, Cornelia Baeßler, Mauro Bastianini, Alessandro Campanaro, Giorgio Matteucci, Stefan Stoll*

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Creator	*Mark Frenzel (UFZ), Cornelia Baeßler (UFZ), Mauro Bastianini (CNR-ISMAR), Alessandro Campanaro (CFS), Giorgio Matteucci (CNR-ISAFOM / CNR-IBAF), Stefan Stoll (Senckenberg),*
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Contact information:

Mark Frenzel – Editor
Helmholtz Centre for Environmental Research (UFZ)
Theodor-Lieser-Str. 4, 06120 Halle, Germany
E-mail: mark.frenzel@ufz.de
Tel +44 345 5585304, Fax +44 345 5585329

Cornelia Baeßler
Helmholtz Centre for Environmental Research (UFZ)
Theodor-Lieser-Str. 4, 06120 Halle, Germany
E-mail: cornelia.baessler@ufz.de
Tel +44 345 5585317, Fax +44 345 5585329

Mauro Bastianini
National Research Council (CNR-ISMAR)
Institute of Marine Sciences
Castello 1364/a, 30122 Venezia, Italy
E-mail: mauro.bastianini@ismar.cnr.it
Tel +39 041 2404711, Fax +39 041 5204126

Alessandro Campanaro
CFS - Centro Nazionale Biodiversità Forestale "Bosco Fontana" di Verona
and Sapienza Università di Roma - Dipartimento di Biologia e Biotecnologie
Via Carlo Ederle 16a, 37100, Verona, Italy
E-mail: ale.naro@gmail.com
Tel +39 334 6197732

Giorgio Matteucci
National Research Council of Italy
Inst. Of Agroenvironmental and Forest Biology and Inst. For Agriculture and Forestry Systems in the Mediterranean (CNR-ISAFOM / CNR-IBAF)
Via Salaria, km 29, 300 00015 Monterotondo Scalo (RM), Italy
E-mail: giorgio.matteucci@cnr.it
Tel +39 06 90672533, Fax +39 06 9064492

Stefan Stoll
Senckenberg Gesellschaft für Naturforschung (SENCK)
Abt. Limnologie und Naturschutzforschung
Clamecystraße 12, 63571 Gelnhausen, Germany
E-mail: stefan.stoll@senckenberg.de
Tel: +44 6051 61954 3123, Fax: +44 6051 61954 3118

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1.0	2011-12-15	Frenzel	Text and mail merge of table contents to text document
1.1	2012-01-12	Frenzel	Adjustments; completion of text; formatting
2.0	2013-01-20	Frenzel	Revision of parameters; updating and inclusion of literature

Content

1 Preface to version 2

The second version is going to be better tuned with the needs of the user and with the input from the community of colleagues working in the field of ecosystem research. The manual is intended to be a "living document" depending on constant critical review and input like references and parameter property descriptions.

The most important changes in version 2 are:

- We omitted the level II indicators, as we decided to focus on adding information to the level I instead. Level II needs much more input before we may add it in a later version again.
- Separating parameters in different parameter fact sheets if several parameters have been listed in one fact sheet.
- The literature references are included now in the fact sheets of single parameters / indicators and in a general and in ecosystem-specific bibliographies as well.

Moreover, in the meantime an online ranking survey was conducted addressing EnvEurope partners, LTER-Europe and the ILTER community. The aim of this survey was to identify the top ranked parameters according to the criteria of ecological importance, sensitivity to changes, measurement effort and the necessary level of instrumentation. The structure of the survey is copied from the structure of the fact sheets. The results will give support to decisions of site managers for the priority of parameters to be selected.

Outlook: the printed version or even the PDF with enabled navigation is nice to have, but nowadays this is not timely. We are planning a web-based version which is makes navigation even more simple and allows adding items (e.g. parameters, parameter properties, references) by the user.

2 Introduction

Why to create another manual of manuals for ecosystem-related research and monitoring? We would like to emphasize that the separation between the research and monitoring communities is often artificial, as data gained by monitoring are often the base for research on long term time series. Furthermore, ecosystem research often develops methods that, later on, are taken up in ecosystem monitoring. Thus in our understanding, beside the long-term research, the monitoring aspect is always included in the Long Term Ecosystem Research (LTER) background. The idea for this kind of compendium was born within the LTER-Europe (http://www.lter-europe.net/) community and may be of relevance to all networks which need to ensure comparability of data and therefore have to agree on common standards to exploit the added value of networking. Since the foundation of LTER-Europe there was a demand for standardised parameters and harmonised methods which should be applied throughout all LTER-Europe sites, but indeed this concerns in general all sites dealing with aspects of ecosystem research. The willingness to work on these issues was manifested in 2008 by the establishment of an expert panel "Standardisation and Harmonisation" within the LTER-Europe network, which recently merged with the expert panel "Technology" to form the panel on "Standardisation and Technology" (http://www.lter-europe.net/ep/ep-std). The starting ground for this expert panel was already prepared by the network of excellence ALTER-Net (A Long-Term Biodiversity, Ecosystem and Awareness Research Network; http://www.alter-net.info/). In 2010 this task has been essentially boosted by the Life+ project EnvEurope (http://www.enveurope.eu/) focusing on the assessment of environmental quality and pressures across Europe making use of the LTER network as an integrated and shared system for ecosystem monitoring.

At this time, LTER-Europe covers more than 300 sites throughout Europe (67 of which are included in EnvEurope). The single LTER-Europe sites have been established for different reasons. Many of those established on terrestrial systems have joined the LTER network coming from the International Cooperative Programmes Integrated Monitoring (ICP IM) and ICP Forest, focusing on the impact of air pollution on ecosystems. These sites are often operated since at least one decade, measuring numerous parameters following well elaborated protocols. Some of them are highly instrumented, even beyond the needs from the ICP monitoring programmes. Other LTER-Europe sites developed from more specific research questions and projects run by their responsible institutions. These sites often provide more heterogeneous data and time series of different lengths but sometimes focus on very relevant research issues (e.g. climate change impacts on ecosystems). Both type of sites can benefit by entering a common network (e.g. LTER), bringing specific approaches for a fruitful integration. Furthermore, LTER sites are also quite heterogeneous in terms of the investigated ecosystem (terrestrial, freshwater and marine environments), size (plot to landscape scale), complexity (more ecosystems included, social scale considered), infrastructure, instrumentation, staff resources and long-term funding. This heterogeneity, on one side may limit the generation and use of data-sets suitable for cross-site analysis which is one of the basic aims of the LTER network while, on the other side, can offer material for analysis of ecological processes in different eco-domains.

Hence the need for common sets of parameters and methods is obvious, although we are aware of a possible low level of commitment to implement these sets at individual sites, due to the lack of available supporting central funding within the network. For that reason the first intended classification of mandatory and optional parameters (and related methods) was changed to a recommendation of first and second level indicators / parameters. In the process of dealing with this issue in an iterative and participative way by including the ecosystem research community, we realized that several goals had to be modified to meet the needs of the "practitioners" which are in most cases the site managers; as an example, people may not be willing to switch to different methods if they are expected to continue producing time series of comparable data for reporting duties. Therefore we propose rather to develop and agree on data standards like frequency, accuracy and spatial scale of parameter measurements than to elaborate new methods. This approach was stimulated by the data product descriptions scheme developed for the National Ecological Observatory Network (US) –NEON (http://www.neoninc.org/) which will enter its construction phase in 2013.

Thus harmonisation of methods is interpreted in the sense of this manual as the setting of data properties of parameters enabling for comparison of data sets with the aim of joint analysis. At the same time, the used methods need to be reported and should be chosen among methods proposed by existing networks or

projects (i.e. accepted at “large scale”), methods generally used by the relevant scientific community and in the interested ecosystem and/or methods already published (i.e. peer reviewed).

Parallel to the bottom-up process of selecting suitable parameters and methods that are commonly applied, represent the state of the art and ensure comparability of the data, an overarching concept was chosen that ties these data together. The selected conceptual framework of Ecological Integrity is described in chapter 4. In this integrated approach, many indicators will be a novel concept for many sites, since only few sites will deal with an observation of ecosystems based on the ecological integrity framework.

Starting to work on this task we did not realize the dimension of the product, because it was intended to comprehensively cover research and monitoring at LTER sites. At the same time, we were not looking to “reinvent the wheel” and we were ready to consider taking on board already established and accepted methods in the different eco-domains. Furthermore, we did not foresee the related conceptual work, the challenging task of motivating people to contribute and the implication of dealing with terrestrial, river, lake and marine systems. Hence it turned out to be quite demanding in terms of knowledge that had and still has to be collected. Thus this manual is intended to be a “living document” which means that the present version is the “final” starting point and that we are looking forward to filling the remaining empty cells or change entries after being analysed through expert knowledge from the ecosystem research community. Considering this, it is evident that this manual will need regular updates to incorporate new approaches and methods and will be subjected to continuous review in order to be at pace with the developments in Long Term Ecosystem Research and monitoring.

3 Definitions

Especially often used terms should be defined unambiguously to safeguard a common understanding. Therefore we provide the following definitions:

Index: A complex measure based on several parameters and / or calculations (e.g. Shannon index). Indices are often used as indicators too.

Indicator: A proxy for several ecosystem aspects. Individual indicators are designed to translate complex information in a concise and easily understandable manner in order to represent a particular phenomenon (e.g. biodiversity). It quantifies e.g. the magnitude of stress, habitat characteristics, degree of exposure to stressors or of ecological response. Indicators may be simple (e.g. just one indicator species) or complex (e.g. habitat connectivity) and, sometimes, can be equal to a parameter.

Manual: A user guide which is a technical communication document intended to give assistance to people using particular methods.

Method: A method of procedure consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses. Methods are the key to interpretation, reliability and evaluation of results and the way allowing other people to repeat and reproduce results. Compared to a protocol it is less detailed.

Monitoring: “Monitoring is an intermittent (regular or irregular) series of observations in time, carried out to show the extent of compliance with a formulated standard or degree of deviation from an expected norm.” (after Hellawell 1991, modified by Brown 2000)

“Monitoring in the sense used here, is distinct from surveillance, which is repeated survey using a standard methodology undertaken to provide a series of observations over time. Surveillance can yield valuable information on trends in the state of biodiversity and Earth science, but does not by itself establish whether objectives or standards have been met. Information derived from surveillance may be used to inform judgements on the condition of features on sites.” (Joint Nature Conservation Committee, http://jncc.defra.gov.uk/page-2268)

Observation: Any “measurement” by human sense impressions (subjective, qualitative) or by use of technical devices, e.g. sensors, measuring tape, satellite image (objective, quantitative). Quantitative measurements reduce an observation to a number which can be recorded.

Parameter: Same meaning as "variable“, “the measured item”. Parameters will often be identical with the indicator itself, but not every indicator is identical with the parameter assigned to it.

Protocol: A predefined written procedural method in the design and implementation of technical sequences in experiments and observations. They are used whenever it is desirable to standardise a laboratory or field method to ensure successful replication of results by others.

4 Related approaches

Being aware of the work done about identification of environmental indicators we did not intend to start from scratch, but it is important to know that the indicator sets mentioned below have been developed for specific purposes. The following list of "indicator initiatives" is extracted from the report "Conceptual framework for indicator assignment and selection for LTER-sites" which is available as download at the LTER-Europe website (http://www.lter-europe.net/ep/ep-std).

Examples on indicator initiatives for biodiversity:

- Streamlining European 2010 Biodiversity Indicators (SEBI 2010)
- Group on Earth Observations Biodiversity Observation Network (GEO BON)
- Living Planet Index (LPI)
- Species Trend Index (STI)
- National Biodiversity Index (NBI)
- Red Lists
- Biomare

Examples on initiatives for integrative environmental indicators:

- Sustainability indicators (EU)
- EEA core set of environmental indicators
- OECD key environmental indicators
- TEEB (The Economics of Ecosystem and Biodiversity)
- Natural Capital Index (NCI)
- HANPP (Human appropriation of net primary productivity)
- Critical Load Exceedence Index (CLE)
- Connectivity Indices
- Corine Land Cover (CLC)
- National Ecological Observatory Network (US) –NEON

Compared to the approach taken in EnvEurope, the above mentioned initiatives are not aimed at getting an holistic view on ecosystems, but on particular aspects like halting biodiversity loss and relevance for policy (SEBI 2010; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2010:1165:FIN:EN:PDF) or focusing at policy-relevant indicators giving answers to selected priority policy questions (EEA core set of indicators 2004; http://www.eea.europa.eu/data-and-maps/indicators/freight-transport-demand/eea-core-set-of-indicators-csi).

5 The conceptual framework of Ecological Integrity

Why is it advisable to develop and tune a conceptual framework for the specific needs of ecosystem research? The first important reason is that there is no such concept developed and agreed within the LTER community, which opens the opportunity to assign each measured parameter to a conceptual framework that takes into consideration all aspects of ecosystems. Another important argument is that any indicator selection has to be defensible by explaining why a specific set of indicators and parameters set is chosen for monitoring. In the EnvEurope project this framework has been developed by Benjamin Burkhard & Felix Mueller (University Kiel, 2011) on the base of the ecological integrity concept. Having this generic framework at hand was regarded as a considerable progress by the LTER community. The detailed report "Conceptual framework for indicator assignment and selection for LTER-sites" is available at http://www.lter-europe.net/ep/ep-std.

Briefly, the idea of ecological integrity is based on the guiding principle for precaution against unspecific ecological risks in the framework of sustainable development. Its aim is to safeguard relevant ecosystem services and preserve the capability to continue self-organized development of systems and services. The self-organizing capacity of ecosystems describes (a) their ability to develop towards a higher degree of self-organization, which is characterized by more complex structures, or (2) to adapt to changing external conditions by keeping the current degree of self-organization. Thus, the result of self-organizing processes in ecosystems is the build-up and the maintenance of complex structures.

Table 1 shows the main components of the ecological integrity concept, starting from the structural components describing biotic diversity and abiotic heterogeneity and considering also, as well as processes (input, output, storage) related to the energy, matter and water balances. While the structural components describe mainly the state of the system (that can react to pressures, e.g. land use), the process components are directly reflecting states, changes and pressures (e.g. nitrogen input). If there would be one "ideal" quantifiable indicator for each of the higher level of ecological integrity indicators (Table 1, right column), we will end up with 19 indicators for characterisation of an ecosystem. However, this number easily increases two- or three fold since often several indicators (e.g. bird, butterfly diversity) are necessary to feed in the information for a higher level indicator (e.g. fauna diversity).

The fact sheets of the indicators are basically structured according to the scheme of ecological integrity.

Table 1: The components and basic indicators of Ecological Integrity. Note that the expert work starts with identifying the concrete lower indicators to be measured pointing at the higher, quite general ecological integrity indictors.

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

6 The process of indicator selection

The process was guided by

(1) assignment of indicators to the conceptual framework of ecological integrity,
(2) including as much expert knowledge as possible and
(3) applying a participative, bottom-up approach which aims at including the LTER community and especially the site managers who are intended as the end users of selected indicator sets.

The main steps towards this target were several EnvEurope workshops (Halle 2010, Budapest 2011, Rome 2011, Bucharest 2011) with group working dedicated to this issue and furthermore by demanding email requests to EnvEurope and EXPEER partners to amend and contribute to a continuously increasing table of indicators, parameters and a lot of descriptive characteristics.

The first prioritisation of the best indicators targeting at the higher ecological integrity indicators was done by "acclamation" and group discussion based on expert experience and knowledge. The next step has to go back to the basic criteria for indicator selection. They need to be

- biologically relevant (maintaining balanced communities)
- providing univocal information
- broadly applicable to many sites and stressors
- Integrative (biotic indicators)
- interpretable: distinguishing "good from bad" states
- and last but not least cost-effective: maximum information per unit effort

The review of the indicators presented in the fact sheets of this manual will be an iterative process which again needs to be done with the support of the LTER community.

Of course the importance or applicability of several indicators will be habitat-specific which again will increase their numbers. Just imagine the differences in the approaches for forests or semi-dry grasslands or deserts. Some basic or core indicators will be the same, but there will be specific sets important for a certain habitat only.

For the final "distillation" of all indicators down to a manageable set the fruitful combinations of certain parameters creating most added value will be considered. This supports strongly the criterion of cost-effectiveness. An example for the added value of the combination of certain parameters is bird species richness + habitat mapping + richness of vascular plants.

In October 2012 an online survey in the LTER community started aiming to provide a ranking of the parameters of this manual according to criteria of IMPORTANCE and COSTS: (1) ecological relevance, (2) sensitivity to environmental changes (ecological responsiveness), (3) measurement effort related to the total working time needed to generate ecologically meaningful data for an interval of one year, (4) the level of instrumentation in terms of the financial effort (equipment, consumables) for an interval of one year. The main aim of this ranking was to create a sound base for qualified recommendations of parameters for (long term) ecosystem research and monitoring. The survey will be closed by the end of February 2013 and the results will be included in the next update of this manual.

7 Fact sheets: Recommendations for Indicators and Parameters

The fact sheet section provides the list of fact sheets for each indicator (which can be a parameter itself) or parameter which was proposed to be important and representative for the base ecological integrity indicators listed in table 1.

Each indicator fact sheet gives basic information of parameters for the different ecosystems. The information preceding each fact sheet is intended to assign an indicator to

1. the first level components of Ecological Integrity: **Ecosystem Structures** and **Ecosystem Processes**
2. the second level components of Ecological Integrity: (1) **Biotic Diversity** and (2) **Abiotic Heterogeneity**; (3) **Energy,** (4) **Matter**, and (5) **Water budget**
3. the base Ecological Integrity indicator. e.g. **Flora Diversity**Parameter characteristics

The parameter characteristics are the backbone of the fact sheets. All information about an indicator and / or parameter is considered as "data" in this context. This approach of characterizing indicators is chosen in order to create a matrix for comparison and comparability of indicators. The comparability of data is often related to certain basic features like frequency of measurements, spatial scale covered etc. Method references are separated according to national / international use. Only those references described in English and applied at an international level (or intended to become a kind of international standard) are recommended for LTER-Europe-wide use.

List of fact sheet data characteristics:

- **Manageable Indicator** - Indicator related to the Ecological Integrity framework in a way that it is covering aspects of a basic Ecological Integrity Indicator (e.g. energy input, see table 1)
- **Parameter targeting at the manageable indicator** - This is the item to be measured. Sometimes the parameter is identical with the indicator.
- **Important related indices** - These are related to the described parameter in a way that the parameter is a component of the related index (e.g. species richness; a related index is Shannon diversity)
- **Property: Frequency -** How often a parameter should be measured within a certain time.
- **Property: Precision** – Resolution in terms of taxonomic level, device generated data in time and digits etc.
- **Property: Time scale (incl. seasonality); temporal resolution** - Time of the season when measurements should be performed; accuracy of temporal resolution (e.g. seconds, minutes, hours)
- **Property: Basic spatial scale** – Spatial scale (plot size up to landscape) of measurement
- **Property: Base Units** – Recommended units, e.g. m, mm, mmol
- **Mandatory meta data** – Sufficient to characterize the parameter and the method
- **Method applied (key phrases)** – Short method characterization
- **Method references** (specific to sites, not internationally applied) – Only nationally or by a certain institution approved and applied, mostly only in national language available
- **Method references** (established, internationally applied) – Elaborated, internationally applied and proved methods, available in English

Not included yet:

- **Method used by international networks** - names of networks applying this method
- **Parameter used by modelling community** - important to increase synergies between field measurements and modellers
- **SITES using this method** (list) - site identifiers or site names; important for knowledge exchange about exact protocols and popularity of a method

8 References – sorted by topics

8.1 Ecological Integrity

(Burkhard, Kroll, Nedkov, & Muller, 2012; *Ecological Integrity: Integrating Environment, Conservation, and Health*, 2000; Grumbine, 1994; Karr, 1993; Karr & Dudley, 1981; Müller, Hoffmann-Kroll, & Wiggering, 2000; Noss, 1990; Schoolmaster, Grace, & Schweiger, 2012)

Burkhard, B., Kroll, F., Nedkov, S., & Muller, F. (2012). Mapping ecosystem service supply, demand and budgets. *Ecological Indicators, 21*, 17-29.

Ecological Integrity: Integrating Environment, Conservation, and Health. (2000). Island Press; 1 edition (November 1, 2000).

Grumbine, R. E. (1994). What is ecosystem management? [Article]. *Conservation Biology, 8*(1), 27-38.

Karr, J. R. (1993). Defining and assessing ecological integrity - beyond water quality. [Article]. *Environmental Toxicology and Chemistry, 12*(9), 1521-1531.

Karr, J. R., & Dudley, D. R. (1981). Ecological Perspective on Water-Quality Goals. *Environmental Management, 5*(1), 55-68.

Müller, F., Hoffmann-Kroll, R., & Wiggering, H. (2000). Indicating ecosystem integrity - theoretical concepts and environmental requirements. *Ecological Modelling, 130*(1-3), 13-23.

Noss, R. F. (1990). Can we maintain biological and ecological integrity? [Editorial Material]. *Conservation Biology, 4*(3), 241-243.

Schoolmaster, D. R., Grace, J. B., & Schweiger, E. W. (2012). A general theory of multimetric indices and their properties. [Article]. *Methods in Ecology and Evolution, 3*(4), 773-781.

8.2 Terrestrial

(Anderson & Domsch, 1978; British Trust for Ornithology; Butterbach-Bahl, Gasche, Breuer, & Papen, 1997; Dierschke, 1994; Dobbertin & Neumann, 2010; Espelta, Cortés, Molowny-Horas, Sánchez-Humanes, & Retana, 2008; European Commision DG Environment, 2007; European Environment Agency; "Field book for describing and sampling soils (Version 2.0)," 2002; Filippa, Freppaz, Williams, & Zanini, 2010; Finnish Environment Institute, 2004; "The GLORIA* Field Manual – Multi-Summit Approach (*Global Observation Research Initiative in Alpine Environments)," 2011; Granke, 2006; Harmon et al., 1986; Hillel, 1980; Holub et al., 2005; ICOS; ICP IM Programme Centre Finnish Environment Institute (Helsinki, 2003; Ilvesniemi et al., 2009; Ilvesniemi et al., 2010; International Union of Soil Sciences Working Group WRB, 2006; Jakucs, 1985; Kumar & Monteith, 1982; Lawson, Lamar, & Schwartz, 2008; Petriccione, 2005; Pollard, 1977; Pollard & Yates, 1994; Reich et al., 2012; Rossi, Parolo, & Ulian, 2009; Rossi, Parolo, Zonta, Crawford, & Leonardi, 2006; Rothe, Huber, Kreutzer, & Weis, 2002; Soil Staff Survey, 2010; Sparks, Jaroszewicz, Krawczyk, & Tryjanowski, 2009; Angela Stanisci, Carranza, Pelino, & Chiarucci, 2011; A. Stanisci, Pelino, & Blasi, 2005; Sutherland, 2006; Sykes, 1996; Toth, Papp, & Lenkey, 1975; UNECE (United Nations Economic Commission for Europe), 2010; United Kingdom Butterfly Monitoring Scheme; Vesala et al., 2005; Voříšek, Klvaňová, Wotton, & Gregory, 2008; Wikum & Shanholtzer, 1978; WMO Observing and Information Systems Department; Woiwod, 1996; World Meteorological Organization, 2010; World Meterological Organization, 2008, 2008 (Updated in 2010))

Anderson, J. P. E., & Domsch, K. H. (1978). A physiological method for the quantitative measurement of microbial biomass in soils. *Soil Biology and Biochemistry, 10*(3), 215-221.

British Trust for Ornithology. Volunteer surveys - Download forms & instructions. from http://www.bto.org/volunteer-surveys/bbs/taking-part/download-forms-instructions

Butterbach-Bahl, K., Gasche, R., Breuer, L., & Papen, H. (1997). Fluxes of NO and N2O from temperate forest soils: impact of forest type, N deposition and of liming on the NO and N2O emissions. *Nutrient Cycling in Agroecosystems, 48*(1), 79-90.

Dierschke, H. (1994). *Pflanzensoziologie*. Stuttgart: Verlag Eugen Ulmer.

Dobbertin, M., & Neumann, M. (2010). Tree Growth. Manual Part V, *Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests* (pp. 29). Hamburg: UNECE ICP Forests Programme Co-ordinating Centre.

Espelta, J. M., Cortés, P., Molowny-Horas, R., Sánchez-Humanes, B., & Retana, J. (2008). Masting mediated by summer drought reduces acron predation in mediterranean oak forests. *Ecology, 89*(3), 805-817.

European Commision DG Environment. (2007). Interpretation manual of European Union habitatspp. 144). Available from http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

European Environment Agency. Habitat types search. from http://eunis.eea.europa.eu/habitats.jsp

Field book for describing and sampling soils (Version 2.0). (2002). In P. J. Schoeneberger, D. A. Wysocki, E. C. Benham & W. D. Broderson (Eds.) Available from ftp://ftp-fc.sc.egov.usda.gov/NSSC/Field_Book/FieldBookVer2.pdf, http://leg5.state.va.us/reg_agent/frmView.aspx?Viewid=e16fe002164~1&typ=40&actno=002164&mime=application/pdf

Filippa, G., Freppaz, M., Williams, M. W., & Zanini, E. (2010). Major element chemistry in inner alpine snowpacks (Aosta Valley Region, NW Italy). *Cold Regions Science and Technology, 64*(2), 158-166.

Finnish Environment Institute. (2004). ICP IM manual - Methodology and Reporting of Subprogrammes. from http://www.ymparisto.fi/default.asp?node=6412&lan=en

The GLORIA* Field Manual – Multi-Summit Approach (*Global Observation Research Initiative in Alpine Environments). (2011). In H. Pauli, M. Gottfried, D. Hohenwallner, K. Reiter, R. Casale & G. Grabherr (Eds.)pp. 89). Available from http://www.gloria.ac.at/downloads/GLORIA_MS4_Web_english_withNOTES201106.pdf

Granke, O. (2006). ForestBIOTA work report - Assessment of Ground Vegetation. In F. R. C. f. F. a. F. Products (Eds.)pp. 20). Available from http://www.forestbiota.org/docs/report_GV.pdf

Harmon, M. E., Franklin, J. F., Swanson, F. J., Sollins, P., Gregory, S. V., Lattin, J. D., et al. (1986). Ecology of coarse woody debris in temperate ecosystems. [Review]. *Advances in Ecological Research, 15*, 133-302.

Hillel, D. (1980). *Fundamentals of soil physics*: Academic Press Inc.

Holub, S. M., Lajtha, K., Spears, J. D. H., Toth, J. A., Crow, S. E., Caldwell, B. A., et al. (2005). Organic matter manipulations have little effect on gross and net nitrogen transformations in two temperate forest mineral soils in the USA and central Europe. *Forest Ecology and Management, 214*(1-3), 320-330.

ICOS. Integrated Carbon Observation System. from http://www.icos-infrastructure.eu/

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

Ilvesniemi, H., Levula, J., Ojansuu, R., Kolari, P., Kulmala, L., Pumpanen, J., et al. (2009). Long-term measurements of the carbon balance of a boreal Scots pine dominated forest ecosystem. *Boreal Environment Research, 14*(4), 731-753.

Ilvesniemi, H., Pumpanen, J., Duursma, R., Hari, P., Keronen, P., Kolari, P., et al. (2010). Water balance of a boreal Scots pine forest. *Boreal Environment Research, 15*(4), 375-396.

International Union of Soil Sciences Working Group WRB. (2006). World reference base for soil resources 2006, A framework for international classification, correlation and communication Available from ftp://ftp.fao.org/agl/agll/docs/wsrr103e.pdf

Jakucs, P. (1985). *Ecology of an oak forest in Hungary* (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó.

Kumar, M., & Monteith, J. L. (1982). Remote sensing of crop growth. In H. Smith (Ed.), *Plants and the daylight spectrum* (pp. 133-144). London: Academic Press.

Lawson, D. M., Lamar, C. K., & Schwartz, M. W. (2008). Quantifying plant population persistence in human-dominated landscapes. *Conservation Biology, 22*(4), 922-928.

Petriccione, B. (2005). Short-term changes in key plant communities of Central Apennines (Italy). *Acta botanica Gallica, 152*(4), 545-561.

Pollard, E. (1977). Method for assessing changes in abundance of butterflies. [Article]. *Biological Conservation, 12*(2), 115-134.

Pollard, E., & Yates, T. J. (1994). *Monitoring Butterflies for Ecology and Conservation: The British Butterfly Monitoring Scheme*: Springer.

Reich, P. B., Tilman, D., Isbell, F., Mueller, K., Hobbie, S. E., Flynn, D. F. B., et al. (2012). Impacts of Biodiversity Loss Escalate Through Time as Redundancy Fades. *Science, 336*(6081), 589-592.

Rossi, G., Parolo, G., & Ulian, T. (2009). Human trampling as a threat factor for the conservation of peripheral plant populations. [Article]. *Plant Biosystems, 143*(1), 104-113.

Rossi, G., Parolo, G., Zonta, L. A., Crawford, J. A., & Leonardi, A. (2006). Salix herbacea L. fragmented small population in the N-Apennines (Italy): response to human trampling disturbance. *Biodiversity and Conservation, 15*(12), 3881-3893.

Rothe, A., Huber, C., Kreutzer, K., & Weis, W. (2002). Deposition and soil leaching in stands of Norway spruce and European Beech: Results from the Hoglwald research in comparison with other European case studies. *Plant and Soil, 240*(1), 33-45.

Soil Staff Survey. (2010). Keys to Soil Taxonomy. In U. S. D. o. Agriculture & N. R. C. Service (Eds.) Available from http://soils.usda.gov/technical/classification/tax_keys/

Sparks, T. H., Jaroszewicz, B., Krawczyk, M., & Tryjanowski, P. (2009). Advancing phenology in Europe's last lowland primeval forest: non-linear temperature response. *Climate Research, 39*(3), 221-226.

Stanisci, A., Carranza, M., Pelino, G., & Chiarucci, A. (2011). Assessing the diversity pattern of cryophilous plant species in high elevation habitats. *Plant Ecology, 212*(4), 595-600.

Stanisci, A., Pelino, G., & Blasi, C. (2005). Vascular plant diversity and climate change in the alpine belt of the central Apennines (Italy). *Biodiversity and Conservation, 14*(6), 1301-1318.

Sutherland, W. J. (2006). Ecological Census Techniques. In W. J. Sutherland (Eds.), A Handbookpp. 432). Available from http://www.ecolab.bas.bg/main/Members/snikolov/Sutherland_2006_Ecological_Census_Techniques.pdf

Sykes, J. M. (1996). BB Protocol - Breeding birds. *To record the annual distribution and abundance of breeding birds within selected areas of ECN sites*, from http://www.ecn.ac.uk/measurements/terrestrial/b/bi/bb

Toth, J. A., Papp, L. B., & Lenkey, B. (1975). Litter decomposition in an oak forest ecosystem (Quercetum petreae Cerris) in northern Hungary studied in the framework of "Sikfökut Project". In G. Kilbertus, O. Reisinger, A. Mourey & J. A. Cancela da Fonseca (Eds.), *Biodegradation et Humification* (pp. 41 - 58). Sarreguemines: Pierrance Editeur.

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

United Kingdom Butterfly Monitoring Scheme. Methods for recording butterfly transects. from http://www.ukbms.org/Methods.aspx#top

Vesala, T., Suni, T., Rannik, U., Keronen, P., Markkanen, T., Sevanto, S., et al. (2005). Effect of thinning on surface fluxes in a boreal forest. *Global Biogeochemical Cycles, 19*(2).

Voříšek, P., Klvaňová, A., Wotton, S., & Gregory, R. D. (2008). A Best Practice Guide for wild bird monitoring schemes. In E. E. B. C. Council) (Eds.) Available from http://www.ebcc.info/index.php?ID=365

Wikum, D. A., & Shanholtzer, G. F. (1978). Application of the Braun-Blanquet cover-abundance scale for vegetation analysis in land development studies. *Environmental Management, 2*(4), 323-329.

WMO Observing and Information Systems Department. Instruments and Methods of Observation. from http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html

Woiwod, I. P. (1996). The ECN butterflies protocol from http://www.ecn.ac.uk/measurements/terrestrial/i/ib

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

World Meterological Organization. (2008). Guide to Hydrological Practices (WMO-No. 168). In W. M. Organization (Eds.), Volume I Hydrology – From Measurement to Hydrological Information (Vol. Vol 1, Available from http://www.hydrology.nl/images/docs/hwrp/WMO_Guide_168_Vol_I_en.pdf

World Meterological Organization. (2008 (Updated in 2010)). Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). In W. M. Organization (Eds.) Available from http://www.wmo.int/pages/prog/www/IMOP/CIMO-Guide.html, http://www.wmo.int/pages/themes/wmoprod/guides.html

8.3 Rivers

(Carpente, 1966; CEN (European Committee for Standardization), 1992a, 1992b, 1996, 1998, 2004a, 2004b, 2005, 2006, 2007; Clesceris, Greenberg, & Eaton, 1999; European Commision DG Environment, 2007; European Commission Environment; European Environment Agency; Fame Consortium, 2004; Finnish Environment Institute, 2004; Golterman, Clymo, & Ohnstad, 1978; Haase et al., 2004; Hillebrand, Durselen, Kirschtel, Pollingher, & Zohary, 1999; ICOS; ICP IM Programme Centre Finnish Environment Institute (Helsinki, 2003; ICP Waters Programme Centre, 2010; Intergovernmental Oceanographic Commission of UNESCO, 2010; ISE - CNR Water Chemistry Laboratory, 2012; ISO (International Organization for Standardization), 1996, 1997, 1999, 2003, 2004, 2005; Kestemont & Goffaux, 2002; Kirchman, Knees, & Hodson, 1985; Novak & Bode, 1992; NS SHARE Project, 2005; Sandin, Friberg, Furse, Clarke, & Larsen, 2004; Schaumburg et al., 2004; Sutherland, 2006; Wetzel & Likens, 1991; Winkler, Beyer, & Gnauck, 1980; WMO Observing and Information Systems Department; World Meteorological Organization, 2010; World Meterological Organization, 2008, 2008 (Updated in 2010); YSI Environmental, 2011)

Carpente, J. H. (1966). New measurements of oxygen solubility in pure and natural water. [Article]. *Limnology and Oceanography, 11*(2), 264-&.

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983).

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990).

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996).

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997).

CEN (European Committee for Standardization). (2004a). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004).

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003).

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005).

CEN (European Committee for Standardization). (2006). EN 15204:2006; Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique).

CEN (European Committee for Standardization). (2007). EN 15460:2007; Water quality - Guidance standard for the surveying of macrophytes in lakes.

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). *Standard Methods for Examination of Water & Wastewater* (20 ed.).

European Commision DG Environment. (2007). Interpretation manual of European Union habitatspp. 144). Available from http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

European Commission Environment. The EU Water Framework Directive - integrated river basin management for Europe. from http://ec.europa.eu/environment/water/water-framework/index_en.html

European Environment Agency. Habitat types search. from http://eunis.eea.europa.eu/habitats.jsp

Fame Consortium. (2004). Manual for the application of the European Fish Index - EFI, A fish-based method to assess the ecological status of european rivers in support of the Water Framework Directive - FAMEpp. 92). Available from http://fame.boku.ac.at/downloads/manual_Version_Februar2005.pdf

Finnish Environment Institute. (2004). ICP IM manual - Methodology and Reporting of Subprogrammes. from http://www.ymparisto.fi/default.asp?node=6412&lan=en

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). *Methods for physical and chemical analysis of fresh waters*: Blackwell Scientific.

Haase, P., Lohse, S., Pauls, S., Schindehutte, K., Sundermann, A., Rolauffs, P., et al. (2004). Assessing streams in Germany with benthic invertebrates: development of a practical standardised protocol for macro invertebrate sampling and sorting. *Limnologica, 34*(4), 349-365.

Hillebrand, H., Durselen, C. D., Kirschtel, D., Pollingher, U., & Zohary, T. (1999). Biovolume calculation for pelagic and benthic microalgae. *Journal of Phycology, 35*(2), 403-424.

ICOS. Integrated Carbon Observation System. from http://www.icos-infrastructure.eu/

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

ICP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61

Intergovernmental Oceanographic Commission of UNESCO. (2010). Microscopic and molecular methods for quantitative phytoplankton analysis. In B. Karlson, C. Cusack & E. Bresnan (Eds.)pp. 110). Available from http://www.mbari.org/ESP/pdfs/Marin%20and%20Scholin_2010.pdf

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

ISO (International Organization for Standardization). (1996). ISO 13395:1996; Water quality -- Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (pp. 18).

ISO (International Organization for Standardization). (1997). ISO 11905-1:1997; Water quality -- Determination of nitrogen -- Part 1: Method using oxidative digestion with peroxodisulfate (pp. 13).

ISO (International Organization for Standardization). (1999). ISO 7027:1999; Water quality -- Determination of turbidity (pp. 10).

ISO (International Organization for Standardization). (2003). ISO 15681-1:2003; Water quality -- Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) -- Part 1: Method by flow injection analysis (FIA).

ISO (International Organization for Standardization). (2004). ISO 6878:2004; Water quality -- Determination of phosphorus -- Ammonium molybdate spectrometric method.

ISO (International Organization for Standardization). (2005). ISO 11732:2005; Water quality -- Determination of ammonium nitrogen -- Method by flow analysis (CFA and FIA) and spectrometric detection.

Kestemont, P., & Goffaux, D. (2002). Metric Selection and Sampling Procedures for FAME (D 4 - 6), Final Report: Development, Evaluation & Implementation of a Standardised Fish-based Assessment Method for the Ecological Status of European Rivers - A Contribution to the Water Framework Directive (FAME)pp. 90). Available from http://fame.boku.ac.at/downloads/D4_6_metrics_and_sampling_procedure.pdf

Kirchman, D., Knees, E., & Hodson, R. (1985). Leucine incorporation and its potential as a measure of protein-synthesis by bacteria in natural aquatic systems. [Article]. *Applied and Environmental Microbiology, 49*(3), 599-607.

Novak, M. A., & Bode, R. W. (1992). Percent Model Affinity: A New Measure of Macroinvertebrate Community Composition. *Journal of the North American Benthological Society, 11*(1), 80-85.

NS SHARE Project. (2005). North South Shared Aquatic Resource (NS Share): Methods Manual I River Macrophytes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20I%20%20River%20Macrophyte.pdf

Sandin, L., Friberg, N., Furse, M., Clarke, R., & Larsen, S. (2004). Inter-calibration and harmonisation of "invertebrate methods", Standardisation of river classification: Framework method for calibrating different biological survey results against ecological classifications to be developed for the Water Framework Directivepp. 238). Available from http://www.eu-star.at/pdf/Deliverable8.pdf

Schaumburg, J., Schranz, C., Foerster, J., Gutowski, A., Hofmann, G., Meilinger, P., et al. (2004). Ecological classification of macrophytes and phytobenthos for rivers in Germany according to the Water Framework Directive. *Limnologica, 34*(4), 283-301.

Sutherland, W. J. (2006). Ecological Census Techniques. In W. J. Sutherland (Eds.), A Handbookpp. 432). Available from

http://www.ecolab.bas.bg/main/Members/snikolov/Sutherland_2006_Ecological_Census_Techniques.pdf

Wetzel, R. G., & Likens, G. E. (1991). *Limnological Analyses*. New York: Springer.

Winkler, W., Beyer, J., & Gnauck, A. (1980). Improvement of the accuracy of prediction of stochastic models of the oxygen concentration in flowing waters. [Article]. *Acta Hydrochimica Et Hydrobiologica, 8*(1), 107-110.

WMO Observing and Information Systems Department. Instruments and Methods of Observation. from http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

World Meterological Organization. (2008). Guide to Hydrological Practices (WMO-No. 168). In W. M. Organization (Eds.), Volume I Hydrology – From Measurement to Hydrological Information (Vol. Vol 1, Available from http://www.hydrology.nl/images/docs/hwrp/WMO_Guide_168_Vol_I_en.pdf

World Meterological Organization. (2008 (Updated in 2010)). Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). In W. M. Organization (Eds.) Available from http://www.wmo.int/pages/prog/www/IMOP/CIMO-Guide.html, http://www.wmo.int/pages/themes/wmoprod/guides.html

YSI Environmental. (2011). The Basics of Chlorophyll Measurement. from http://www.ysi.com/parametersdetail.php?Chlorophyll-6

8.4 Lakes

(Bíró, Specziár, & Keresztessy, 2003; Bondavalli, Bodini, Rossetti, & Allesina, 2006; Carpente, 1966; CEN (European Committee for Standardization), 1992a, 1992b, 1996, 1998, 2004a, 2004b, 2005, 2006, 2007; Clesceris, Greenberg, & Eaton, 1999; European Commision DG Environment, 2007; European Environment Agency; Finnish Environment Institute, 2004; Gerking, 1957; Golterman, Clymo, & Ohnstad, 1978; Hillebrand, Durselen, Kirschtel, Pollingher, & Zohary, 1999; ICOS; ICP IM Programme Centre Finnish Environment Institute (Helsinki, 2003; ICP Waters Programme Centre, 2010; Intergovernmental Oceanographic Commission of UNESCO, 2010; ISE - CNR Water Chemistry Laboratory, 2012; ISO (International Organization for Standardization), 1996, 1997, 2003, 2004, 2005; Kirchman, Knees, & Hodson, 1985; MacIsaac & Stockner, 1993; Nõges et al., 2003; Noges et al., 2003; Novak & Bode, 1992; NS SHARE Project, 2005a, 2005b, 2005c, 2005d; Ozimek & Kowalczewski, 1984; Parpală, G.-Tóth, Zinevici, Németh, & Szalontai, 2003; Schaumburg et al., 2004; Slusarczyk, 2009; Specziár & Bíró, 1998; Sutherland, 2006; Tolonen & Hamalainen, 2010; Wellburn, 1994; Wetzel & Likens, 1991; Wiederholm, 1980; WMO Observing and Information Systems Department; World Meteorological Organization, 2010; World Meterological Organization, 2008, 2008 (Updated in 2010); YSI Environmental, 2011)

Bíró, P., Specziár, A., & Keresztessy, K. (2003). Diversity of fish species assemblages distributed in the drainage area of Lake Balaton (Hungary). *Hydrobiologia, 506-509*(1), 459-464.

Bondavalli, C., Bodini, A., Rossetti, G., & Allesina, S. (2006). Detecting stress at the whole-ecosystem level: The case of a mountain lake (Lake Santo, Italy). [Article]. *Ecosystems, 9*(5), 768-787.

Carpente, J. H. (1966). New measurements of oxygen solubility in pure and natural water. [Article]. *Limnology and Oceanography, 11*(2), 264-&.

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983).

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990).

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996).

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997).

CEN (European Committee for Standardization). (2004a). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004).

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003).

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005).

CEN (European Committee for Standardization). (2006). EN 15204:2006; Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique).

CEN (European Committee for Standardization). (2007). EN 15460:2007; Water quality - Guidance standard for the surveying of macrophytes in lakes.

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). *Standard Methods for Examination of Water & Wastewater* (20 ed.).

European Commision DG Environment. (2007). Interpretation manual of European Union habitatspp. 144). Available from http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

European Environment Agency. Habitat types search. from http://eunis.eea.europa.eu/habitats.jsp

Finnish Environment Institute. (2004). ICP IM manual - Methodology and Reporting of Subprogrammes. from http://www.ymparisto.fi/default.asp?node=6412&lan=en

Gerking, S. D. (1957). A Method of Sampling the Littoral Macrofauna and Its Application. *Ecology, 38*(2), 219-226.

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). *Methods for physical and chemical analysis of fresh waters*: Blackwell Scientific.

Hillebrand, H., Durselen, C. D., Kirschtel, D., Pollingher, U., & Zohary, T. (1999). Biovolume calculation for pelagic and benthic microalgae. *Journal of Phycology, 35*(2), 403-424.

ICOS. Integrated Carbon Observation System. from http://www.icos-infrastructure.eu/

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

ICP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61

Intergovernmental Oceanographic Commission of UNESCO. (2010). Microscopic and molecular methods for quantitative phytoplankton analysis. In B. Karlson, C. Cusack & E. Bresnan (Eds.)pp. 110). Available from http://www.mbari.org/ESP/pdfs/Marin%20and%20Scholin_2010.pdf

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

ISO (International Organization for Standardization). (1996). ISO 13395:1996; Water quality -- Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (pp. 18).

ISO (International Organization for Standardization). (1997). ISO 11905-1:1997; Water quality -- Determination of nitrogen -- Part 1: Method using oxidative digestion with peroxodisulfate (pp. 13).

ISO (International Organization for Standardization). (2003). ISO 15681-1:2003; Water quality -- Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) -- Part 1: Method by flow injection analysis (FIA).

ISO (International Organization for Standardization). (2004). ISO 6878:2004; Water quality -- Determination of phosphorus -- Ammonium molybdate spectrometric method.

ISO (International Organization for Standardization). (2005). ISO 11732:2005; Water quality -- Determination of ammonium nitrogen -- Method by flow analysis (CFA and FIA) and spectrometric detection.

Kirchman, D., Knees, E., & Hodson, R. (1985). Leucine incorporation and its potential as a measure of protein-synthesis by bacteria in natural aquatic systems. [Article]. *Applied and Environmental Microbiology, 49*(3), 599-607.

MacIsaac, E. A., & Stockner, J. G. (1993). Enumeration of phototrophic picoplankton by autofluorescence microscopy. In P. F. Kemp, B. F. Sherr, E. B. Sherr & J. J. Cole (Eds.), *Handbook of methods in aquatic microbial ecology* (pp. 187-198). Boca Raton, Fla: Crc Pr Inc.

Nõges, P., Nõges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijów, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. *Hydrobiologia, 506-509*(1), 51-58.

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. *Hydrobiologia, 506*(1-3), 51-58.

Novak, M. A., & Bode, R. W. (1992). Percent Model Affinity: A New Measure of Macroinvertebrate Community Composition. *Journal of the North American Benthological Society, 11*(1), 80-85.

NS SHARE Project. (2005a). North South Shared Aquatic Resource (NS Share): Methods Manual II Lake Macrophytes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20II%20Lake%20Macrophyte.pdf

NS SHARE Project. (2005b). North South Shared Aquatic Resource (NS Share): Methods Manual III Littoral Macroinvertebrates - Lakes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20III%20Littoral%20Invertebrates%20Lakes/Methods%20Manual%20III%20Littoral%20Invertebrates%20Lakes.pdf

NS SHARE Project. (2005c). North South Shared Aquatic Resource (NS Share): Methods Manual IV Profundal/Sub-littoral Macroinvertebrates - Lakes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20IV%20Profundal%20-sublittoral%20invertebrates%20Lakes/Methods_Manual_IV%20Profundal_sublittoral%20invertebrates%20lakes.pdf

NS SHARE Project. (2005d). North South Shared Aquatic Resource (NS Share): Methods Manual V Fish. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20V%20Fish/Methods%20Manual%20V%20Fish.pdf

Ozimek, T., & Kowalczewski, A. (1984). Long-term changes of the submerged macrophytes in eutrophic lake Mikolajskie (North Poland). [Article]. *Aquatic Botany, 19*(1-2), 1-11.

Parpală, L., G.-Tóth, L., Zinevici, V., Németh, P., & Szalontai, K. (2003). Structure and production of the metazoan zooplankton in Lake Balaton (Hungary) in summer. *Hydrobiologia, 506-509*(1), 347-351.

Schaumburg, J., Schranz, C., Hofmann, G., Stelzer, D., Schneider, S., & Schmedtje, U. (2004). Macrophytes and phytobenthos as indicators of ecological status in German lakes - a contribution to the implementation of the Water Framework Directive. *Limnologica, 34*(4), 302-314.

Slusarczyk, M. (2009). Extended lifespan traded for diapause in Daphnia. *Freshwater Biology, 54*(11), 2252-2262.

Specziár, A., & Bíró, P. (1998). Spatial distribution and short-term changes of benthic macrofauna in Lake Balaton (Hungary). *Hydrobiologia, 389*(1), 203-216.

Sutherland, W. J. (2006). Ecological Census Techniques. In W. J. Sutherland (Eds.), A Handbookpp. 432). Available from http://www.ecolab.bas.bg/main/Members/snikolov/Sutherland_2006_Ecological_Census_Techniques.pdf

Tolonen, K. T., & Hamalainen, H. (2010). Comparison of sampling methods and habitat types for detecting impacts on lake littoral macroinvertebrate assemblages along a gradient of human disturbance. *Fundamental and Applied Limnology / Archiv für Hydrobiologie, 176*(1), 43-59.

Wellburn, A. R. (1994). The spectral determination of chlorophyll-a and chlorophyll-b, as well as total carotinoids, using various solvents with spectrophotometers of different resolution. *Journal of Plant Physiology, 144*(3), 307-313.

Wetzel, R. G., & Likens, G. E. (1991). *Limnological Analyses*. New York: Springer.

Wiederholm, T. (1980). Use of Benthos in Lake Monitoring. *Journal (Water Pollution Control Federation), 52*(3), 537-547.

WMO Observing and Information Systems Department. Instruments and Methods of Observation. from http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

World Meterological Organization. (2008). Guide to Hydrological Practices (WMO-No. 168). In W. M. Organization (Eds.), Volume I Hydrology – From Measurement to Hydrological Information (Vol. Vol 1, Available from http://www.hydrology.nl/images/docs/hwrp/WMO_Guide_168_Vol_I_en.pdf

World Meterological Organization. (2008 (Updated in 2010)). Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). In W. M. Organization (Eds.) Available from http://www.wmo.int/pages/prog/www/IMOP/CIMO-Guide.html, http://www.wmo.int/pages/themes/wmoprod/guides.html

YSI Environmental. (2011). The Basics of Chlorophyll Measurement. from http://www.ysi.com/parametersdetail.php?Chlorophyll-6

8.5 Marine

(Buia, Gambi, & Dappiano, 2004; Carpente, 1966; CEN (European Committee for Standardization), 1992a, 1992b, 1996, 1998, 2004a, 2004b, 2005, 2006, 2007; Clesceris, Greenberg, & Eaton, 1999; European Commision DG Environment, 2007; European Environment Agency; Hansen & Koroleff, 2007; Hillebrand, Durselen, Kirschtel, Pollingher, & Zohary, 1999; "ICES Zooplankton Methodology Manual," 2000; ICOS; ICP Waters Programme Centre, 2010; Intergovernmental Oceanographic Commission of UNESCO, 2010; ISE - CNR Water Chemistry Laboratory, 2012; ISO (International Organization for Standardization), 1996, 1997, 2003, 2004, 2005; Kirchman, Knees, & Hodson, 1985; Krause-Jensen, Sagert, Schubert, & Bostrom, 2008; Lopez y Royo et al., 2010; Lorenti & De Falco, 2004; MacIsaac & Stockner, 1993; Migliaccio, De Martino, Silvestre, & Procaccini, 2005; Orfanidis, Panayotidis, & Stamatis, 2001; Robinson & Williams, 2005; Steeman-Nielsen, 1952; Steinhardt, Karez, Selig, & Schubert, 2009; Strickland & Parsons, 1972; Sutherland, 2006; Wellburn, 1994; WMO Observing and Information Systems Department; World Meteorological Organization, 2010; World Meterological Organization, 2008 (Updated in 2010); YSI Environmental, 2011; Zupo, Buia, Gambi, Lorenti, & Procaccini, 2006)

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems *Biologia Marina Mediterranea* (Vol. 11, pp. 133-183).

Carpente, J. H. (1966). New measurements of oxygen solubility in pure and natural water. [Article]. *Limnology and Oceanography, 11*(2), 264-&.

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983).

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990).

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996).

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997).

CEN (European Committee for Standardization). (2004a). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004).

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003).

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005).

CEN (European Committee for Standardization). (2006). EN 15204:2006; Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique).

CEN (European Committee for Standardization). (2007). EN 15460:2007; Water quality - Guidance standard for the surveying of macrophytes in lakes.

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). *Standard Methods for Examination of Water & Wastewater* (20 ed.).

European Commision DG Environment. (2007). Interpretation manual of European Union habitatspp. 144). Available from http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

European Environment Agency. Habitat types search. from http://eunis.eea.europa.eu/habitats.jsp

Hansen, H. P., & Koroleff, F. (2007). Determination of nutrients. In K. Grasshoff, K. Kremling & M. Ehrhardt (Eds.), *Methods of Seawater Analysis* (3. ed.). Weinheim: Wiley-VCH Verlag GmbH.

Hillebrand, H., Durselen, C. D., Kirschtel, D., Pollingher, U., & Zohary, T. (1999). Biovolume calculation for pelagic and benthic microalgae. *Journal of Phycology, 35*(2), 403-424.

ICES Zooplankton Methodology Manual. (2000). In R. Harris, P. Wiebe, J. Lenz, H.-R. Skjoldal & M. Huntley (Eds.) Available from http://www.sciencedirect.com/science/book/9780123276452

ICOS. Integrated Carbon Observation System. from http://www.icos-infrastructure.eu/

ICP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61

Intergovernmental Oceanographic Commission of UNESCO. (2010). Microscopic and molecular methods for quantitative phytoplankton analysis. In B. Karlson, C. Cusack & E. Bresnan (Eds.)pp. 110). Available from http://www.mbari.org/ESP/pdfs/Marin%20and%20Scholin_2010.pdf

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

ISO (International Organization for Standardization). (1996). ISO 13395:1996; Water quality -- Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (pp. 18).

ISO (International Organization for Standardization). (1997). ISO 11905-1:1997; Water quality -- Determination of nitrogen -- Part 1: Method using oxidative digestion with peroxodisulfate (pp. 13).

ISO (International Organization for Standardization). (2003). ISO 15681-1:2003; Water quality -- Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) -- Part 1: Method by flow injection analysis (FIA).

ISO (International Organization for Standardization). (2004). ISO 6878:2004; Water quality -- Determination of phosphorus -- Ammonium molybdate spectrometric method.

ISO (International Organization for Standardization). (2005). ISO 11732:2005; Water quality -- Determination of ammonium nitrogen -- Method by flow analysis (CFA and FIA) and spectrometric detection.

Kirchman, D., Knees, E., & Hodson, R. (1985). Leucine incorporation and its potential as a measure of protein-synthesis by bacteria in natural aquatic systems. [Article]. *Applied and Environmental Microbiology, 49*(3), 599-607.

Krause-Jensen, D., Sagert, S., Schubert, H., & Bostrom, C. (2008). Empirical relationships linking distribution and abundance of marine vegetation to eutrophication. [Review]. *Ecological Indicators, 8*(5), 515-529.

Lopez y Royo, C., Pergent, G., Alcoverro, T., Buia, M. C., Casazza, G., Martínez-Crego, B., et al. (2010). The seagrass Posidonia oceanica as indicator of coastal water quality: Experimental intercalibration of classification systems. *Ecological Indicators*, 7.

Lorenti, M., & De Falco, G. (2004). Measurement and characterization of abiotic variables *Biologica Marina Mediterranea* (Vol. 11, pp. 38).

MacIsaac, E. A., & Stockner, J. G. (1993). Enumeration of phototrophic picoplankton by autofluorescence microscopy. In P. F. Kemp, B. F. Sherr, E. B. Sherr & J. J. Cole (Eds.), *Handbook of methods in aquatic microbial ecology* (pp. 187-198). Boca Raton, Fla: Crc Pr Inc.

Migliaccio, M., De Martino, F., Silvestre, F., & Procaccini, G. (2005). Meadow-scale genetic structure in Posidonia oceanica. [Article]. *Marine Ecology-Progress Series, 304*, 55-65.

Orfanidis, S., Panayotidis, P., & Stamatis, N. (2001). Ecological evaluation of transitional and coastal waters: A marine benthic macrophytes-based model. *Mediterranean Marine Science, 2*(2), 20.

Robinson, C., & Williams, P. l. B. (2005). Respiration and its measurement in surface marine waters. In P. A. del Giorgio & P. l. B. Williams (Eds.), *Respiration in Aquatic Ecosystems* (pp. 147-180). Oxford (UK): Oxford University Press.

Steeman-Nielsen, E. (1952). The use of radioactive carbon (14C) for measuring organic production in the sea. *J. Cons. Perm. Int. Explor. Mer, 18*, 23.

Steinhardt, T., Karez, R., Selig, U., & Schubert, H. (2009). The German procedure for the assessment of ecological status in relation to the biological quality element “Macroalgae & Angiosperms” pursuant to the European Water Framework Directive (WFD) for inner coastal waters of the Baltic Sea. *Rostocker Meeresbiologische Beitrage, 22*, 7-42.

Strickland, J. D., & Parsons, T. R. (1972). A manual of seawater analysis. *Canada Fisheries Research Board Bulletin*.

Sutherland, W. J. (2006). Ecological Census Techniques. In W. J. Sutherland (Eds.), A Handbookpp. 432). Available from http://www.ecolab.bas.bg/main/Members/snikolov/Sutherland_2006_Ecological_Census_Techniques.pdf

Wellburn, A. R. (1994). The spectral determination of chlorophyll-a and chlorophyll-b, as well as total carotinoids, using various solvents with spectrophotometers of different resolution. *Journal of Plant Physiology, 144*(3), 307-313.

WMO Observing and Information Systems Department. Instruments and Methods of Observation. from http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

World Meterological Organization. (2008 (Updated in 2010)). Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). In W. M. Organization (Eds.) Available from http://www.wmo.int/pages/prog/www/IMOP/CIMO-Guide.html, http://www.wmo.int/pages/themes/wmoprod/guides.html

YSI Environmental. (2011). The Basics of Chlorophyll Measurement. from http://www.ysi.com/parametersdetail.php?Chlorophyll-6

Zupo, V., Buia, M. C., Gambi, M. C., Lorenti, M., & Procaccini, G. (2006). Temporal variations in the spatial distribution of shoot density in a Posidonia oceanica meadow and patterns of genetic diversity. [Article]. *Marine Ecology-an Evolutionary Perspective, 27*(4), 328-338.

9 References - alphabetically

(Anderson & Domsch, 1978; Bíró, Specziár, & Keresztessy, 2003; Bondavalli, Bodini, Rossetti, & Allesina, 2006; Braun-Blanquet, 1932; British Trust for Ornithology; Buia, Gambi, & Dappiano, 2004; Burkhard, Kroll, Müller, & Windhorst, 2009; Burkhard, Kroll, Nedkov, & Muller, 2012; Butterbach-Bahl, Gasche, Breuer, & Papen, 1997; Cadotte et al., 2010; Carpente, 1966; CEN (European Committee for Standardization), 1992a, 1992b, 1996, 1998, 2004a, 2004b, 2005, 2006, 2007; Cerny, 1999; Clesceris, Greenberg, & Eaton, 1999; Dierschke, 1994; Dobbertin & Neumann, 2010; *Ecological Integrity: Integrating Environment, Conservation, and Health*, 2000; Espelta, Cortés, Molowny-Horas, Sánchez-Humanes, & Retana, 2008; Estación Biológica de Doñana CSIC; European Commision DG Environment, 2007; European Commission Environment; European Environment Agency; Fame Consortium, 2004; "Field book for describing and sampling soils (Version 2.0)," 2002; Filippa, Freppaz, Williams, & Zanini, 2010; Finnish Environment Institute, 2004; Gerking, 1957; *Global Seagrass Research Methods*, 2001; "The GLORIA* Field Manual – Multi-Summit Approach (*Global Observation Research Initiative in Alpine Environments)," 2011; Golterman, Clymo, & Ohnstad, 1978; Granke, 2006; Grumbine, 1994; Haase et al., 2004; Hansen & Koroleff, 2007; Harmon et al., 1986; Hellawell, 1991; Hillebrand, Durselen, Kirschtel, Pollingher, & Zohary, 1999; Hillel, 1980; Holub et al., 2005; "ICES Zooplankton Methodology Manual," 2000; ICOS; ICP IM Programme Centre Finnish Environment Institute (Helsinki, 2003; ICP Waters Programme Centre, 2010; Ilvesniemi et al., 2009; Ilvesniemi et al., 2010; Intergovernmental Oceanographic Commission of UNESCO, 2010; International Union of Soil Sciences Working Group WRB, 2006; ISE - CNR Water Chemistry Laboratory, 2012; ISO (International Organization for Standardization), 1996, 1997, 1999, 2003, 2004, 2005; Jakucs, 1985; JM Hellawell; Kanalas et al., 2010; Karr, 1993; Karr & Dudley, 1981; Kestemont & Goffaux, 2002; Kirchman, Knees, & Hodson, 1985; Krause-Jensen, Sagert, Schubert, & Bostrom, 2008; Kumar & Monteith, 1982; Lawson, Lamar, & Schwartz, 2008; Lopez y Royo et al., 2010; Lorenti & De Falco, 2004; MacIsaac & Stockner, 1993; McNeill et al., 2006; *Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods*, 1986; *Methods of Soil Analysis. Part 3. Chemical Methods*, 1996; Migliaccio, De Martino, Silvestre, & Procaccini, 2005; Morris & Doak, 2002; Müller, Hoffmann-Kroll, & Wiggering, 2000; Nõges et al., 2003; Noges et al., 2003; Noss, 1990; Novak & Bode, 1992; NS SHARE Project, 2005a, 2005b, 2005c, 2005d, 2005e; Orfanidis, Panayotidis, & Stamatis, 2001; Ozimek & Kowalczewski, 1984; Parpală, G.-Tóth, Zinevici, Németh, & Szalontai, 2003; Petchey, O'Gorman, & Flynn, 2009; Petriccione, 2005; Pollard, 1977; Pollard & Yates, 1994; Reich et al., 2012; Robinson & Williams, 2005; Rossi, Parolo, & Ulian, 2009; Rossi, Parolo, Zonta, Crawford, & Leonardi, 2006; Rothe, Huber, Kreutzer, & Weis, 2002; Sandin, Friberg, Furse, Clarke, & Larsen, 2004; Schaumburg, Schranz, Foerster, et al., 2004; Schaumburg, Schranz, Hofmann, et al., 2004; Schoolmaster, Grace, & Schweiger, 2012; Slusarczyk, 2009; Soil Staff Survey, 2010; Sparks, Jaroszewicz, Krawczyk, & Tryjanowski, 2009; Specziár & Bíró, 1998; Angela Stanisci, Carranza, Pelino, & Chiarucci, 2011; A. Stanisci, Pelino, & Blasi, 2005; Statistic Netherlands, 2006; Steeman-Nielsen, 1952; Steinhardt, Karez, Selig, & Schubert, 2009; Strickland & Parsons, 1972; Sutherland, 2006; Sykes, 1996; Tolonen & Hamalainen, 2010; Toth, Papp, & Lenkey, 1975; UNECE (United Nations Economic Commission for Europe), 2010; United Kingdom Butterfly Monitoring Scheme; Vesala et al., 2005; Voříšek, Klvaňová, Wotton, & Gregory, 2008; Wellburn, 1994; Wetzel & Likens, 1991; Wiederholm, 1980; Wikum & Shanholtzer, 1978; Winkler, Beyer, & Gnauck, 1980; WMO Observing and Information Systems Department; Woiwod, 1996; World Meteorological Organization, 2010; World Meterological Organization, 2008, 2008 (Updated in 2010); YSI Environmental, 2011; Zupo, Buia, Gambi, Lorenti, & Procaccini, 2006)

Anderson, J. P. E., & Domsch, K. H. (1978). A physiological method for the quantitative measurement of microbial biomass in soils. *Soil Biology and Biochemistry, 10*(3), 215-221.

Bíró, P., Specziár, A., & Keresztessy, K. (2003). Diversity of fish species assemblages distributed in the drainage area of Lake Balaton (Hungary). *Hydrobiologia, 506-509*(1), 459-464.

Bondavalli, C., Bodini, A., Rossetti, G., & Allesina, S. (2006). Detecting stress at the whole-ecosystem level: The case of a mountain lake (Lake Santo, Italy). [Article]. *Ecosystems, 9*(5), 768-787.

Braun-Blanquet, J. (1932). *Plant sociology - the study of plant communities* (1st ed.): McGraw-Hill book company, inc.

British Trust for Ornithology. Volunteer surveys - Download forms & instructions. from http://www.bto.org/volunteer-surveys/bbs/taking-part/download-forms-instructions

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems *Biologia Marina Mediterranea* (Vol. 11, pp. 133-183).

Burkhard, B., Kroll, F., Müller, F., & Windhorst, W. (2009). Landscape´s capacities to provide ecosystem services - a concept for land-cover based assessments. *Landscape Online, 15*(22).

Burkhard, B., Kroll, F., Nedkov, S., & Muller, F. (2012). Mapping ecosystem service supply, demand and budgets. *Ecological Indicators, 21*, 17-29.

Butterbach-Bahl, K., Gasche, R., Breuer, L., & Papen, H. (1997). Fluxes of NO and N2O from temperate forest soils: impact of forest type, N deposition and of liming on the NO and N2O emissions. *Nutrient Cycling in Agroecosystems, 48*(1), 79-90.

Cadotte, M. W., Jonathan Davies, T., Regetz, J., Kembel, S. W., Cleland, E., & Oakley, T. H. (2010). Phylogenetic diversity metrics for ecological communities: integrating species richness, abundance and evolutionary history. *Ecology Letters, 13*(1), 96-105.

Carpente, J. H. (1966). New measurements of oxygen solubility in pure and natural water. [Article]. *Limnology and Oceanography, 11*(2), 264-&.

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983).

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990).

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996).

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997).

CEN (European Committee for Standardization). (2004a). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004).

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003).

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005).

CEN (European Committee for Standardization). (2006). EN 15204:2006; Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique).

CEN (European Committee for Standardization). (2007). EN 15460:2007; Water quality - Guidance standard for the surveying of macrophytes in lakes.

Cerny, M. (1999). MOLAR - MOuntain LAke Research - Measuring and Modelling the Dynamic Response of Remote Mountain Lake Ecosystems to Environmental Change. EU project no. ENV4-CT95-0007 from http://www.mountain-lakes.org/molar/

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). *Standard Methods for Examination of Water & Wastewater* (20 ed.).

Dierschke, H. (1994). *Pflanzensoziologie*. Stuttgart: Verlag Eugen Ulmer.

Dobbertin, M., & Neumann, M. (2010). Tree Growth. Manual Part V, *Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests* (pp. 29). Hamburg: UNECE ICP Forests Programme Co-ordinating Centre.

Ecological Integrity: Integrating Environment, Conservation, and Health. (2000). Island Press; 1 edition (November 1, 2000).

Espelta, J. M., Cortés, P., Molowny-Horas, R., Sánchez-Humanes, B., & Retana, J. (2008). Masting mediated by summer drought reduces acron predation in mediterranean oak forests. *Ecology, 89*(3), 805-817.

Estación Biológica de Doñana CSIC. Singular Scientific and Technological Infrastructure. from http://icts.ebd.csic.es/CambiarIdiomaAction.do;jsessionid=DC4D0AC18742FC6CC3A2740B92181DD2.icts_A?idioma=ingles

European Commision DG Environment. (2007). Interpretation manual of European Union habitatspp. 144). Available from http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

European Commission Environment. The EU Water Framework Directive - integrated river basin management for Europe. from http://ec.europa.eu/environment/water/water-framework/index_en.html
European Environment Agency. Habitat types search. from http://eunis.eea.europa.eu/habitats.jsp
Fame Consortium. (2004). Manual for the application of the European Fish Index - EFI, A fish-based method to assess the ecological status of european rivers in support of the Water Framework Directive - FAMEpp. 92). Available from http://fame.boku.ac.at/downloads/manual_Version_Februar2005.pdf
Field book for describing and sampling soils (Version 2.0). (2002). In P. J. Schoeneberger, D. A. Wysocki, E. C. Benham & W. D. Broderson (Eds.) Available from ftp://ftp-fc.sc.egov.usda.gov/NSSC/Field_Book/FieldBookVer2.pdf, http://leg5.state.va.us/reg_agent/frmView.aspx?Viewid=e16fe002164~1&typ=40&actno=002164&mime=application/pdf
Filippa, G., Freppaz, M., Williams, M. W., & Zanini, E. (2010). Major element chemistry in inner alpine snowpacks (Aosta Valley Region, NW Italy). *Cold Regions Science and Technology, 64*(2), 158-166.
Finnish Environment Institute. (2004). ICP IM manual - Methodology and Reporting of Subprogrammes. from http://www.ymparisto.fi/default.asp?node=6412&lan=en
Gerking, S. D. (1957). A Method of Sampling the Littoral Macrofauna and Its Application. *Ecology, 38*(2), 219-226.
Global Seagrass Research Methods. (2001). Elsevier.
The GLORIA* Field Manual – Multi-Summit Approach (*Global Observation Research Initiative in Alpine Environments). (2011). In H. Pauli, M. Gottfried, D. Hohenwallner, K. Reiter, R. Casale & G. Grabherr (Eds.)pp. 89). Available from http://www.gloria.ac.at/downloads/GLORIA_MS4_Web_english_withNOTES201106.pdf
Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). *Methods for physical and chemical analysis of fresh waters*: Blackwell Scientific.
Granke, O. (2006). ForestBIOTA work report - Assessment of Ground Vegetation. In F. R. C. f. F. a. F. Products (Eds.)pp. 20). Available from http://www.forestbiota.org/docs/report_GV.pdf
Grumbine, R. E. (1994). What is ecosystem management? [Article]. *Conservation Biology, 8*(1), 27-38.
Haase, P., Lohse, S., Pauls, S., Schindehutte, K., Sundermann, A., Rolauffs, P., et al. (2004). Assessing streams in Germany with benthic invertebrates: development of a practical standardised protocol for macro invertebrate sampling and sorting. *Limnologica, 34*(4), 349-365.
Hansen, H. P., & Koroleff, F. (2007). Determination of nutrients. In K. Grasshoff, K. Kremling & M. Ehrhardt (Eds.), *Methods of Seawater Analysis* (3. ed.). Weinheim: Wiley-VCH Verlag GmbH.
Harmon, M. E., Franklin, J. F., Swanson, F. J., Sollins, P., Gregory, S. V., Lattin, J. D., et al. (1986). Ecology of coarse woody debris in temperate ecosystems. [Review]. *Advances in Ecological Research, 15*, 133-302.
Hellawell, J. M. (1991). Development of a rationale for monitoring. In F. B. Goldsmith (Ed.), *Monitoring for conservation and ecology* (pp. 1-14). New York: Chapman and Hall.
Hillebrand, H., Durselen, C. D., Kirschtel, D., Pollingher, U., & Zohary, T. (1999). Biovolume calculation for pelagic and benthic microalgae. *Journal of Phycology, 35*(2), 403-424.
Hillel, D. (1980). *Fundamentals of soil physics*: Academic Press Inc.
Holub, S. M., Lajtha, K., Spears, J. D. H., Toth, J. A., Crow, S. E., Caldwell, B. A., et al. (2005). Organic matter manipulations have little effect on gross and net nitrogen transformations in two temperate forest mineral soils in the USA and central Europe. *Forest Ecology and Management, 214*(1-3), 320-330.
ICES Zooplankton Methodology Manual. (2000). In R. Harris, P. Wiebe, J. Lenz, H.-R. Skjoldal & M. Huntley (Eds.) Available from http://www.sciencedirect.com/science/book/9780123276452
ICOS. Integrated Carbon Observation System. from http://www.icos-infrastructure.eu/
ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en
ICP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61
Ilvesniemi, H., Levula, J., Ojansuu, R., Kolari, P., Kulmala, L., Pumpanen, J., et al. (2009). Long-term measurements of the carbon balance of a boreal Scots pine dominated forest ecosystem. *Boreal Environment Research, 14*(4), 731-753.

Ilvesniemi, H., Pumpanen, J., Duursma, R., Hari, P., Keronen, P., Kolari, P., et al. (2010). Water balance of a boreal Scots pine forest. *Boreal Environment Research, 15*(4), 375-396.

Intergovernmental Oceanographic Commission of UNESCO. (2010). Microscopic and molecular methods for quantitative phytoplankton analysis. In B. Karlson, C. Cusack & E. Bresnan (Eds.)pp. 110). Available from http://www.mbari.org/ESP/pdfs/Marin%20and%20Scholin_2010.pdf

International Union of Soil Sciences Working Group WRB. (2006). World reference base for soil resources 2006, A framework for international classification, correlation and communication Available from ftp://ftp.fao.org/agl/agll/docs/wsrr103e.pdf

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

ISO (International Organization for Standardization). (1996). ISO 13395:1996; Water quality -- Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (pp. 18).

ISO (International Organization for Standardization). (1997). ISO 11905-1:1997; Water quality -- Determination of nitrogen -- Part 1: Method using oxidative digestion with peroxodisulfate (pp. 13).

ISO (International Organization for Standardization). (1999). ISO 7027:1999; Water quality -- Determination of turbidity (pp. 10).

ISO (International Organization for Standardization). (2003). ISO 15681-1:2003; Water quality -- Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) -- Part 1: Method by flow injection analysis (FIA).

ISO (International Organization for Standardization). (2004). ISO 6878:2004; Water quality -- Determination of phosphorus -- Ammonium molybdate spectrometric method.

ISO (International Organization for Standardization). (2005). ISO 11732:2005; Water quality -- Determination of ammonium nitrogen -- Method by flow analysis (CFA and FIA) and spectrometric detection.

Jakucs, P. (1985). *Ecology of an oak forest in Hungary* (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó.

JM Hellawell, D. o. a. r. f. m., in: Monitoring for conservation and ecology (1991), Goldsmith, FB (ed.), Chapman and Hall, NY, pp.1-14.

Kanalas, P., Fenyvesi, A., Kis, J., Szollosi, E., Olah, V., Ander, I., et al. (2010). Seasonal and diurnal variability in sap flow intensity of mature sessile oak (Quercus petraea (Matt.) Liebl.) trees in ralation to microclimatic conditions. *Acta Biologica Hungarica, 61*, 95-108.

Karr, J. R. (1993). Defining and assessing ecological integrity - beyond water quality. [Article]. *Environmental Toxicology and Chemistry, 12*(9), 1521-1531.

Karr, J. R., & Dudley, D. R. (1981). Ecological Perspective on Water-Quality Goals. *Environmental Management, 5*(1), 55-68.

Kestemont, P., & Goffaux, D. (2002). Metric Selection and Sampling Procedures for FAME (D 4 - 6), Final Report: Development, Evaluation & Implementation of a Standardised Fish-based Assessment Method for the Ecological Status of European Rivers - A Contribution to the Water Framework Directive (FAME)pp. 90). Available from http://fame.boku.ac.at/downloads/D4_6_metrics_and_sampling_procedure.pdf

Kirchman, D., Knees, E., & Hodson, R. (1985). Leucine incorporation and its potential as a measure of protein-synthesis by bacteria in natural aquatic systems. [Article]. *Applied and Environmental Microbiology, 49*(3), 599-607.

Krause-Jensen, D., Sagert, S., Schubert, H., & Bostrom, C. (2008). Empirical relationships linking distribution and abundance of marine vegetation to eutrophication. [Review]. *Ecological Indicators, 8*(5), 515-529.

Kumar, M., & Monteith, J. L. (1982). Remote sensing of crop growth. In H. Smith (Ed.), *Plants and the daylight spectrum* (pp. 133-144). London: Academic Press.

Lawson, D. M., Lamar, C. K., & Schwartz, M. W. (2008). Quantifying plant population persistence in human-dominated landscapes. *Conservation Biology, 22*(4), 922-928.

Lopez y Royo, C., Pergent, G., Alcoverro, T., Buia, M. C., Casazza, G., Martínez-Crego, B., et al. (2010). The seagrass Posidonia oceanica as indicator of coastal water quality: Experimental intercalibration of classification systems. *Ecological Indicators*, 7.

Lorenti, M., & De Falco, G. (2004). Measurement and characterization of abiotic variables *Biologica Marina Mediterranea* (Vol. 11, pp. 38).

MacIsaac, E. A., & Stockner, J. G. (1993). Enumeration of phototrophic picoplankton by autofluorescence microscopy. In P. F. Kemp, B. F. Sherr, E. B. Sherr & J. J. Cole (Eds.), *Handbook of methods in aquatic microbial ecology* (pp. 187-198). Boca Raton, Fla: Crc Pr Inc.

McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Hawksworth, D. L., Marhold, K., et al. (2006). International Code of Botanical Nomenclature (Vienna Code). In J. McNeill (Eds.), Regnum Vegetatible (Vol. 146, Available from http://ibot.sav.sk/icbn/main.htm

Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods. (1986).

Methods of Soil Analysis. Part 3. Chemical Methods. (1996).

Migliaccio, M., De Martino, F., Silvestre, F., & Procaccini, G. (2005). Meadow-scale genetic structure in Posidonia oceanica. [Article]. *Marine Ecology-Progress Series, 304*, 55-65.

Morris, W. F., & Doak, D. F. (2002). *Quantitative Conservation Biology: Theory and Practice of Population Viability Analysis*.

Müller, F., Hoffmann-Kroll, R., & Wiggering, H. (2000). Indicating ecosystem integrity - theoretical concepts and environmental requirements. *Ecological Modelling, 130*(1-3), 13-23.

Nõges, P., Nõges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijów, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. *Hydrobiologia, 506-509*(1), 51-58.

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. *Hydrobiologia, 506*(1-3), 51-58.

Noss, R. F. (1990). Can we maintain biological and ecological integrity? [Editorial Material]. *Conservation Biology, 4*(3), 241-243.

Novak, M. A., & Bode, R. W. (1992). Percent Model Affinity: A New Measure of Macroinvertebrate Community Composition. *Journal of the North American Benthological Society, 11*(1), 80-85.

NS SHARE Project. (2005a). North South Shared Aquatic Resource (NS Share): Methods Manual I River Macrophytes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20I%20%20River%20Macrophyte.pdf

NS SHARE Project. (2005b). North South Shared Aquatic Resource (NS Share): Methods Manual II Lake Macrophytes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20II%20Lake%20Macrophyte.pdf

NS SHARE Project. (2005c). North South Shared Aquatic Resource (NS Share): Methods Manual III Littoral Macroinvertebrates - Lakes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20III%20Littoral%20Invertebrates%20Lakes/Methods%20Manual%20III%20Littoral%20Invertebrates%20Lakes.pdf

NS SHARE Project. (2005d). North South Shared Aquatic Resource (NS Share): Methods Manual IV Profundal/Sub-littoral Macroinvertebrates - Lakes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20IV%20Profundal%20-sublittoral%20invertebrates%20Lakes/Methods_Manual_IV%20Profundal_sublittoral%20invertebrates%20lakes.pdf

NS SHARE Project. (2005e). North South Shared Aquatic Resource (NS Share): Methods Manual V Fish. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20V%20Fish/Methods%20Manual%20V%20Fish.pdf

Orfanidis, S., Panayotidis, P., & Stamatis, N. (2001). Ecological evaluation of transitional and coastal waters: A marine benthic macrophytes-based model. *Mediterranean Marine Science, 2*(2), 20.

Ozimek, T., & Kowalczewski, A. (1984). Long-term changes of the submerged macrophytes in eutrophic lake Mikolajskie (North Poland). [Article]. *Aquatic Botany, 19*(1-2), 1-11.

Parpală, L., G.-Tóth, L., Zinevici, V., Németh, P., & Szalontai, K. (2003). Structure and production of the metazoan zooplankton in Lake Balaton (Hungary) in summer. *Hydrobiologia, 506-509*(1), 347-351.

Petchey, O. L., O'Gorman, E., & Flynn, D. F. B. (2009). A functional guide to functional diversity measures. In S. Naeem, D. E. Bunker, A. Hector, M. Loreau & C. Perrings (Eds.), *Biodiversity, Ecosystem Functioning, and Human Wellbeing - An Ecological and Economic Perspective* (pp. 384).

Petriccione, B. (2005). Short-term changes in key plant communities of Central Apennines (Italy). *Acta botanica Gallica, 152*(4), 545-561.

Pollard, E. (1977). Method for assessing changes in abundance of butterflies. [Article]. *Biological Conservation, 12*(2), 115-134.

Pollard, E., & Yates, T. J. (1994). *Monitoring Butterflies for Ecology and Conservation: The British Butterfly Monitoring Scheme*: Springer.

Reich, P. B., Tilman, D., Isbell, F., Mueller, K., Hobbie, S. E., Flynn, D. F. B., et al. (2012). Impacts of Biodiversity Loss Escalate Through Time as Redundancy Fades. *Science, 336*(6081), 589-592.

Robinson, C., & Williams, P. l. B. (2005). Respiration and its measurement in surface marine waters. In P. A. del Giorgio & P. l. B. Williams (Eds.), *Respiration in Aquatic Ecosystems* (pp. 147-180). Oxford (UK): Oxford University Press.

Rossi, G., Parolo, G., & Ulian, T. (2009). Human trampling as a threat factor for the conservation of peripheral plant populations. [Article]. *Plant Biosystems, 143*(1), 104-113.

Rossi, G., Parolo, G., Zonta, L. A., Crawford, J. A., & Leonardi, A. (2006). Salix herbacea L. fragmented small population in the N-Apennines (Italy): response to human trampling disturbance. *Biodiversity and Conservation, 15*(12), 3881-3893.

Rothe, A., Huber, C., Kreutzer, K., & Weis, W. (2002). Deposition and soil leaching in stands of Norway spruce and European Beech: Results from the Hoglwald research in comparison with other European case studies. *Plant and Soil, 240*(1), 33-45.

Sandin, L., Friberg, N., Furse, M., Clarke, R., & Larsen, S. (2004). Inter-calibration and harmonisation of "invertebrate methods", Standardisation of river classification: Framework method for calibrating different biological survey results against ecological classifications to be developed for the Water Framework Directivepp. 238). Available from http://www.eu-star.at/pdf/Deliverable8.pdf

Schaumburg, J., Schranz, C., Foerster, J., Gutowski, A., Hofmann, G., Meilinger, P., et al. (2004). Ecological classification of macrophytes and phytobenthos for rivers in Germany according to the Water Framework Directive. *Limnologica, 34*(4), 283-301.

Schaumburg, J., Schranz, C., Hofmann, G., Stelzer, D., Schneider, S., & Schmedtje, U. (2004). Macrophytes and phytobenthos as indicators of ecological status in German lakes - a contribution to the implementation of the Water Framework Directive. *Limnologica, 34*(4), 302-314.

Schoolmaster, D. R., Grace, J. B., & Schweiger, E. W. (2012). A general theory of multimetric indices and their properties. [Article]. *Methods in Ecology and Evolution, 3*(4), 773-781.

Slusarczyk, M. (2009). Extended lifespan traded for diapause in Daphnia. *Freshwater Biology, 54*(11), 2252-2262.

Soil Staff Survey. (2010). Keys to Soil Taxonomy. In U. S. D. o. Agriculture & N. R. C. Service (Eds.) Available from http://soils.usda.gov/technical/classification/tax_keys/

Sparks, T. H., Jaroszewicz, B., Krawczyk, M., & Tryjanowski, P. (2009). Advancing phenology in Europe's last lowland primeval forest: non-linear temperature response. *Climate Research, 39*(3), 221-226.

Specziár, A., & Bíró, P. (1998). Spatial distribution and short-term changes of benthic macrofauna in Lake Balaton (Hungary). *Hydrobiologia, 389*(1), 203-216.

Stanisci, A., Carranza, M., Pelino, G., & Chiarucci, A. (2011). Assessing the diversity pattern of cryophilous plant species in high elevation habitats. *Plant Ecology, 212*(4), 595-600.

Stanisci, A., Pelino, G., & Blasi, C. (2005). Vascular plant diversity and climate change in the alpine belt of the central Apennines (Italy). *Biodiversity and Conservation, 14*(6), 1301-1318.

Statistic Netherlands. (2006). TRIM (TRends and Indices for Monitoring data). from http://www.cbs.nl/en-GB/menu/themas/natuur-milieu/methoden/trim/default.htm?Languageswitch=on

Steeman-Nielsen, E. (1952). The use of radioactive carbon (14C) for measuring organic production in the sea. *J. Cons. Perm. Int. Explor. Mer, 18*, 23.

Steinhardt, T., Karez, R., Selig, U., & Schubert, H. (2009). The German procedure for the assessment of ecological status in relation to the biological quality element "Macroalgae & Angiosperms" pursuant to the European Water Framework Directive (WFD) for inner coastal waters of the Baltic Sea. *Rostocker Meeresbiologische Beitrage, 22*, 7-42.

Strickland, J. D., & Parsons, T. R. (1972). A manual of seawater analysis. *Canada Fisheries Research Board Bulletin*.

Sutherland, W. J. (2006). Ecological Census Techniques. In W. J. Sutherland (Eds.), A Handbookpp. 432). Available from http://www.ecolab.bas.bg/main/Members/snikolov/Sutherland_2006_Ecological_Census_Techniques.pdf

Sykes, J. M. (1996). BB Protocol - Breeding birds. *To record the annual distribution and abundance of breeding birds within selected areas of ECN sites*, from http://www.ecn.ac.uk/measurements/terrestrial/b/bi/bb

Tolonen, K. T., & Hamalainen, H. (2010). Comparison of sampling methods and habitat types for detecting impacts on lake littoral macroinvertebrate assemblages along a gradient of human disturbance. *Fundamental and Applied Limnology / Archiv für Hydrobiologie, 176*(1), 43-59.

Toth, J. A., Papp, L. B., & Lenkey, B. (1975). Litter decomposition in an oak forest ecosystem (Quercetum petreae Cerris) in northern Hungary studied in the framework of "Sikfökut Project". In G. Kilbertus, O. Reisinger, A. Mourey & J. A. Cancela da Fonseca (Eds.), *Biodegradation et Humification* (pp. 41 - 58). Sarreguemines: Pierrance Editeur.

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

United Kingdom Butterfly Monitoring Scheme. Methods for recording butterfly transects. from http://www.ukbms.org/Methods.aspx#top

Vesala, T., Suni, T., Rannik, U., Keronen, P., Markkanen, T., Sevanto, S., et al. (2005). Effect of thinning on surface fluxes in a boreal forest. *Global Biogeochemical Cycles, 19*(2).

Voříšek, P., Klvaňová, A., Wotton, S., & Gregory, R. D. (2008). A Best Practice Guide for wild bird monitoring schemes. In E. E. B. C. Council) (Eds.) Available from http://www.ebcc.info/index.php?ID=365

Wellburn, A. R. (1994). The spectral determination of chlorophyll-a and chlorophyll-b, as well as total carotinoids, using various solvents with spectrophotometers of different resolution. *Journal of Plant Physiology, 144*(3), 307-313.

Wetzel, R. G., & Likens, G. E. (1991). *Limnological Analyses*. New York: Springer.

Wiederholm, T. (1980). Use of Benthos in Lake Monitoring. *Journal (Water Pollution Control Federation), 52*(3), 537-547.

Wikum, D. A., & Shanholtzer, G. F. (1978). Application of the Braun-Blanquet cover-abundance scale for vegetation analysis in land development studies. *Environmental Management, 2*(4), 323-329.

Winkler, W., Beyer, J., & Gnauck, A. (1980). Improvement of the accuracy of prediction of stochastic models of the oxygen concentration in flowing waters. [Article]. *Acta Hydrochimica Et Hydrobiologica, 8*(1), 107-110.

WMO Observing and Information Systems Department. Instruments and Methods of Observation. from http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html

Woiwod, I. P. (1996). The ECN butterflies protocol from http://www.ecn.ac.uk/measurements/terrestrial/i/ib

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

World Meterological Organization. (2008). Guide to Hydrological Practices (WMO-No. 168). In W. M. Organization (Eds.), Volume I Hydrology – From Measurement to Hydrological Information (Vol. Vol 1, Available from http://www.hydrology.nl/images/docs/hwrp/WMO_Guide_168_Vol_I_en.pdf

World Meterological Organization. (2008 (Updated in 2010)). Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). In W. M. Organization (Eds.) Available from http://www.wmo.int/pages/prog/www/IMOP/CIMO-Guide.html, http://www.wmo.int/pages/themes/wmoprod/guides.html

YSI Environmental. (2011). The Basics of Chlorophyll Measurement. from http://www.ysi.com/parametersdetail.php?Chlorophyll-6

Zupo, V., Buia, M. C., Gambi, M. C., Lorenti, M., & Procaccini, G. (2006). Temporal variations in the spatial distribution of shoot density in a Posidonia oceanica meadow and patterns of genetic diversity. [Article]. *Marine Ecology-an Evolutionary Perspective, 27*(4), 328-338.

10 Fact sheets for different environments

10.1 Terrestrial Systems

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.1 Flora Diversity ⇨ Vegetation: Species and functional diversity (incl. alien species, threatened species)

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Vascular plants: (1) Full species list (2) Coverage (%) or abundance
Important related indices
Shannon; Simpson; Eveness; species turn-over; rarefaction curves; phylogenetic diversity; Abundance-incidence-curves
Property: Frequency
Annual/periodic - able to be related to single year as basic unit
Property: Precision
Reference to Flora Europea taxonomy, Vienna-nomenclature code; Tokyo- Code; Coverage estimation should be done for vegetation layers (tree, shrub, herb, floor) as objective as possible
Property: Time scale (incl. seasonality), temporal resolution
Depending on the dynamics of the community (often different seasonal aspects). More than once a year if necessary. All species occurring should be recorded.
Property: Basic spatial scale
Stratified sampling - independent plots representative for the site and/or the habitats within the sites; at least 4 replicates; minimum areal depending on biotoe type (100, 25 or 1m²),
Property: Base Units

Species number, percentage cover, frequency

Mandatory meta data

Survey date, location (XY coordinates), plot/area size, frequency of observations, biotope discription, method reference, design of sampling

Method applied (key phrases)

Large plots: vegetation relevés compatible to Braun-Blanquet, e.g. 5 x 5m in open habitat types, 10 x 10m in woody habitat types or transects (at least 20m long) with application of point intercept method; small plots (e.g. 1x1m): point frame method or simple frame method

Method references: specific to sites, not internationally applied

Espelta, J. M., Cortés, P., Molowny-Horas, R., Sánchez-Humanes, B., & Retana, J. (2008). Masting mediated by summer drought reduces acron predation in mediterranean oak forests. Ecology, 89(3), 805-817;

Petriccione, B. (2005). Short-term changes in key plant communities of Central Apennines (Italy). Acta botanica Gallica, 152(4), 545-561;

Rossi, G., Parolo, G., & Ulian, T. (2009). Human trampling as a threat factor for the conservation of peripheral plant populations. [Article]. Plant Biosystems, 143(1), 104-113;

Rossi, G., Parolo, G., Zonta, L. A., Crawford, J. A., & Leonardi, A. (2006). Salix herbacea L. fragmented small population in the N-Apennines (Italy): response to human trampling disturbance. Biodiversity and Conservation, 15(12), 3881-3893;

Sparks, T. H., Jaroszewicz, B., Krawczyk, M., & Tryjanowski, P. (2009). Advancing phenology in Europe's last lowland primeval forest: non-linear temperature response. Climate Research, 39(3), 221-226;

Stanisci, A., Carranza, M., Pelino, G., & Chiarucci, A. (2011). Assessing the diversity pattern of cryophilous plant species in high elevation habitats. Plant Ecology, 212(4), 595-600;

Stanisci, A., Pelino, G., & Blasi, C. (2005). Vascular plant diversity and climate change in the alpine belt of the central Apennines (Italy). Biodiversity and Conservation, 14(6), 1301-1318

Method references: established, internationally applied

Braun-Blanquet, J. (1932). Plant sociology - the study of plant communities (1st ed.): McGraw-Hill book company, inc.;

The GLORIA* Field Manual – Multi-Summit Approach (*Global Observation Research Initiative in Alpine Environments). (2011). In H. Pauli, M. Gottfried, D. Hohenwallner, K. Reiter, R. Casale & G. Grabherr (Eds.)pp. 89). Available from http://www.gloria.ac.at/downloads/GLORIA_MS4_Web_english_withNOTES201106.pdf;

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

Morris, W. F., & Doak, D. F. (2002). Quantitative Conservation Biology: Theory and Practice of Population Viability Analysis;

Petchey, O. L., O'Gorman, E., & Flynn, D. F. B. (2009). A functional guide to functional diversity measures. In S. Naeem, D. E. Bunker, A. Hector, M. Loreau & C. Perrings (Eds.), Biodiversity, Ecosystem Functioning, and Human Wellbeing - An Ecological and Economic Perspective (pp. 384);

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual;

Wikum, D. A., & Shanholtzer, G. F. (1978). Application of the Braun-Blanquet cover-abundance scale for vegetation analysis in land development studies. Environmental Management, 2(4), 323-329.

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.2 Flora Diversity ⇨ Vegetation: Species and functional diversity (incl. alien species, threatened species)

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Mosses: (1) Full species list (2) Coverage (%) or abundance
Important related indices
Shannon; Simpson; Eveness; species turn-over; rarefaction curves; phylogenetic diversity
Property: Frequency
Annual/periodic - able to be related to single year as basic unit
Property: Precision
Reference to Flora Europea taxonomy, Vienna-nomenclature code; Coverage estimation should be done for vegetation layers (tree, shrub, herb, floor) and as objective as possible
Property: Time scale (incl. seasonality), temporal resolution
Depending on the community. More than once a year if necessary but generally all species occurring per year should be recorded.
Property: Basic spatial scale
Stratified random sampling - independent plots representative for the site and/or the habitats within the sites; at least 10 replicates; minimum standard sample unit 1x1m
Property: Base Units
Species number, percentage cover, frequency (no. of individuals)

Mandatory meta data

Survey date, location (XY coordinates), plot/area size, frequency of observations, biotope discription, method reference, design of sampling

Method applied (key phrases)

Large plots: vegetation relevés compatible to Braun-Blanquet, e.g. 5 x 5m in open habitat types, 10 x 10m in woody habitat types or transects (at least 20m long) with application of point intercept method; small plots (e.g. 1x1m): point frame method or simple frame method

Method references: specific to sites, not internationally applied

Espelta, J. M., Cortés, P., Molowny-Horas, R., Sánchez-Humanes, B., & Retana, J. (2008). Masting mediated by summer drought reduces acron predation in mediterranean oak forests. Ecology, 89(3), 805-817;

Petriccione, B. (2005). Short-term changes in key plant communities of Central Apennines (Italy). Acta botanica Gallica, 152(4), 545-561;

Rossi, G., Parolo, G., & Ulian, T. (2009). Human trampling as a threat factor for the conservation of peripheral plant populations. [Article]. Plant Biosystems, 143(1), 104-113;

Rossi, G., Parolo, G., Zonta, L. A., Crawford, J. A., & Leonardi, A. (2006). Salix herbacea L. fragmented small population in the N-Apennines (Italy): response to human trampling disturbance. Biodiversity and Conservation, 15(12), 3881-3893;

Sparks, T. H., Jaroszewicz, B., Krawczyk, M., & Tryjanowski, P. (2009). Advancing phenology in Europe's last lowland primeval forest: non-linear temperature response. Climate Research, 39(3), 221-226;

Stanisci, A., Carranza, M., Pelino, G., & Chiarucci, A. (2011). Assessing the diversity pattern of cryophilous plant species in high elevation habitats. Plant Ecology, 212(4), 595-600;

Stanisci, A., Pelino, G., & Blasi, C. (2005). Vascular plant diversity and climate change in the alpine belt of the central Apennines (Italy). Biodiversity and Conservation, 14(6), 1301-1318

Method references: established, internationally applied

Braun-Blanquet, J. (1932). Plant sociology - the study of plant communities (1st ed.): McGraw-Hill book company, inc.;

The GLORIA* Field Manual – Multi-Summit Approach (*Global Observation Research Initiative in Alpine Environments). (2011). In H. Pauli, M. Gottfried, D. Hohenwallner, K. Reiter, R. Casale & G. Grabherr (Eds.)pp. 89). Available from http://www.gloria.ac.at/downloads/GLORIA_MS4_Web_english_withNOTES201106.pdf;

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

Morris, W. F., & Doak, D. F. (2002). Quantitative Conservation Biology: Theory and Practice of Population Viability Analysis;

Petchey, O. L., O'Gorman, E., & Flynn, D. F. B. (2009). A functional guide to functional diversity measures. In S. Naeem, D. E. Bunker, A. Hector, M. Loreau & C. Perrings (Eds.), Biodiversity, Ecosystem Functioning,

and Human Wellbeing - An Ecological and Economic Perspective (pp. 384);

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual;

Wikum, D. A., & Shanholtzer, G. F. (1978). Application of the Braun-Blanquet cover-abundance scale for vegetation analysis in land development studies. Environmental Management, 2(4), 323-329.

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.3 Flora Diversity ⇨ Vegetation: Species and functional diversity (incl. alien species, threatened species)

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Lichens: (1) Full species list (2) Coverage (%) or abundance
Important related indices
Shannon; Simpson; Eveness; species turn-over; rarefaction curves; phylogenetic diversity
Property: Frequency
Annual/periodic - able to be related to single year as basic unit
Property: Precision
Reference to Flora Europea taxonomy, Vienna-nomenclature code; Coverage estimation should be done for vegetation layers (tree, shrub, herb, floor) and as objective as possible
Property: Time scale (incl. seasonality), temporal resolution
Depending on the community. More than once a year if necessary but generally all species occurring per year should be recorded.
Property: Basic spatial scale
Stratified random sampling - independent plots representative for the site and/or the habitats within the sites; at least 10 replicates; minimum standard sample unit 1x1m
Property: Base Units
Species number, percentage cover, frequency (no. of individuals)

Mandatory meta data

Survey date, location (XY coordinates), plot/area size, frequency of observations, biotope discription, method reference, design of sampling

Method applied (key phrases)

Large plots: vegetation relevés compatible to Braun-Blanquet, e.g. 5 x 5m in open habitat types, 10 x 10m in woody habitat types or transects (at least 20m long) with application of point intercept method; small plots (e.g. 1x1m): point frame method or simple frame method

Method references: specific to sites, not internationally applied

Espelta, J. M., Cortés, P., Molowny-Horas, R., Sánchez-Humanes, B., & Retana, J. (2008). Masting mediated by summer drought reduces acron predation in mediterranean oak forests. Ecology, 89(3), 805-817;

Petriccione, B. (2005). Short-term changes in key plant communities of Central Apennines (Italy). Acta botanica Gallica, 152(4), 545-561;

Rossi, G., Parolo, G., & Ulian, T. (2009). Human trampling as a threat factor for the conservation of peripheral plant populations. [Article]. Plant Biosystems, 143(1), 104-113;

Rossi, G., Parolo, G., Zonta, L. A., Crawford, J. A., & Leonardi, A. (2006). Salix herbacea L. fragmented small population in the N-Apennines (Italy): response to human trampling disturbance. Biodiversity and Conservation, 15(12), 3881-3893;

Sparks, T. H., Jaroszewicz, B., Krawczyk, M., & Tryjanowski, P. (2009). Advancing phenology in Europe's last lowland primeval forest: non-linear temperature response. Climate Research, 39(3), 221-226;

Stanisci, A., Carranza, M., Pelino, G., & Chiarucci, A. (2011). Assessing the diversity pattern of cryophilous plant species in high elevation habitats. Plant Ecology, 212(4), 595-600;

Stanisci, A., Pelino, G., & Blasi, C. (2005). Vascular plant diversity and climate change in the alpine belt of the central Apennines (Italy). Biodiversity and Conservation, 14(6), 1301-1318

Method references: established, internationally applied

Braun-Blanquet, J. (1932). Plant sociology - the study of plant communities (1st ed.): McGraw-Hill book company, inc.;

The GLORIA* Field Manual – Multi-Summit Approach (*Global Observation Research Initiative in Alpine Environments). (2011). In H. Pauli, M. Gottfried, D. Hohenwallner, K. Reiter, R. Casale & G. Grabherr (Eds.)pp. 89). Available from http://www.gloria.ac.at/downloads/GLORIA_MS4_Web_english_withNOTES201106.pdf;

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

Morris, W. F., & Doak, D. F. (2002). Quantitative Conservation Biology: Theory and Practice of Population Viability Analysis;

Petchey, O. L., O'Gorman, E., & Flynn, D. F. B. (2009). A functional guide to functional diversity measures. In S. Naeem, D. E. Bunker, A. Hector, M. Loreau & C. Perrings (Eds.), Biodiversity, Ecosystem Functioning,

and Human Wellbeing - An Ecological and Economic Perspective (pp. 384);

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual;

Wikum, D. A., & Shanholtzer, G. F. (1978). Application of the Braun-Blanquet cover-abundance scale for vegetation analysis in land development studies. Environmental Management, 2(4), 323-329.

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.4 Flora Diversity ⇨ Population trends of vascular plants

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Plants: Changes in population size over time (feasible only für single target species!) this parameter is partly covered by the abundance of vasculare plants!!
Important related indices
Population growth rate; probability of extinction or decline if at least 10 counts are available
Property: Frequency
Once a year if possible. Longer time lags are also possible (be aware of normal variation in population sizes!)
Property: Precision
Count of all individuals (or another easy unit such as ramets, genets…) in the population, or within (3-) 5 permanent plots
Property: Time scale (incl. seasonality), temporal resolution
Spring to summer, in order to be able to combine with sampling of reproductive indexes and recruitment success
Property: Basic spatial scale
Permanent plots (size variable depending on plant size, at least 100-300 units should be included) or whole populations if they are small (<100-300 plants)
Property: Base Units
Frequency of individuals (number of ramets, shoots, genets, or visual units)

Mandatory meta data

Survey date, GPS location, area size, biotope description, method of counting, estimation of population size and population growth rate

Method applied (key phrases)

Counting individuals (or different units used to estimate frequency of plants) in permanent areas;

depending on distribution and size, small populations (approx. less than 300 plants, easily covered by eye) should be counted as a whole; for larger or fragmented populations (not to be assessed by eye) a minimum of (3-) 5 permanent plots should be set. Plants should be counted in the same way every sampling year

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Morris, W. F., & Doak, D. F. (2002). Quantitative Conservation Biology: Theory and Practice of Population Viability Analysis.

Lawson, D. M., Lamar, C. K., & Schwartz, M. W. (2008). Quantifying plant population persistence in human-dominated landscapes. Conservation Biology, 22(4), 922-928.

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.5 Flora Diversity ⇨ Forest: Stand characteristics, stand diversity

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Forest: (1) Age, (2) Age classes, (3) Height, (4) Distribution
Important related indices
Property: Frequency
once, 5-10 years, on occasion
Property: Precision
Site characteristics
Property: Time scale (incl. seasonality), temporal resolution
summer measurements
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)

Survey

Method references: specific to sites, not internationally applied

Ilvesniemi, H., Levula, J., Ojansuu, R., Kolari, P., Kulmala, L., Pumpanen, J., et al. (2009). Long-term measurements of the carbon balance of a boreal Scots pine dominated forest ecosystem. Boreal Environment Research, 14(4), 731-753

Method references: established, internationally applied

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual;

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.6 Fauna Diversity ⇨ Species richness: Birds (incl. alien species, threatened species)

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Breeding or nesting Birds (only!): (1) Full species list (2) Abundance (Common Birds)
Important related indices
Shannon; Simpson; Abundance-incidence-curves
Property: Frequency
Yearly up to every 3 years, 3-4 surveys per year during the breeding season starting at sunrise; point transect: 5-10 minutes count per point
Property: Precision
1. To characterise habitat-specific communities (representative sample areas) 2. Reference to accepted taxonomy (e.g. http://www.birdlife.org/datazone/info/taxonomy; http://www.faunaeur.org/)
Property: Time scale (incl. seasonality), temporal resolution
March-September
Property: Basic spatial scale
Line transects: 1-2 km, if several lines, then at least 200m apart; avoid crossing markedly different habitats; Point transects: distance between points at least 200m, about 20 points per site

Property: Base Units

Numbers of individuals; behaviour categories

Mandatory meta data

Survey date and time, location, area size, distance bands, frequency of observations, behaviour categories, biotope discription, method reference, design of sampling, biotope inventory of the sampled area

Method applied (key phrases)

Line transects, point transects, point counts, point-stop, fixed distance bands, regular or systematic approach, random approach

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

British Trust for Ornithology. Volunteer surveys - Download forms & instructions. from http://www.bto.org/volunteer-surveys/bbs/taking-part/download-forms-instructions;

Sutherland, W. J. (2006). Ecological Census Techniques. In W. J. Sutherland (Eds.), A Handbookpp. 432). Available from http://www.ecolab.bas.bg/main/Members/snikolov/Sutherland_2006_Ecological_Census_Techniques.pdf;

Sykes, J. M. (1996). BB Protocol - Breeding birds. To record the annual distribution and abundance of breeding birds within selected areas of ECN sites, from http://www.ecn.ac.uk/measurements/terrestrial/b/bi/bb;

Voříšek, P., Klvaňová, A., Wotton, S., & Gregory, R. D. (2008). A Best Practice Guide for wild bird monitoring schemes. In E. E. B. C. Council) (Eds.) Available from http://www.ebcc.info/index.php?ID=365;

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.7 Fauna Diversity ⇨ Species richness: Butterflies (incl. alien species, threatened species, sedentary and migratory species)

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Butterflies: (1) Full species list (2) Abundance (grassland habitats)
Important related indices
Shannon; Simpson; abundance-incidence curves
Property: Frequency
Yearly, at least 5 (detection of about 80% of species), better 7-10 surveys
Property: Precision
1. To characterise the annual community of related habitats 2. Reference to accepted taxonomy (e.g. http://www.bc-europe.eu/category.asp?catid=9; http://www.faunaeur.org/)
Property: Time scale (incl. seasonality), temporal resolution
March-September
Property: Basic spatial scale
50m (line transects) at least 300 m (line transects) in a single defined habitat type
Property: Base Units

Number of individuals (adults, larvae?)

Mandatory meta data

Survey date and time, number of surveys, location (site name, coordinates, altitude), transect length, frequency of observations, biotope description, method reference, design of sampling, biotope inventory of the sampled area

Method applied (key phrases)

Line transect, counts of individuals

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Pollard, E. (1977). Method for assessing changes in abundance of butterflies. [Article]. Biological Conservation, 12(2), 115-134;

Pollard, E., & Yates, T. J. (1994). Monitoring Butterflies for Ecology and Conservation: The British Butterfly Monitoring Scheme: Springer;

United Kingdom Butterfly Monitoring Scheme. Methods for recording butterfly transects. from http://www.ukbms.org/Methods.aspx#top;

Woiwod, I. P. (1996). The ECN butterflies protocol from http://www.ecn.ac.uk/measurements/terrestrial/i/ib

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.8 Within Habitat Structure ⇨ Vegetation structure

Definition of *Within Habitat Structure*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Plants: (1) Vertical and horizontal vegetation structure within habitats, (2) number, type and coverage of layers (including mulch or litter?)
Important related indices
Age structure; fractal dimension; LSM (landscape metrics)
Property: Frequency
Periodic (once a year or once every 3-5 years; annual communities 1-3 times a year)
Property: Precision
Reference habitate typology: EUNIS and CORINE(?)
Property: Time scale (incl. seasonality), temporal resolution
Depends on the community
Property: Basic spatial scale
startified sampling - independent plots, leaf area sensors
Property: Base Units
Year, fractal dimension
Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling
Method applied (key phrases)
Remote sensing, aerial photographs (forest), verified through field work, vegetation relevés compatible to Braun-Blanquet
Method references: specific to sites, not internationally applied
Jakucs, P. (1985). Ecology of an oak forest in Hungary (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó
Method references: established, internationally applied
European Environment Agency. Habitat types search. from http://eunis.eea.europa.eu/habitats.jsp

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.9 Within Habitat Structure ⇨ Vegetation composition

Definition of *Within Habitat Structure*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Plants: Life forms (species traits: grasses, herbs, insect pollination, legumes, tap roots, flowering period, life periode (annuals), migration ability,..)
Important related indices
Age structure; fractal dimension; LSM (landscape metrics)
Property: Frequency
According to vegetation relevés (based on species lists from field work with species trait data bases)
Property: Precision
Reference habitate typology: EUNIS or CORINE??
Property: Time scale (incl. seasonality), temporal resolution
according to vegetation relevés
Property: Basic spatial scale
Vector data, habitat map (representative for the site)
Property: Base Units
accordng to vegetation relevés, abundance-incidence curves
Mandatory meta data

according to vegetation relevés, trait bases used
Method applied (key phrases)
according to vegetation relevés
Method references: specific to sites, not internationally applied
Jakucs, P. (1985). Ecology of an oak forest in Hungary (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó
Method references: established, internationally applied
European Environment Agency. Habitat types search. from http://eunis.eea.europa.eu/habitats.jsp

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.10 Within Habitat Structure ⇨ Deadwood

Definition of *Within Habitat Structure*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Forest: Deadwood (1) volume (CWD), (2) position, (3) decaying rate
Important related indices
Property: Frequency
10 yearly
Property: Precision
1 m3
Property: Time scale (incl. seasonality), temporal resolution
Trees without leaves , no smow
Property: Basic spatial scale
Property: Base Units
m3/ha (volume of deadwood), 9 classes (position), 5 classes (decaying rate)
Mandatory meta data

Method applied (key phrases)

Transects

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Harmon, M. E., Franklin, J. F., Swanson, F. J., Sollins, P., Gregory, S. V., Lattin, J. D., et al. (1986). Ecology of coarse woody debris in temperate ecosystems. [Review]. Advances in Ecological Research, 15, 133-302

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.11 Soil ⇨ Soil physical characteristics: soil horizons, soil water retention curves, total porosity, particle size distribution, stone content

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: SOIL: Classification according to FAO World reference base for soil resources (WRB 2006)
Important related indices
Diagnostic horizons; geomorphic conditions
Property: Frequency
At beginning of survey, then periodically (every 10 years)
Property: Precision
To characterise the site, reference list, description of soil layers including depth (cm)
Property: Time scale (incl. seasonality), temporal resolution
Once (every 10 years)
Property: Basic spatial scale
Site 5 replicates per site type (soil depth to be included)
Property: Base Units
Horizon, pedon, soil order (classification)
Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling, classification used

Method applied (key phrases)

Soil survey (FAO)

Method references: specific to sites, not internationally applied

AG Boden, Bodenkundliche Kartieranleitung, 4. Auflage (KA4), Hannover, 1994, 392.

Method references: established, internationally applied

Field book for describing and sampling soils, Version 2.0. (2002). In P. J. Schoeneberger, D. A. Wysocki, E. C. Benham & W. D. Broderson (Eds.) Available from ftp://ftp-fc.sc.egov.usda.gov/NSSC/Field_Book/FieldBookVer2.pdf;

International Union of Soil Sciences Working Group WRB. (2006). World reference base for soil resources 2006, A framework for international classification, correlation and communication Available from ftp://ftp.fao.org/agl/agll/docs/wsrr103e.pdf;

Soil Staff Survey. (2010). Keys to Soil Taxonomy. In U. S. D. o. Agriculture & N. R. C. Service (Eds.) Available from http://soils.usda.gov/technical/classification/tax_keys/

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.12 Soil ⇨ Soil bulk density

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: Bulk density
Important related indices
Property: Frequency
At beginning of survey, then periodically (every 3 - 5 years)
Property: Precision
To characterise the site and essential for soil Carbon stocks!!!
Property: Time scale (incl. seasonality), temporal resolution
Once (per year?) in case of no management
Property: Basic spatial scale
At least 3 replicates per horizon at every chosen plot
Property: Base Units
Density of natural undisturbed soil
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Stainless steel cylinder of known volume (normally 100 cm3)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods. (1986)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.13 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: Inorganic C and N content
Important related indices
Organic and inorganic C and N; total N; pH; exchangeable cations; base saturation
Property: Frequency
Continuous/periodical, every year or seasonal
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Once (per year?) monthly
Property: Basic spatial scale
at least 3 replicates per horizon at every chosen plot
Property: Base Units
Content of elements, pH, exchangeable cations
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Methods of Soil Analysis. Part 3. Chemical Methods. (1996)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.14 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: Base saturation
Important related indices
Organic and inorganic C and N; total N; pH; exchangeable cations; base saturation
Property: Frequency
Continuous/periodical, every year or seasonal
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Once (per year?) monthly
Property: Basic spatial scale
at least 3 replicates per horizon at every chosen plot
Property: Base Units
Content of elements, pH, exchangeable cations
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Methods of Soil Analysis. Part 3. Chemical Methods. (1996)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.15 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: Cation exchange capacity
Important related indices
Organic and inorganic C and N; total N; pH; exchangeable cations; base saturation
Property: Frequency
Continuous/periodical, every year or seasonal
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Once (per year?) monthly
Property: Basic spatial scale
at least 3 replicates per horizon at every chosen plot
Property: Base Units
Content of elements, pH, exchangeable cations
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Methods of Soil Analysis. Part 3. Chemical Methods. (1996)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.16 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: pH value
Important related indices
Organic and inorganic C and N; total N; pH; exchangeable cations; base saturation
Property: Frequency
Continuous/periodical, every year or seasonal
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Once (per year?) monthly
Property: Basic spatial scale
at least 3 replicates per horizon at every chosen plot
Property: Base Units
Content of elements, pH, exchangeable cations
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Methods of Soil Analysis. Part 3. Chemical Methods. (1996)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.17 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: Disssolved organic (1) Carbon (DOC) and (2) Nitrogen (DON) concentration
Important related indices
Organic and inorganic C and N; total N; pH; exchangeable cations; base saturation
Property: Frequency
Continuous/periodical, every year or seasonal
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Once (per year?) monthly
Property: Basic spatial scale
at least 3 replicates per horizon at every chosen plot
Property: Base Units
Content of elements
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Methods of Soil Analysis. Part 3. Chemical Methods. (1996)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.18 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: Soil solution chemistry
Important related indices
Organic and inorganic C and N; total N; pH; exchangeable cations; base saturation
Property: Frequency
Continuous/periodical, every year or seasonal
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Once (per year?) monthly
Property: Basic spatial scale
at least 3 replicates per horizon at every chosen plot
Property: Base Units
Content of elements
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Methods of Soil Analysis. Part 3. Chemical Methods. (1996)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.19 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: Temperature
Important related indices
Property: Frequency
Continuous in hourly resolution, at least at least 3 different soil depths
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Continous, hourly
Property: Basic spatial scale
Point to field scale
Property: Base Units
°C
Mandatory meta data
Location, area, soil map

Method applied (key phrases)
Temperature Sensors, PT100
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.20 Soil ⇨ Soil chemistry (related to profile)

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil: moisture (profiles)
Important related indices
N; C; P
Property: Frequency
Continuous/periodical, every 2-3 months
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/periodical
Property: Basic spatial scale
Plot: at least 3 replicates per soil depth, at least 3 sopil depths)
Property: Base Units
Water content, water potential, concentration of ions
Mandatory meta data
Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)
Device (sensors ,e.g. TDR; tensiometer)
Method references: specific to sites, not internationally applied
Jakucs, P. (1985). Ecology of an oak forest in Hungary (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó
Method references: established, internationally applied
Hillel, D. (1980). Fundamentals of soil physics: Academic Press Inc.; ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.21 Atmosphere ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Atmosphere*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Atmosphere: Air temperature
Important related indices
Fluxes of chemicals in the atmosphere
Property: Frequency
Continuous/subdaily (half-hourly)
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
Conce+P5ntration per time unit (mg/m); W/m²

Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.22 Atmosphere ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Atmosphere*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Atmosphere: Wind speed
Important related indices
Fluxes of chemicals in the atmosphere
Property: Frequency
Continuous/subdaily (half-hourly)
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
Conce+P5ntration per time unit (mg/m); W/m²

Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.23 Atmosphere ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Atmosphere*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Atmosphere: Vapor pressure deficit (VPD)
Important related indices
Fluxes of chemicals in the atmosphere
Property: Frequency
Continuous/subdaily (half-hourly)
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
Conce+P5ntration per time unit (mg/m); W/m²

Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.24 Atmosphere ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Atmosphere*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Atmosphere: CO2
Important related indices
Fluxes of chemicals in the atmosphere
Property: Frequency
Continuous/subdaily (half-hourly)
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
Conce+P5ntration per time unit (mg/m); W/m²

Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.25 Atmosphere ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Atmosphere*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Atmosphere: O3
Important related indices
Fluxes of chemicals in the atmosphere
Property: Frequency
Continuous/subdaily (half-hourly)
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
Conce+P5ntration per time unit (mg/m); W/m²

Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.26 Atmosphere ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Atmosphere*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Atmosphere: 1) SO4, (2) NOx concentrations
Important related indices
Fluxes of chemicals in the atmosphere
Property: Frequency
Continuous/subdaily (half-hourly)
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
Conce+P5ntration per time unit (mg/m); W/m²

Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.27 Habitat ⇨ Cover of CORINE land use (better: EUNIS habitats); EU Habitat Directive (connection to remote sensing)

Definition of *Habitat*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Habitat: (1) Land cover, (2) related metrics (e.g. connectivity, fragmentation, diversity)
Important related indices
Landscape metrics (e.g. SHDI; MPS; PROX; ENN)
Property: Frequency
Periodic (depends on community dynamics)
Property: Precision
To characterise the site (spatial resolution)
Property: Time scale (incl. seasonality), temporal resolution
Every 3 years (depends on dynamics of land use changes and community changes)
Property: Basic spatial scale
Site/landscape
Property: Base Units
Landscape
Mandatory meta data

Survey date, location, area size, year of observation, methods of sampling
Method applied (key phrases)
Maps (surveys/checked)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.28 E_input ⇨ Energy input: Radiation

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Photoshynthetic active radiation (PAR)
Important related indices
Property: Frequency
Continuous (half hourly) / site characterisation
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous / annual
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data

Location, plot/Area size, frequency of observations, biotope discription, method reference
Method applied (key phrases)
Device / calculation; Pyranometer
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en; World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf; UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.29 E_input ⇨ Energy input: Radiation

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Direct and diffuse sky radiation
Important related indices
Property: Frequency
Continuous (half hourly) / site characterisation
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous / annual
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data

Location, plot/Area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Device / calculation;

Pyranometer

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.30 E_input ⇨ Photosynthetic energy fluxes: a) energy input (light absorption); b) energy partitioning (photochemical vs non-photochemical)

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Light absorption (greeness indexes, e.g. NDVI)
Important related indices
NDVI; PRI; NPQ; Photochemical Yield; Non-Photochemical Yield; Light Use Efficiency
Property: Frequency
Measurements are continuous (30 min averages). But Active Fluorescence has a minimum practical Frequency of 5-15 minutes.
Property: Precision
Sensor field-of-view needs to be representative of the unit under study. Few meters for canopy level, or few mm for leaf level.
Property: Time scale (incl. seasonality), temporal resolution
Annual coverage. Snow problems.
Property: Basic spatial scale
From a few mm (leaf level measurements) to tenths of meters (tower level measurements)
Property: Base Units
mmol Quanta m-2 s-1

Mandatory meta data

PAR, Temperature, precise sensor orientation (canopy level), Stand structure (BRDF computing): tree density, size, LAI,…

Method applied (key phrases)

Photodiode sensor

Radiometer

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.31 E_input ⇨ Photosynthetic energy fluxes: a) energy input (light absorption); b) energy partitioning (photochemical vs non-photochemical)

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Energy partitioning (PRI Photochemical Reflectance Index)
Important related indices
NDVI; PRI; NPQ; Photochemical Yield; Non-Photochemical Yield; Light Use Efficiency
Property: Frequency
Measurements are continuous (30 min averages). But Active Fluorescence has a minimum practical Frequency of 5-15 minutes.
Property: Precision
Sensor field-of-view needs to be representative of the unit under study. Few meters for canopy level, or few mm for leaf level.
Property: Time scale (incl. seasonality), temporal resolution
Annual coverage. Snow problems.
Property: Basic spatial scale
From a few mm (leaf level measurements) to tenths of meters (tower level measurements)
Property: Base Units
mmol Quanta m-2 s-1

Mandatory meta data

PAR, Temperature, precise sensor orientation (canopy level), Stand structure (BRDF computing): tree density, size, LAI,…

Method applied (key phrases)

Photodiode sensor

Radiometer

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.32 E_input ⇨ Photosynthetic energy fluxes: a) energy input (light absorption); b) energy partitioning (photochemical vs non-photochemical)

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Active and passive fluorescence
Important related indices
NDVI; PRI; NPQ; Photochemical Yield; Non-Photochemical Yield; Light Use Efficiency
Property: Frequency
Measurements are continuous (30 min averages). But Active Fluorescence has a minimum practical Frequency of 5-15 minutes.
Property: Precision
Sensor field-of-view needs to be representative of the unit under study. Few meters for canopy level, or few mm for leaf level.
Property: Time scale (incl. seasonality), temporal resolution
Annual coverage. Snow problems.
Property: Basic spatial scale
From a few mm (leaf level measurements) to tenths of meters (tower level measurements)
Property: Base Units
mmol Quanta m-2 s-1

Mandatory meta data

PAR, Temperature, precise sensor orientation (canopy level), Stand structure (BRDF computing): tree density, size, LAI,…

Method applied (key phrases)

Photodiode sensor

Radiometer

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.33 E_storage ⇨ Biomass

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Incremental biomass: Above-ground Net Primary Production (ANPP) as a proxy
Important related indices
Volume/mass of ecosystem components; Light-use efficiency
Property: Frequency
Annual
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Annual (more sampling may be needed)
Property: Basic spatial scale
Site
Property: Base Units
Cubic meters, metric tons
Mandatory meta data
Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)
Sampling
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.34 E_output ⇨ Reflectivity

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Albedo (diffuse reflectivity of a surface)
Important related indices
Eddy covariance Light-use efficiency
Property: Frequency
Albedo: continuous, 10-30 min
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous
Property: Basic spatial scale
Site
Property: Base Units
Weight/volume units per time units µmol m-2 s-1
Mandatory meta data

Location, plot/Area size, frequency of observations, biotope discription, method reference
Method applied (key phrases)
Measured on selected meteorological stations 4-component net radiation sensors
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.35 E_output ⇨ Heat flux

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Heat flux
Important related indices
Eddy covariance; Light-use efficiency
Property: Frequency
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous
Property: Basic spatial scale
Site
Property: Base Units
Weight/volume units per time units µmol m-2 s-1
Mandatory meta data
Location, plot/Area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)
Measured on selected meteorological stations 4-component net radiation sensors
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.36 E_output ⇨ Respiration

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Respiration (production of carbon dioxide by living organisms)
Important related indices
Eddy covariance; Light-use efficiency
Property: Frequency
Respiration: 3x per year
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous
Property: Basic spatial scale
Site
Property: Base Units
Weight/volume units per time units µmol m-2 s-1
Mandatory meta data
Location, plot/Area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Measured on selected meteorological stations

4-component net radiation sensors

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Anderson, J. P. E., & Domsch, K. H. (1978). A physiological method for the quantitative measurement of microbial biomass in soils. Soil Biology and Biochemistry, 10(3), 215-221;

ICOS. Integrated Carbon Observation System. from http://www.icos-infrastructure.eu/;

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.37 E_efficiency measures ⇨ Energy efficiency

Definition of *E_efficiency measures*: *The amount of energy necessary to maintain a specific biomass, also serving as a stress indicator for the system.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Respiration per biomass
Important related indices
Eddy covariance
Property: Frequency
Continuous, temporal resolution 30 min
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous
Property: Basic spatial scale
Plot/site
Property: Base Units
µmol m-2 s-1
Mandatory meta data
Location, plot/Area size, frequency of observations, biotope discription, method reference Measuring height, fetch, type of gas analyser (closed, open, enclosed),

Method applied (key phrases)
Sampling/biometry/proxy variables
Method references: specific to sites, not internationally applied
Vesala, T., Suni, T., Rannik, U., Keronen, P., Markkanen, T., Sevanto, S., et al. (2005). Effect of thinning on surface fluxes in a boreal forest. [Article]. Global Biogeochemical Cycles, 19(2)
Method references: established, internationally applied
Kumar, M., & Monteith, J. L. (1982). Remote sensing of crop growth. In H. Smith (Ed.), Plants and the daylight spectrum (pp. 133-144). London: Academic Press

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.38 M_input ⇨ Deposition of main nutrients

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Deposition base cations (K, Na, Ca, Mg)
Important related indices
Concentration; ion ratio
Property: Frequency
Monthly to Annual; (Ignatova) => deposition measurements every 15 days; Weathering- once
Property: Precision
To characterise the site, influx determination
Property: Time scale (incl. seasonality), temporal resolution
Periodical (monthly)
Property: Basic spatial scale
Site
Property: Base Units
kg/ha,
Mandatory meta data
Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Collectors; sampling

Method references: specific to sites, not internationally applied

Filippa, G., Freppaz, M., Williams, M. W., & Zanini, E. (2010). Major element chemistry in inner alpine snowpacks (Aosta Valley Region, NW Italy). Cold Regions Science and Technology, 64(2), 158-166

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.39 M_input ⇨ Deposition of main nutrients

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Deposition SO42-
Important related indices
Concentration; ion ratio
Property: Frequency
Monthly to Annual; (Ignatova) => deposition measurements every 15 days; Weathering- once
Property: Precision
To characterise the site, influx determination
Property: Time scale (incl. seasonality), temporal resolution
Periodical (monthly)
Property: Basic spatial scale
Site
Property: Base Units
kg/ha,
Mandatory meta data
Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Collectors; sampling

Method references: specific to sites, not internationally applied

Filippa, G., Freppaz, M., Williams, M. W., & Zanini, E. (2010). Major element chemistry in inner alpine snowpacks (Aosta Valley Region, NW Italy). Cold Regions Science and Technology, 64(2), 158-166

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.40 M_input ⇨ Deposition of main nutrients

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Deposition Cl-
Important related indices
Concentration; ion ratio
Property: Frequency
Monthly to Annual; (Ignatova) => deposition measurements every 15 days; Weathering- once
Property: Precision
To characterise the site, influx determination
Property: Time scale (incl. seasonality), temporal resolution
Periodical (monthly)
Property: Basic spatial scale
Site
Property: Base Units
kg/ha,
Mandatory meta data
Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Collectors; sampling

Method references: specific to sites, not internationally applied

Filippa, G., Freppaz, M., Williams, M. W., & Zanini, E. (2010). Major element chemistry in inner alpine snowpacks (Aosta Valley Region, NW Italy). Cold Regions Science and Technology, 64(2), 158-166

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.41 M_input ⇨ Deposition of main nutrients

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Wet and dry deposition of atmospheric N (NH4+, NO3-)
Important related indices
N-excess
Property: Frequency
Continuous (monthly, weekly, seasonal),
Property: Precision
Characterisation of site
Property: Time scale (incl. seasonality), temporal resolution
Continuous
Property: Basic spatial scale
Site
Property: Base Units
kg N ha -1 yr-1
Mandatory meta data
Measuring height, fetch, type of measurement (e.g. Eddy covariance, eddy accumulation, relaxed eddy accumulation), O3 concentration

Method applied (key phrases)

traps/collectors

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.42 M_storage ⇨ Biomass

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Vegetation biomass: (a) aboveground, (b) belowground
Important related indices
Concentration; ion ratio; NDVI; REIP; LAI
Property: Frequency
Annual/periodic, depends on the objective: yield level, proxy for transpiration, proxy for site fertility, nutrient storages, nutrient export, carbon storage,..; relevant for many different issues beyond carbon cycle
Property: Precision
To characterise the site, the community, the ressource availability, mass determinations…
Property: Time scale (incl. seasonality), temporal resolution
Depends on site type, habitat type and objective
Property: Basic spatial scale
Plot or site or habitat (remote sensing)
Property: Base Units
kg/ha; LAI: m2/m2; spectral indices (NDVI,REIP)
Mandatory meta data

Date, location, plot or area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Estimation, surveys, biometry, proxies (e.g. plant height in grasslands), remote sensing

Method references: specific to sites, not internationally applied

Holub, S. M., Lajtha, K., Spears, J. D. H., Toth, J. A., Crow, S. E., Caldwell, B. A., et al. (2005). Organic matter manipulations have little effect on gross and net nitrogen transformations in two temperate forest mineral soils in the USA and central Europe. Forest Ecology and Management, 214(1-3), 320-330

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.43 M_storage ⇨ S, N content of biomass

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: S, N content of biomass
Important related indices
Concentration; ion ratio
Property: Frequency
Annual/periodic
Property: Precision
To characterise the site, mass determinations
Property: Time scale (incl. seasonality), temporal resolution
Depend on site type
Property: Basic spatial scale
Plot/site
Property: Base Units
kg/ha, LAI: (m2/m2)
Mandatory meta data
Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Estimation, surveys, biometry, proxies (e.g. plant height in grasslands)

Method references: specific to sites, not internationally applied

Holub, S. M., Lajtha, K., Spears, J. D. H., Toth, J. A., Crow, S. E., Caldwell, B. A., et al. (2005). Organic matter manipulations have little effect on gross and net nitrogen transformations in two temperate forest mineral soils in the USA and central Europe. Forest Ecology and Management, 214(1-3), 320-330

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.44 M_storage ⇨ Matter storage

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nitrogen fixation
Important related indices
Concentration; ion ratio
Property: Frequency
Annual/periodic
Property: Precision
To characterise the site, mass determinations
Property: Time scale (incl. seasonality), temporal resolution
Depend on site type
Property: Basic spatial scale
Plot/site
Property: Base Units
kg/ha, LAI: (m2/m2)
Mandatory meta data
Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Estimation, surveys, biometry, proxies (e.g. plant height in grasslands)

Method references: specific to sites, not internationally applied

Holub, S. M., Lajtha, K., Spears, J. D. H., Toth, J. A., Crow, S. E., Caldwell, B. A., et al. (2005). Organic matter manipulations have little effect on gross and net nitrogen transformations in two temperate forest mineral soils in the USA and central Europe. Forest Ecology and Management, 214(1-3), 320-330

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.45 M_storage ⇨ Nitrogen fixation

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Leaf Area Index (LAI; proxy for photosynthetic primary production and evapotranspiration; estimation by remote sensing)
Important related indices
Property: Frequency
Annual/bi-annual
Property: Precision
biomass as an integrative measure + competitive outcome (species success)
Property: Time scale (incl. seasonality), temporal resolution
Once a year
Property: Basic spatial scale
Plot (1x1m)
Property: Base Units
g/species and area unit
Mandatory meta data
Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.46 M_output ⇨ Significant matter export: (1) harvesting, grazing; (2) leaching; (3) gas emissions (NH3, denitrification products)

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Utilized matter yield (harvesting, grazing)
Important related indices
Exploitation; water/wind transport of materials
Property: Frequency
Annual/seasonal, monthly calc. from daily flow
Property: Precision
To characterise the site (when relevant)
Property: Time scale (incl. seasonality), temporal resolution
To characterise the site (when relevant)
Property: Basic spatial scale
Site
Property: Base Units
Metric tons per area unit
Mandatory meta data

Date, location, plot/area size, frequency of observations, biotope discription, method reference
Method applied (key phrases)
Estimation, surveys
Method references: specific to sites, not internationally applied
Toth, J. A., Papp, L. B., & Lenkey, B. (1975). Litter decomposition in an oak forest ecosystem (Quercetum petreae Cerris) in northern Hungary studied in the framework of "Sikfökut Project". In G. Kilbertus, O. Reisinger, A. Mourey & J. A. Cancela da Fonseca (Eds.), Biodegradation et Humification (pp. 41 - 58). Sarreguemines: Pierrance Editeur
Method references: established, internationally applied
ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.47 M_output ⇨ Green House Gas (GHG) exchange

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Respiration: CO2 fluxes
Important related indices
Property: Frequency
constant, conitinuous, hourly
Property: Precision
To characterise the site, nutrient losses
Property: Time scale (incl. seasonality), temporal resolution
Constant
Property: Basic spatial scale
Plot, Site, spatial heterogeinity
Property: Base Units
kg C ha-2 yr-1
Mandatory meta data

Location, plot/Area size, frequency of observations, biotope discription, method reference
Method applied (key phrases)
static or dynamic chamber design
Method references: specific to sites, not internationally applied
Butterbach-Bahl, K., Gasche, R., Breuer, L., & Papen, H. (1997). Fluxes of NO and N2O from temperate forest soils: impact of forest type, N deposition and of liming on the NO and N2O emissions. Nutrient Cycling in Agroecosystems, 48(1), 79-90
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.48 M_output ⇨ Nitrate leaching

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: NO3- leaching
Important related indices
Property: Frequency
continuous, at least at 3-5 different locations
Property: Precision
To characterise the site, nutrient losses
Property: Time scale (incl. seasonality), temporal resolution
Constant
Property: Basic spatial scale
Plot, Site, spatial heterogeinity
Property: Base Units
kg N ha-1 yr-1; mg N L-1
Mandatory meta data

Location, plot/Area size, frequency of observations, biotope discription, method reference
Method applied (key phrases)
Suction cups (tension ceramic lysimeters
Method references: specific to sites, not internationally applied
Rothe, A., Huber, C., Kreutzer, K., & Weis, W. (2002). Deposition and soil leaching in stands of Norway spruce and European Beech: Results from the Hoglwald research in comparison with other European case studies. Plant and Soil, 240(1), 33-45
Method references: established, internationally applied
UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.49 M_efficiency measures ⇨ Nutrient cycling

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Litter residence time
Important related indices
Property: Frequency
Annual/periodic
Property: Precision
To characterise the site, mass losses
Property: Time scale (incl. seasonality), temporal resolution
Annual/periodic
Property: Basic spatial scale
Plot/site
Property: Base Units
Mandatory meta data

Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Litterfall/standing litter; litterbags,

Method references: specific to sites, not internationally applied

Toth, J. A., Papp, L. B., & Lenkey, B. (1975). Litter decomposition in an oak forest ecosystem (Quercetum petreae Cerris) in northern Hungary studied in the framework of "Sikfökut Project". In G. Kilbertus, O. Reisinger, A. Mourey & J. A. Cancela da Fonseca (Eds.), Biodegradation et Humification (pp. 41 - 58). Sarreguemines: Pierrance Editeur

Method references: established, internationally applied

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.50 M_efficiency measures ⇨ Nutrient cycling

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Litter decomposition
Important related indices
Property: Frequency
Annual/periodic
Property: Precision
To characterise the site, mass losses
Property: Time scale (incl. seasonality), temporal resolution
Annual/periodic
Property: Basic spatial scale
Plot/site
Property: Base Units
Mandatory meta data

Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Litterfall/standing litter; litterbags,

Method references: specific to sites, not internationally applied

Toth, J. A., Papp, L. B., & Lenkey, B. (1975). Litter decomposition in an oak forest ecosystem (Quercetum petreae Cerris) in northern Hungary studied in the framework of "Sikfökut Project". In G. Kilbertus, O. Reisinger, A. Mourey & J. A. Cancela da Fonseca (Eds.), Biodegradation et Humification (pp. 41 - 58). Sarreguemines: Pierrance Editeur

Method references: established, internationally applied

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.51 M_efficiency measures ⇨ Nutrient cycling

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Litter C/N ratio
Important related indices
Property: Frequency
Annual/periodic
Property: Precision
To characterise the site, mass losses
Property: Time scale (incl. seasonality), temporal resolution
Annual/periodic
Property: Basic spatial scale
Plot/site
Property: Base Units
Mandatory meta data

Date, location, plot/area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Litterfall/standing litter; litterbags,

Method references: specific to sites, not internationally applied

Toth, J. A., Papp, L. B., & Lenkey, B. (1975). Litter decomposition in an oak forest ecosystem (Quercetum petreae Cerris) in northern Hungary studied in the framework of "Sikfökut Project". In G. Kilbertus, O. Reisinger, A. Mourey & J. A. Cancela da Fonseca (Eds.), Biodegradation et Humification (pp. 41 - 58). Sarreguemines: Pierrance Editeur

Method references: established, internationally applied

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.52 W_input ⇨ Precipitation, throughfall, runoff

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Precipitation
Important related indices
Property: Frequency
Continuous (10 min)
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Continuous
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Location, plot/Area size, frequency of observations, biotope discription, method reference

Method applied (key phrases)

Tipping-bucket gauges, present weather sensors

Method references: specific to sites, not internationally applied

Ilvesniemi, H., Pumpanen, J., Duursma, R., Hari, P., Keronen, P., Kolari, P., et al. (2010). Water balance of a boreal Scots pine forest. Boreal Environment Research, 15(4), 375-396

Method references: established, internationally applied

World Meteorological Organization. (2010). Commission for Instruments and Methods of Observation (WMO-No. 1064). In W. M. Organization (Eds.), Fifteenth session - Abridged final report with resolutions and recommendationspp. 84). Available from http://www.wmo.int/pages/prog/www/CIMO/CIMO15-WMO1064/1064_en.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.53 W_storage ⇨ Soil water

Definition of *W_storage*: *The capacity of an ecosystem to store water when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil water content (SWC)
Important related indices
Concentration; ion ratio
Property: Frequency
Annual / seasonal
Property: Precision
To characterise the site (accurate measurements in combination with knowledge of soil properties important to derive soil water potential)
Property: Time scale (incl. seasonality), temporal resolution
Continuous - to characterise the site (when relevant), water contents and flow
Property: Basic spatial scale
Site/plot
Property: Base Units
%
Mandatory meta data
Location, plot/Area size, model tool reference, device reference

Method applied (key phrases)

Water balance, devices

Method references: specific to sites, not internationally applied

Jakucs, P. (1985). Ecology of an oak forest in Hungary (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó;

Kanalas, P., Fenyvesi, A., Kis, J., Szollosi, E., Olah, V., Ander, I., et al. (2010). Seasonal and diurnal variability in sap flow intensity of mature sessile oak (Quercus petraea (Matt.) Liebl.) trees in ralation to microclimatic conditions. Acta Biologica Hungarica, 61, 95-108

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.54 W_storage ⇨ Soil moisture

Definition of *W_storage*: *The capacity of an ecosystem to store water when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Soil moisture
Important related indices
Property: Frequency
Continuous, at least in 3 replicates per soil layer at at least 3 different locations
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Continous
Property: Basic spatial scale
Point to field scale
Property: Base Units
Mandatory meta data
Location, area, soil map

Method applied (key phrases)
Electromagnetic sensors (TDR), wireless soil moisture sensor networks (for plot to field scale), 3 depths including repetitions pf-Meter, tensiometer
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.55 W_storage ⇨ Water bodies

Definition of *W_storage*: *The capacity of an ecosystem to store water when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water depth and level
Important related indices
Concentration; ion ratio
Property: Frequency
Annual/seasonal; level monthly
Property: Precision
To characterise the site (accurate measurements in combination with knowledge of soil properties important to derive soil water potential)
Property: Time scale (incl. seasonality), temporal resolution
Continuous - to characterise the site (when relevant), water contents and flow
Property: Basic spatial scale
Site/plot
Property: Base Units
%
Mandatory meta data

Location, plot/Area size, model tool reference, device reference
Method applied (key phrases)
Water balance, devices
Method references: specific to sites, not internationally applied
Jakucs, P. (1985). Ecology of an oak forest in Hungary (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó; Kanalas, P., Fenyvesi, A., Kis, J., Szollosi, E., Olah, V., Ander, I., et al. (2010). Seasonal and diurnal variability in sap flow intensity of mature sessile oak (Quercus petraea (Matt.) Liebl.) trees in ralation to microclimatic conditions. Acta Biologica Hungarica, 61, 95-108
Method references: established, internationally applied
ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.56 W_output ⇨ Evapotranspiration

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Potential evapotranspiration (PET) - sum of evaporation and plant transpiration from the Earth's land surface to atmosphere
Important related indices
Property: Frequency
Annual, every 2-3 months; monthly, daily
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Annual
Property: Basic spatial scale
Site, catchment
Property: Base Units

Mandatory meta data

Location, plot/area size, model tool reference

Method applied (key phrases)

From basic climate parameters, models, discharge weirs

Water Runoff gauge

e.g. Venturi flume, V-notch weir, Laser-Doppler

Method references: specific to sites, not internationally applied

Jakucs, P. (1985). Ecology of an oak forest in Hungary (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó

Method references: established, internationally applied

ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.57 W_output ⇨ Surface runoff

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Surface runoff
Important related indices
Property: Frequency
Annual, every 2-3 months; monthly, daily
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Annual
Property: Basic spatial scale
Site, catchment
Property: Base Units
Mandatory meta data

Location, plot/area size, model tool reference
Method applied (key phrases)
Water Runoff gauge e.g. Venturi flume, V-notch weir, Laser-Doppler
Method references: specific to sites, not internationally applied
Jakucs, P. (1985). Ecology of an oak forest in Hungary (I. K. Kecskés, Trans.). Budapest: Akadémiai Kiadó
Method references: established, internationally applied
ICP IM Programme Centre Finnish Environment Institute (Helsinki, F. (2003). Manual for Integrated Monitoring - Convention on Long-range Transboundary Air Pollution of the UNECE Available from http://www.ymparisto.fi/default.asp?node=6329&lan=en;

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.1.58 W_efficiency measures ⇨ Water balance

Definition of *W_efficiency measures*: *The water cycling affected by plant processes in the system.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Ratio transpiration / evaporation
Important related indices
Property: Frequency
Annual
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Annual
Property: Basic spatial scale
Plot/site
Property: Base Units
Mandatory meta data
Location, plot/area size, model tool reference
Method applied (key phrases)

Calculated/modelled
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

10.2 River Systems

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.1 Flora Diversity ⇨ Abundance of macrophytes (percentage cover) or phytobenthos

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Abundance of macrophytes (percentage cover) or phytobenthos
Important related indices
Shannon, Simpson, Species turn-over, Rarefaction curves, Phylogenetic diversity, Population growth rate, Eutrophication indicators e.g. ROTT
Property: Frequency
Annual
Property: Precision
Macrophytes with reference to Flora Europaea taxonomy, International Code of Botanical Nomenclature (Vienna Code), Rare species are important and should be included; Phytobenthos at least genus level
Property: Time scale (incl. seasonality), temporal resolution
Mostly summer. But in communities with strong seasonal gradients more than one sampling per year may be necessary (all species ocurring should be recorded). Phytobenthos: sampling after prolonged periods of low water is recommended to avoid atypical communities in areas of intermittent inundation
Property: Basic spatial scale
Macrophytes: sampling of min. 100m reach, representative for the site, coverage of all microhabitats;

Phytobenthos: sampling of min. 20m reach, representative for the site, coverage of all microhabitats;

Sampling effort relative to microhabitat coverage within sampled reach

Property: Base Units

%,

number

Mandatory meta data

Survey date, location, plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Macrophytes: Water Framework Directive-compliant vegetation relevee;

Phytobenthos: filamentous algae: estimate of percent coverage of each microhabitat, diatoms: at least 5 subsamples of approx. 100 cm² per reach, at least a pooled sample volume of 5ml sedimented Phytobenthos material; species detection at 1000-1500 magnification, determination of min. 400 diatoms per sample

Method references: specific to sites, not internationally applied

Schaumburg, J., Schranz, C., Foerster, J., Gutowski, A., Hofmann, G., Meilinger, P., et al. (2004). Ecological classification of macrophytes and phytobenthos for rivers in Germany according to the Water Framework Directive. Limnologica, 34(4), 283-301

Method references: established, internationally applied

European Commission Environment. The EU Water Framework Directive - integrated river basin management for Europe. from http://ec.europa.eu/environment/water/water-framework/index_en.html;

NS SHARE Project. (2005a). North South Shared Aquatic Resource (NS Share): Methods Manual I River Macrophytes. Retrieved from http://www.nsshare.com/publications/documents/Ecological%20Classification%20Tools/Methods%20Manuals%20T1/Methods%20Manual%20I%20%20River%20Macrophyte.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.2 Fauna Diversity ⇨ Macroinvertebrate abundances

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Abundance of macroinvertebrates
Important related indices
Shannon, Simpson, Species turn-over, Rarefaction curves, Phylogenetic diversity, Population growth rate; Indices indicating organic pollution and hydromorphological degradation (ASPT/Saprobic indices/Fauna Indices)
Property: Frequency
Annual
Property: Precision
Determination of taxa down to the lowest feasible taxonomic level, e.g. as proposed by the EU Water Framework Directive compliant 'Operational Taxa List' (species level, at least genus level)
Property: Time scale (incl. seasonality), temporal resolution
Spring/summer; depends on stream type and ecoregion
Property: Basic spatial scale
Macroinvertebrates: sampling of min. 100m reach, representative for the site, coverage of all microhabitats; Sampling effort relative to microhabitat coverage within sampled reach
Property: Base Units
Number

Mandatory meta data

Survey date, location, plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water Framework Directive-compliant sampling protocol

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

European Commission Environment. The EU Water Framework Directive - integrated river basin management for Europe. from http://ec.europa.eu/environment/water/water-framework/index_en.html;

Kestemont, P., & Goffaux, D. (2002). Metric Selection and Sampling Procedures for FAME (D 4 - 6), Final Report: Development, Evaluation & Implementation of a Standardised Fish-based Assessment Method for the Ecological Status of European Rivers - A Contribution to the Water Framework Directive (FAME)pp. 90). Available from http://fame.boku.ac.at/downloads/D4_6_metrics_and_sampling_procedure.pdf;

Sandin, L., Friberg, N., Furse, M., Clarke, R., & Larsen, S. (2004). Inter-calibration and harmonisation of "invertebrate methods", Standardisation of river classification: Framework method for calibrating different biological survey results against ecological classifications to be developed for the Water Framework Directivepp. 238). Available from http://www.eu-star.at/pdf/Deliverable8.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.3 Fauna Diversity ⇨ Fish: species list and abundances

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fish: species list and abundances
Important related indices
Shannon, Simpson, Species turn-over, Rarefaction curves, Phylogenetic diversity, Population growth rate; Indices indicating organic pollution and hydromorphological degradation, e.g. European Fish Index
Property: Frequency
Annual
Property: Precision
Species level
Property: Time scale (incl. seasonality), temporal resolution
Summer/fall; depends on stream type and ecoregion
Property: Basic spatial scale
Sampling of min. 200m reach (small stream), min 400m reach (large stream), coverage of all available microhabitats; Sampling effort relative to microhabitat coverage within sampled reach
Property: Base Units
Number
Mandatory meta data

Survey date, location, plot/area size, frequency of observations, biotope description, method reference, design of sampling
Method applied (key phrases)
Electrofishing: Water Framework Directive-compliant protocol
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Fame Consortium. (2004). Manual for the application of the European Fish Index - EFI, A fish-based method to assess the ecological status of european rivers in support of the Water Framework Directive - FAMEpp. 92). Available from http://fame.boku.ac.at/downloads/manual_Version_Februar2005.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.4 Invasive species ⇨ Proportion of invasive to non-native species

Definition of *Invasive species*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fauna & flora: Invasive species: (1) species numbers, (2) species abundance (e.g. related to native species)
Important related indices
Proportion of invasive/non-native species in a group
Property: Frequency
Monthly/yearly, depending on group
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point (depending on lake size many points)
Property: Base Units
%
Mandatory meta data
Survey date, location, plot/area size, frequency of observations, biotope description, method reference,

design of sampling
Method applied (key phrases)
Depends on taxon (macrophyte, phytobenthos, macroinvertebrate, fish)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.5 Soil ⇨ Sediment characterization

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Sediment: Granulometric fractions
Important related indices
Sediment substrate composition
Property: Frequency
After disturbance events/ yearly; Depending on river type, longer intervals may be sufficient
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Not very important
Property: Basic spatial scale
Generally three replicates per station
Property: Base Units
%, concentrations, …
Mandatory meta data
Survey date, location, plot/area size, frequency of observations, biotope description, method reference,

design of sampling
Method applied (key phrases)
Box corer
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.6 Soil ⇨ Sediment characterization

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Sediment: Proportion of organic contents
Important related indices
Sediment substrate composition
Property: Frequency
After disturbance events/ yearly; Depending on river type, longer intervals may be sufficient
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Not very important
Property: Basic spatial scale
Generally three replicates per station
Property: Base Units
%, concentrations, …
Mandatory meta data
Survey date, location, plot/area size, frequency of observations, biotope description, method reference,

design of sampling
Method applied (key phrases)
Box corer
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.7 Water ⇨ Water: physico-chemistry, hydrologic parameters

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Temperature
Important related indices
Daily/monthly/seasonal/annual means, maxima, minima, amplitudes
Property: Frequency
Ideal resolution: daily or higher measuring frequency.
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Depends on parameter, preferably SI units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Loggers
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
CP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.8 Water ⇨ Water: physico-chemistry, hydrologic parameters

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Turbidity
Important related indices
Daily/monthly/seasonal/annual means, maxima, minima, amplitudes
Property: Frequency
Ideal resolution: daily or higher measuring frequency.
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Depends on parameter, preferably SI units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Loggers
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
CP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.9 Water ⇨ Water: physico-chemistry, hydrologic parameters

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: (1) Conductivity, (2) pH)
Important related indices
Daily/monthly/seasonal/annual means, maxima, minima, amplitudes
Property: Frequency
Ideal resolution: daily or higher measuring frequency.
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Depends on parameter, preferably SI units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Loggers
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
CP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.10 Water ⇨ Water: physico-chemistry, hydrologic parameters

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Gauge level (or discharge)
Important related indices
Daily/monthly/seasonal/annual means, maxima, minima, amplitudes
Property: Frequency
Ideal resolution: daily or higher measuring frequency.
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Depends on parameter, preferably SI units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Loggers
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
CP Waters Programme Centre. (2010). ICP Waters Programme Manual 2010pp. 91). Available from http://www.icp-waters.no/LinkClick.aspx?fileticket=Sk4xcfQaPGo%3d&tabid=61

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.11 Air ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Air*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Air: Temperature
Important related indices
Wind fetch
Property: Frequency
Continuous/daily, for analysis these data can be used to calculate monthly/seasonla/annual means…
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Survey date, location, plot/area size, frequency of observations, biotope description, method reference,

design of sampling
Method applied (key phrases)
Automatic sampling devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.12 Air ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Air*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Air: (1) Wind direction, (2) Wind speed
Important related indices
Wind fetch
Property: Frequency
Continuous/daily, for analysis these data can be used to calculate monthly/seasonla/annual means…
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Survey date, location, plot/area size, frequency of observations, biotope description, method reference,

design of sampling
Method applied (key phrases)
Automatic sampling devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.13 Habitat ⇨ Habitat type diversity

Definition of *Habitat*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Habitat: Diversity and coverage of different microhabitat types
Important related indices
Shannon, Spatial diversity indices
Property: Frequency
Annually
Property: Precision
Field estimates, coverages can be reliably estimated on a 5% interval, microhabitat classification e.g. according to AQEM/STAR site protocol
Property: Time scale (incl. seasonality), temporal resolution
Annual, together with biotic sampling
Property: Basic spatial scale
Plot/stream reach
Property: Base Units
Mandatory meta data

Survey date, location, plot/area size, frequency of observations, biotope description, method reference, design of sampling
Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.14 Habitat ⇨ Hydromorphological intactness

Definition of *Habitat*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Hydromorphology of the stream reach
Important related indices
Property: Frequency
5-annually
Property: Precision
Hydromorphology can be classified according to AQEM/STAR site protocol (estimates in 5/10/20% steps, according to variable); land use is best assessed with CORINE land use data / GIS
Property: Time scale (incl. seasonality), temporal resolution
Uncritical, best together with biotic sampling
Property: Basic spatial scale
Site/landscape
Property: Base Units
Mandatory meta data
Survey date, location, plot/area size, frequency of observations, biotope description, method reference,

design of sampling

Method applied (key phrases)

Hydromorphology: WFD-compliant protocol (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0060:EN:NOT);

land use: CORINE/EUNIS land use/habitats;

EU Habitat Directive (connection to remote sensing)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.);

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.15 Habitat ⇨ Land use in catchment

Definition of *Habitat*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Coverage of land use classes (at least CORINE) in catchment
Important related indices
Property: Frequency
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.16 E_input ⇨ Radiation: total irradiance, PAR; Temperature: heat fluxes

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Water temperature, (2) radiation (direct, diffuse, PAR)
Important related indices
Temperature: daily/monthly/seasonal/annual means, maxima, minima, amplitudes
Property: Frequency
Ideal resolution for temperature: daily or higher measuring frequency;
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year (temperature); Summer (PAR)
Property: Basic spatial scale
Site
Property: Base Units
Diverse
Mandatory meta data

Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)

Temperature loggers, remote sensing

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Finnish Environment Institute. (2004). ICP IM manual - Methodology and Reporting of Subprogrammes. from http://www.ymparisto.fi/default.asp?node=6412&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual;

World Meterological Organization. (2008 (Updated in 2010)). Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). In W. M. Organization (Eds.) Available from http://www.wmo.int/pages/prog/www/IMOP/CIMO-Guide.html, http://www.wmo.int/pages/themes/wmoprod/guides.html

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.17 E_storage ⇨ Biomass

Definition of *E_storage*: *The capacity of an ecosystem to store nutrients, energy and water when available and to release them when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Biomass
Important related indices
Property: Frequency
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.18 E_storage ⇨ Nitrogen fixation

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nitrogen fixation
Important related indices
Property: Frequency
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.19 E_output ⇨ Albedo

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Albedo (diffuse reflectivity of a surface)
Important related indices
Property: Frequency
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.20 E_output ⇨ Respiration

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Respiration (production of carbon dioxide by living organisms)
Important related indices
Property: Frequency
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.21 E_output ⇨ Drift

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Drift
Important related indices
Property: Frequency
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.22 M_input ⇨ Suspended organic particles

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) Dissolved organic carbon (DOC), (2) particulate organic carbon (POC)
Important related indices
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.);

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.23 M_input ⇨ Nutrients (N)

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) total N, (2) NO3-N, NH4-N
Important related indices
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.);

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.24 M_input ⇨ Nutrients (P)

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) total P, (2) soluble reactive phosphorus (SPR)
Important related indices
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)

Devices

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.);

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.25 M_storage ⇨ Living biomass

Definition of *M_storage*: *The capacity of an ecosystem to store nutrients when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Biomass of phytobenthos, (2) Chlorophyll
Important related indices
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.26 M_storage ⇨ Living biomass

Definition of *M_storage*: *The capacity of an ecosystem to store nutrients when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Biomass of main groups of consumers (fish, benthic invertebrates, plankton in large rivers)
Important related indices
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope

description
Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.27 M_storage ⇨ Dead biomass

Definition of *M_storage*: *The capacity of an ecosystem to store nutrients when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Mass of organic sediments
Important related indices
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.28 M_output ⇨ Loss of suspended organic particles

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient output: (1) Dissolved organic carbon (DOC), (2) particulate organic carbon (POC)
Important related indices
Property: Frequency
Variable
Property: Precision
Variable
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope

description
Method applied (key phrases)
Drift rates: drift netting
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.29 M_output ⇨ Loss of nutrients (N)

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient output: (1) total N, (2) NO3-N, NH4-N
Important related indices
Property: Frequency
Variable
Property: Precision
Variable
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope

description
Method applied (key phrases)
Drift rates: drift netting
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.30 M_output ⇨ Loss of nutrients (P)

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient output: (1) total P, (2) soluble reactive phosphorus (SPR)
Important related indices
Property: Frequency
Variable
Property: Precision
Variable
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope

description
Method applied (key phrases)
Drift rates: drift netting
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.31 M_output ⇨ Drift rates, emergence data, harvesting

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Drift rates of benthic invertebrates
Important related indices
Property: Frequency
Variable
Property: Precision
Variable
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope

description
Method applied (key phrases)
Drift rates: drift netting
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.32 M_output ⇨ Drift rates, emergence data, harvesting

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fishing yields
Important related indices
Property: Frequency
Variable
Property: Precision
Variable
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope

description
Method applied (key phrases)
Drift rates: drift netting
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.33 M_output ⇨ Drift rates, emergence data, harvesting

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Biomass of emerging insects
Important related indices
Property: Frequency
Variable
Property: Precision
Variable
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Location, plot/area size that this measurement is representative for, frequency of observations, biotope

description
Method applied (key phrases)
Drift rates: drift netting
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.34 W_input ⇨ Precipitation

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Precipitation
Important related indices
Property: Frequency
Ideal resolution: daily or higher measuring frequency
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.35 W_input ⇨ Discharge upstream of monitored reach

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Discharge upstream of monitored reach
Important related indices
Property: Frequency
Ideal resolution: daily or higher measuring frequency
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.36 W_storage ⇨ Water retention, storage

Definition of *W_storage*: *The capacity of an ecosystem to store water when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water velocity or water retention time
Important related indices
Property: Frequency
Daily
Property: Precision
Instrumental or model
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
location, plot/area size that this measurement is representative for, frequency of observations, biotope description

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.37 W_output ⇨ Discharge at downstream end of monitored reach, evaporation

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Discharge at downstream end of monitored reach
Important related indices
Property: Frequency
Ideal resolution: daily or higher measuring frequency
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data

location, plot/area size that this measurement is representative for, frequency of observations, biotope description
Method applied (key phrases)
Devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.2.38 W_output ⇨ Discharge at downstream end of monitored reach, evaporation

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Evaporation
Important related indices
Property: Frequency
Ideal resolution: daily or higher measuring frequency
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data

location, plot/area size that this measurement is representative for, frequency of observations, biotope description
Method applied (key phrases)
Devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

10.3 Lake Systems

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.1 Flora Diversity ⇨ Flora diversity indices (taxonomic, functional) on primary producers

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Flora: Abundance of macrophytes (percentage cover)
Important related indices
See species richness measures in Base units column; Shannon
Property: Frequency
Once a year in the growth season
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point (small lakes); Large lakes: several sampling points to cover within-lake heterogeneities
Property: Base Units
Species richness: no. of species/lake

Species density: number of species/m2 km2 or m3

Rarefied species richness: e.g. number of species/100 or 1000 sampled individuals

% of biomass (% abundance of particular phytoplankton taxa)

mg/m3 (biomass of particular phytoplankton taxa)

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Vegetation relevees; Water column sampling, different levels (depths);

Consider collection with a pipe of integrated water sample from epilimnion/euphotic zone

Method references: specific to sites, not internationally applied

Ozimek, T., & Kowalczewski, A. (1984). Long-term changes of the submerged macrophytes in eutrophic lake Mikolajskie (North Poland). [Article]. Aquatic Botany, 19(1-2), 1-11;

Wellburn, A. R. (1994). The spectral determination of chlorophyll-a and chlorophyll-b, as well as total carotinoids, using various solvents with spectrophotometers of different resolution. Journal of Plant Physiology, 144(3), 307-313;

YSI Environmental. (2011). The Basics of Chlorophyll Measurement. from http://www.ysi.com/parametersdetail.php?Chlorophyll-6

Method references: established, internationally applied

CEN (European Committee for Standardization). (2006). EN 15204:2006; Water quality - Guidance standard on the enumeration of phytoplankton using inverted microscopy (Utermöhl technique);

CEN (European Committee for Standardization). (2007). EN 15460:2007; Water quality - Guidance standard for the surveying of macrophytes in lakes;

Cerny, M. (1999). MOLAR - MOuntain LAke Research - Measuring and Modelling the Dynamic Response of Remote Mountain Lake Ecosystems to Environmental Change. EU project no. ENV4-CT95-0007 from http://www.mountain-lakes.org/molar/;

MacIsaac, E. A., & Stockner, J. G. (1993). Enumeration of phototrophic picoplankton by autofluorescence microscopy. In P. F. Kemp, B. F. Sherr, E. B. Sherr & J. J. Cole (Eds.), Handbook of methods in aquatic microbial ecology (pp. 187-198). Boca Raton, Fla: Crc Pr Inc.;

Wetzel, R. G., & Likens, G. E. (1991). Limnological Analyses. New York: Springer

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.2 Flora Diversity ⇨ Flora diversity indices (taxonomic, functional) on primary producers

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Flora: Abundance of phythoplankton: biovolumes of (1) Cyanobacteria (particularly bloom-forming species; N2-fixers), (2) Bacillariophyceae, (3) Chlorophytes, (4) Dinoflagellates, (5) picopytoplankton
Important related indices
Property: Frequency
Phytoplankton and microphytobenthos (monthly or fortnightly).
Property: Precision
Up to species level, at least genus in (1)-(4); for picophytoplankton only total abundance and biovolume
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Hillebrand, H., Durselen, C. D., Kirschtel, D., Pollingher, U., & Zohary, T. (1999). Biovolume calculation for pelagic and benthic microalgae. Journal of Phycology, 35(2), 403-424

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.3 Fauna Diversity ⇨ Fauna diversity indices (taxonomic, functional)

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fauna: Species abundance of (1) rotifers, (2) crustacean zooplankton, (3) copepods
Important related indices
E.g. % Abundance of cyprinid fish, for other indices see Base units column; Shannon; Species richness: no. of species/lake; Species density: number of species/sampled area; Rarefied species richness: e.g. number of species/100 or 1000 sampled individuals; Percent (%) similarity to the model community (PMA, see important indices); Biomass g/m2; Percent model affinity. This index is based on model community comprising the communities of refence site i.e. the sites of pristine or near-natural conditions. Suitable for any group of organisms actually, need for comprising reference model community; Benthic Quality Index (Suitable for assessment of eutrophication and oxygen conditions of hypolimnial zone in Northern Europe.) The index is based on few profundal (deep bottom) macroinvertebrate taxa
Property: Frequency
Monthly / yearly, depending on group
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point (depending on lake size many points)
Property: Base Units

Species richness: no. of species/lake

Species density: number of species/m2 or km2

Rarefied species richness: e.g. number of species/100 or 1 000 sampled individuals

% of biomass (% abundance of particular taxa of interest)

mg/m3 (biomass of particular zooplankton taxa of interest)

Catch per unit of effort in gill-net fishing:

e.g. kg/gill-net/day or no. of ind./gill-net/day

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Fish relevees; Water column sampling, different levels (depths);

Consider collection with a pipe of integrated water sample from epilimnion/euphotic zone

Method references: specific to sites, not internationally applied

Bíró, P., Specziár, A., & Keresztessy, K. (2003). Diversity of fish species assemblages distributed in the drainage area of Lake Balaton (Hungary). Hydrobiologia, 506-509(1), 459-464;

Gerking, S. D. (1957). A Method of Sampling the Littoral Macrofauna and Its Application. Ecology, 38(2), 219-226;

Novak, M. A., & Bode, R. W. (1992). Percent Model Affinity: A New Measure of Macroinvertebrate Community Composition. Journal of the North American Benthological Society, 11(1), 80-85;

Parpală, L., G.-Tóth, L., Zinevici, V., Németh, P., & Szalontai, K. (2003). Structure and production of the metazoan zooplankton in Lake Balaton (Hungary) in summer. Hydrobiologia, 506-509(1), 347-351;

Tolonen, K. T., & Hamalainen, H. (2010). Comparison of sampling methods and habitat types for detecting impacts on lake littoral macroinvertebrate assemblages along a gradient of human disturbance. Fundamental and Applied Limnology / Archiv für Hydrobiologie, 176(1), 43-59;

Wiederholm, T. (1980). Use of Benthos in Lake Monitoring. Journal (Water Pollution Control Federation), 52(3), 537-547

Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.4 Fauna Diversity ⇨ Fauna diversity indices (taxonomic, functional)

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fauna: Species abundance of benthic invertebrates
Important related indices
E.g. % Abundance of cyprinid fish, for other indices see Base units column; Shannon; Species richness: no. of species/lake; Species density: number of species/sampled area; Rarefied species richness: e.g. number of species/100 or 1000 sampled individuals; Percent (%) similarity to the model community (PMA, see important indices); Biomass g/m2; Percent model affinity. This index is based on model community comprising the communities of refence site i.e. the sites of pristine or near-natural conditions. Suitable for any group of organisms actually, need for comprising reference model community; Benthic Quality Index (Suitable for assessment of eutrophication and oxygen conditions of hypolimnial zone in Northern Europe.) The index is based on few profundal (deep bottom) macroinvertebrate taxa
Property: Frequency
Monthly / yearly, depending on group
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point (depending on lake size many points)
Property: Base Units

Species richness: no. of species/lake

Species density: number of species/m2 or km2

Rarefied species richness: e.g. number of species/100 or 1 000 sampled individuals

% of biomass (% abundance of particular taxa of interest)

mg/m3 (biomass of particular zooplankton taxa of interest)

Catch per unit of effort in gill-net fishing:

e.g. kg/gill-net/day or no. of ind./gill-net/day

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Fish relevees; Water column sampling, different levels (depths);

Consider collection with a pipe of integrated water sample from epilimnion/euphotic zone

Method references: specific to sites, not internationally applied

Bíró, P., Specziár, A., & Keresztessy, K. (2003). Diversity of fish species assemblages distributed in the drainage area of Lake Balaton (Hungary). Hydrobiologia, 506-509(1), 459-464;

Gerking, S. D. (1957). A Method of Sampling the Littoral Macrofauna and Its Application. Ecology, 38(2), 219-226;

Novak, M. A., & Bode, R. W. (1992). Percent Model Affinity: A New Measure of Macroinvertebrate Community Composition. Journal of the North American Benthological Society, 11(1), 80-85;

Parpală, L., G.-Tóth, L., Zinevici, V., Németh, P., & Szalontai, K. (2003). Structure and production of the metazoan zooplankton in Lake Balaton (Hungary) in summer. Hydrobiologia, 506-509(1), 347-351;

Tolonen, K. T., & Hamalainen, H. (2010). Comparison of sampling methods and habitat types for detecting impacts on lake littoral macroinvertebrate assemblages along a gradient of human disturbance. Fundamental and Applied Limnology / Archiv für Hydrobiologie, 176(1), 43-59;

Wiederholm, T. (1980). Use of Benthos in Lake Monitoring. Journal (Water Pollution Control Federation), 52(3), 537-547

Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.5 Fauna Diversity ⇨ Fauna diversity indices (taxonomic, functional)

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fauna: Species abundance of fish
Important related indices
E.g. % Abundance of cyprinid fish, for other indices see Base units column; Shannon; Species richness: no. of species/lake; Species density: number of species/sampled area; Rarefied species richness: e.g. number of species/100 or 1000 sampled individuals; Percent (%) similarity to the model community (PMA, see important indices); Biomass g/m2; Percent model affinity. This index is based on model community comprising the communities of refence site i.e. the sites of pristine or near-natural conditions. Suitable for any group of organisms actually, need for comprising reference model community; Benthic Quality Index (Suitable for assessment of eutrophication and oxygen conditions of hypolimnial zone in Northern Europe.) The index is based on few profundal (deep bottom) macroinvertebrate taxa
Property: Frequency
Monthly/yearly, depending on group
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point (depending on lake size many points)
Property: Base Units

Species richness: no. of species/lake

Species density: number of species/m2 or km2

Rarefied species richness: e.g. number of species/100 or 1 000 sampled individuals

% of biomass (% abundance of particular taxa of interest)

mg/m3 (biomass of particular zooplankton taxa of interest)

Catch per unit of effort in gill-net fishing:

e.g. kg/gill-net/day or no. of ind./gill-net/day

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Fish relevees; Water column sampling, different levels (depths);

Consider collection with a pipe of integrated water sample from epilimnion/euphotic zone

Method references: specific to sites, not internationally applied

Bíró, P., Specziár, A., & Keresztessy, K. (2003). Diversity of fish species assemblages distributed in the drainage area of Lake Balaton (Hungary). Hydrobiologia, 506-509(1), 459-464;

Gerking, S. D. (1957). A Method of Sampling the Littoral Macrofauna and Its Application. Ecology, 38(2), 219-226;

Novak, M. A., & Bode, R. W. (1992). Percent Model Affinity: A New Measure of Macroinvertebrate Community Composition. Journal of the North American Benthological Society, 11(1), 80-85;

Parpală, L., G.-Tóth, L., Zinevici, V., Németh, P., & Szalontai, K. (2003). Structure and production of the metazoan zooplankton in Lake Balaton (Hungary) in summer. Hydrobiologia, 506-509(1), 347-351;

Tolonen, K. T., & Hamalainen, H. (2010). Comparison of sampling methods and habitat types for detecting impacts on lake littoral macroinvertebrate assemblages along a gradient of human disturbance. Fundamental and Applied Limnology / Archiv für Hydrobiologie, 176(1), 43-59;

Wiederholm, T. (1980). Use of Benthos in Lake Monitoring. Journal (Water Pollution Control Federation), 52(3), 537-547

Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.6 Invasive species ⇨ Proportion of invasive to non-native species

Definition of *Invasive species*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Flora & fauna: Invasive species numbers and abundances in relation to native species
Important related indices
Property: Frequency
Monthly/yearly, depending on group
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point (depending on lake size many points)
Property: Base Units
%
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Vegetation relevees; fish relevees; Water column sampling, different levels (depths); Consider collection with a pipe of integrated water sample from epilimnion/euphotic zone
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.7 Soil ⇨ Sediment: Particle size distribution

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Sediment: granulometric fractions
Important related indices
Sediment substrate composition
Property: Frequency
Yearly; Longer intervals may be sufficient
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Not very important
Property: Basic spatial scale
Generally three replicates per station
Property: Base Units
%, concentrations, …
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Box corer; Kajak-type circular corer is commonly used in lakes, at least in Nordic countries
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.8 Water ⇨ Seasonal/annual dynamics of temperature

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Temperature (from surface to the bottom)
Important related indices
Tpmix; C:P stochiometry; C:N stochiometry epilimnion thickness
Property: Frequency
Monthly /fortnightly
Property: Precision
High if profiling probes are used
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point measures (for large lakes several points are necessary). The best solution is to have the information of this parameters in the same point of the biotic indicators.
Property: Base Units
Oxygen saturation: % of the maximum Oxygen concentration: mg/l Nutrient concentrations: µg/l or mg/l

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water column sampling/ different levels (depths)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

CEN (European Committee for Standardization). (2004). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004);

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983);

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990);

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996);

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003);

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997);

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005);

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.;

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific;

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. Hydrobiologia, 506(1-3), 51-58

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.9 Water ⇨ Seasonal/annual dynamics of oxygen

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Oxygen (from surface to the bottom)
Important related indices
Tpmix; C:P stochiometry; C:N stochiometry epilimnion thickness
Property: Frequency
Monthly /fortnightly
Property: Precision
High if profiling probes are used
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point measures (for large lakes several points are necessary). The best solution is to have the information of this parameters in the same point of the biotic indicators.
Property: Base Units
Oxygen saturation: % of the maximum Oxygen concentration: mg/l Nutrient concentrations: µg/l or mg/l

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water column sampling/ different levels (depths)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

CEN (European Committee for Standardization). (2004). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004);

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983);

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990);

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996);

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003);

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997);

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005);

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.;

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific;

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. Hydrobiologia, 506(1-3), 51-58

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.10 Water ⇨ Seasonal/annual dynamics of salinity and conductivity

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Salinity and conductivity
Important related indices
Tpmix; C:P stochiometry; C:N stochiometry epilimnion thickness
Property: Frequency
Monthly /fortnightly
Property: Precision
High if profiling probes are used: temperature, oxygen, salinity and conductivity may be measured simultaneously using a multi-parameter probe
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point measures (for large lakes several points are necessary). The best solution is to have the information of this parameters in the same point of the biotic indicators.
Property: Base Units
Oxygen saturation: % of the maximum Oxygen concentration: mg/l Nutrient concentrations: µg/l or mg/l

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water column sampling/ different levels (depths)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

CEN (European Committee for Standardization). (2004). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004);

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983);

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990);

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996);

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003);

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997);

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005);

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.;

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific;

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. Hydrobiologia, 506(1-3), 51-58

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.11 Water ⇨ Seasonal/annual dynamics of turbidity

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Turbidity
Important related indices
Tpmix; C:P stochiometry; C:N stochiometry epilimnion thickness
Property: Frequency
Monthly /fortnightly
Property: Precision
Medium; depending on method used
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point measures (for large lakes several points are necessary). The best solution is to have the information of this parameters in the same point of the biotic indicators.
Property: Base Units
Oxygen saturation: % of the maximum Oxygen concentration: mg/l Nutrient concentrations: µg/l or mg/l

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water column sampling/ different levels (depths)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

CEN (European Committee for Standardization). (2004). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004);

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983);

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990);

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996);

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003);

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997);

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005);

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Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific;

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. Hydrobiologia, 506(1-3), 51-58

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.12 Water ⇨ Seasonal/annual dynamics of nutrients

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: Nutrient concentrations (total phosphor TP, total nitrogen TN, Si)
Important related indices
Tpmix; C:P stochiometry; C:N stochiometry epilimnion thickness
Property: Frequency
Monthly /fortnightly
Property: Precision
High, if autoanalyzer or Ion-exchange chromatography (SOP's) are used
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point measures (for large lakes several points are necessary). The best solution is to have the information of this parameters in the same point of the biotic indicators.
Property: Base Units
Oxygen saturation: % of the maximum Oxygen concentration: mg/l Nutrient concentrations: µg/l or mg/l

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water column sampling/ different levels (depths)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

CEN (European Committee for Standardization). (2004). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004);

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983);

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990);

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996);

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003);

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997);

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005);

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.;

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific;

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. Hydrobiologia, 506(1-3), 51-58

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.13 Water ⇨ Seasonal/annual dynamics of pH

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: pH
Important related indices
Tpmix; C:P stochiometry; C:N stochiometry epilimnion thickness
Property: Frequency
Monthly /fortnightly
Property: Precision
Medium
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point measures (for large lakes several points are necessary). The best solution is to have the information of this parameters in the same point of the biotic indicators.
Property: Base Units
Oxygen saturation: % of the maximum Oxygen concentration: mg/l Nutrient concentrations: µg/l or mg/l

Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water column sampling/ different levels (depths)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

CEN (European Committee for Standardization). (2004). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004);

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983);

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990);

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996);

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003);

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997);

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005);

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.;

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific;

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. Hydrobiologia, 506(1-3), 51-58

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.14 Water ⇨ Seasonal/annual dynamics of transparancy, water color

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water: (1) Secchi depth, (2) color (humic substances)
Important related indices
Tpmix; C:P stochiometry; C:N stochiometry epilimnion thickness
Property: Frequency
Monthly /fortnightly
Property: Precision
Medium
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
uffic
Property: Base Units
Oxygen saturation: % of the maximum Oxygen concentration: mg/l Nutrient concentrations: µg/l or mg/l
Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)

Water column sampling/ different levels (depths)

Method references: specific to sites, not internationally applied

ISE - CNR Water Chemistry Laboratory. (2012, 2012). Analytical methods from http://www.idrolab.ise.cnr.it/index.php?option=com_content&view=article&id=71&Itemid=59&lang=en

Method references: established, internationally applied

CEN (European Committee for Standardization). (2004). EN ISO 6878:2004; Water quality - Determination of phosphorus - Ammonium molybdate spectrometric method (ISO 6878:2004);

CEN (European Committee for Standardization). (1992a). EN 25813:1992; Water quality - Determination of dissolved oxygen - Iodometric method (ISO 5813:1983);

CEN (European Committee for Standardization). (1992b). EN 25814:1992; Water quality - Determination of dissolved oxygen - Electrotechnical probe method (ISO 5814:1990);

CEN (European Committee for Standardization). (1996). EN ISO 13395:1996; Water quality - Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection (ISO 13395:1996);

CEN (European Committee for Standardization). (2004b). EN ISO 15681-1:2004; Water quality - Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) - Part 1: Method by flow injection analysis (FIA) (ISO 15681-1:2003);

CEN (European Committee for Standardization). (1998). EN ISO 11905-1:1998; Water quality - Determination of nitrogen - Part 1: Method using oxidative digestion with peroxodisulfate (ISO 11905-1:1997);

CEN (European Committee for Standardization). (2005). EN ISO 11732:2005; Water quality - Determination of ammonium nitrogen - Method by flow analysis (CFA and FIA) and spectrometric detection (ISO 11732:2005);

Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.;

Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific;

Noges, P., Noges, T., Tuvikene, L., Smal, H., Ligeza, S., Kornijow, R., et al. (2003). Factors controlling hydrochemical and trophic state variables in 86 shallow lakes in Europe. Hydrobiologia, 506(1-3), 51-58

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.15 Air ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Air*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Air: Temperature
Important related indices
Wind fetch
Property: Frequency
Continuous/daily, for analysis these data can be used to calculate monthly/seasonal/annual means…
Property: Precision
Sufficient for calculations targeting at energy budget, heat flux etc.
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Automatic sampling devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.16 Air ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Air*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Air: (1) wind direction, (2) wind speed
Important related indices
Wind fetch
Property: Frequency
Continuous/daily, for analysis these data can be used to calculate monthly/seasonal/annual means…
Property: Precision
Sufficient for calculations targeting at energy input
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Site
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Automatic sampling devices
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.17 Habitat ⇨ Habitat type diversity and coverage

Definition of *Habitat*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Habitat: Coverage of different microhabitat types (e.g. proportion of littoral habitat types of the shoreline like stony, sandy, soft-organic bottom, vegetated)
Important related indices
Shannon; spatial diversity indices
Property: Frequency
Annually
Property: Precision
Field estimates, coverages can be reliably estimated on a 5% interval
Property: Time scale (incl. seasonality), temporal resolution
Annual, together with biotic sampling
Property: Basic spatial scale
Plot/whole lake
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.18 Habitat ⇨ Catchment: land use

Definition of *Habitat*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Coverage of land use classes (at least CORINE) in catchment
Important related indices
Property: Frequency
Annual
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.19 E_input ⇨ Temperature

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water temperature (redundant with Abiotic Heterogeneity parameter)
Important related indices
Temperature: daily/monthly/seasonal/annual means, maxima, minima, amplitudes
Property: Frequency
Daily
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year (temperature) summer (chl a)
Property: Basic spatial scale
Site
Property: Base Units
°C, etc.
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling

Method applied (key phrases)

Temperature loggers,

Remote sensing

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Finnish Environment Institute. (2004). ICP IM manual - Methodology and Reporting of Subprogrammes. from http://www.ymparisto.fi/default.asp?node=6412&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual;

WMO Observing and Information Systems Department. Instruments and Methods of Observation. from http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.20 E_input ⇨ Radiation

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Radiation (direct, diffuse, PAR)
Important related indices
Temperature: daily/monthly/seasonal/annual means, maxima, minima, amplitudes
Property: Frequency
Daily
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All year (temperature) summer (chl a)
Property: Basic spatial scale
Site
Property: Base Units
°C, etc.
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling

Method applied (key phrases)

Temperature loggers,

Remote sensing

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Finnish Environment Institute. (2004). ICP IM manual - Methodology and Reporting of Subprogrammes. from http://www.ymparisto.fi/default.asp?node=6412&lan=en;

UNECE (United Nations Economic Commission for Europe). (2010). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) Available from http://icp-forests.net/page/icp-forests-manual;

WMO Observing and Information Systems Department. Instruments and Methods of Observation. from http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.21 E_storage ⇨ Biomass, Chlorophyll

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Chlorophyll a, (2) biomass of phytoplankton etc. (estimated from cell volume and abundance) [redundant with Flora Diversity parameter]
Important related indices
Property: Frequency
Monthly /fortnightly
Property: Precision
METHOD NEEDS TO BE SPECIFIED for Accuracy assessment!
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Station
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.22 E_output ⇨ Light reflection

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Albedo (diffuse reflectivity of a surface)
Important related indices
Property: Frequency
Yearly
Property: Precision
Estimation
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Model
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.23 E_output ⇨ Respiration

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Respiration (production of carbon dioxide by living organisms)
Important related indices
Property: Frequency
Yearly
Property: Precision
medium; depending on quality of oxygen sensor
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Model
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.24 E_output ⇨ Heat fluxes

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Heat fluxes
Important related indices
Property: Frequency
Yearly
Property: Precision
Estimation
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data

Method applied (key phrases)
Model
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.25 M_input ⇨ Nutrient inputs via precipitation, run-off

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) Dissolved organic carbon (DOC), (2) particulate organic carbon (POC)
Important related indices
Stoichiometric ratios
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.); Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.26 M_input ⇨ Nutrient inputs via precipitation, run-off

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) Total N, (2) NO3-N, NH4-N
Important related indices
Stoichiometric ratios
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.); Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.27 M_input ⇨ Nutrient inputs via precipitation, run-off

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) Total P, (2) soluble reactive phosphorus (SPR)
Important related indices
Stoichiometric ratios
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Clesceris, L. S., Greenberg, A. E., & Eaton, A. D. (1999). Standard Methods for Examination of Water & Wastewater (20 ed.); Golterman, H. L., Clymo, R. S., & Ohnstad, A. M. (1978). Methods for physical and chemical analysis of fresh waters: Blackwell Scientific

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.28 M_storage ⇨ Living biomass

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Biomass
Important related indices
Average POC
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.29 M_storage ⇨ Biologically available carbon in water and sediments

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) DOC, (2) POC
Important related indices
Average POC
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.30 M_storage ⇨ Nitrogen in water and sediments

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) total N, (2) NO3-N, NH4-N [split into biomass and other parameters]
Important related indices
Average POC
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.31 M_storage ⇨ Phosphorus in water and sediments

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) total P, (2) soluble reactive phosphorus (SPR)
Important related indices
Average POC
Property: Frequency
Monthly
Property: Precision
Instrumental
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Point/plot measurement
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Water column sampling, different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.32 M_output ⇨ Sedimentation

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Sediment mass and contents
Important related indices
Sedimentation rate
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Point / plot / whole lake
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Sediment traps integrated measure for unit area
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.33 M_output ⇨ Outflow

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: DOC, POC etc in outflow
Important related indices
Sedimentation rate
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Point / plot / whole lake
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Sediment traps integrated measure for unit area
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.34 M_output ⇨ Harvesting

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fishing yields
Important related indices
Sedimentation rate
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Point / plot / whole lake
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Sediment traps integrated measure for unit area
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.35 M_output ⇨ Outflow

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Biomass of emerging insects
Important related indices
Sedimentation rate
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Point / plot / whole lake
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Sediment traps integrated measure for unit area
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.36 M_efficiency measures ⇨ Trophic transfer efficency

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Primary consumers (kg C/ha/year)/primary production (kg C/ha/year), (2) Carbon content of primary consumers/Carbon content of primary consumers
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Plot
Property: Base Units
Mandatory meta data

Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling
Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.37 M_efficiency measures ⇨ Trophic transfer efficency

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Ratio of secondary consumers/production of primary consumers
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Plot
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.38 M_efficiency measures ⇨ Matter breakdown rates

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Leaf litter breakdown (experimental)
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Plot
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.39 M_efficiency measures ⇨ Production to biomass ratio

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Ratios of primary production (kg C/ha/year) / total living biomass (kg C/ha)
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Plot
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.40 W_input ⇨ Precipitation

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Precipitation
Important related indices
Property: Frequency
Daily
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.41 W_input ⇨ Catchment input

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Discharge of inflowing streams
Important related indices
Property: Frequency
Daily
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.42 W_input ⇨ Catchment input

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Groundwater inflow
Important related indices
Property: Frequency
Daily
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.43 W_storage ⇨ Water level

Definition of *W_storage*: *The capacity of an ecosystem to store water when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water level
Important related indices
Property: Frequency
Daily/weekly
Property: Precision
Measurement
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
cm
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope description, method reference, design of sampling

Method applied (key phrases)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.44 W_output ⇨ Outflow

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Discharge of outflowing stream
Important related indices
Annual outflow, residence time
Property: Frequency
Daily/weekly
Property: Precision
Measurement/Estimation
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Measurement/ model
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.3.45 W_output ⇨ Evaporation

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Evaporation
Important related indices
Annual outflow, residence time
Property: Frequency
Daily/weekly
Property: Precision
Measurement/Estimation
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
Mandatory meta data
Survey date, location (latitude, longitude and depth), plot/area size, frequency of observations, biotope

description, method reference, design of sampling
Method applied (key phrases)
Measurement/ model
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

10.4 Marine Systems

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.1 Flora Diversity ⇨ List of species, diversity indices

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Phytoplankton: Species richness of Bacillariophyceae, Prymnesiophyceae, Dinoflagellates, Nanoflagellates, Cyanobacteria
Important related indices
Shannon, Hulburt, Margalef, Menhinick
Property: Frequency
Phytoplankton: monthly/fortnightly
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station for phytoplankton, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
Phytoplankton: cells l-1 (abundance), mg C l-1 (biomass).
Mandatory meta data

Phytoplankton: survey date and time, location, site depth, sampling depths, frequency of observations, method reference.

Method applied (key phrases)

Water column sampling (Niskin bottles), different levels (depths) for phytoplankton;

Net samples collected at the same dates;

Macrophytes: transect mapping, for microphytobenthos selected sites along the transect, representative for the respective substrate available at the depth stages

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Intergovernmental Oceanographic Commission of UNESCO. (2010). Microscopic and molecular methods for quantitative phytoplankton analysis. In B. Karlson, C. Cusack & E. Bresnan (Eds.)pp. 110). Available from http://www.mbari.org/ESP/pdfs/Marin%20and%20Scholin_2010.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.2 Flora Diversity ⇨ Absolute and relative abundance, diversity indices

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Phytoplankton: Abundance (total, %) and biomass of Bacillariophyceae, Prymnesiophyceae, Dinoflagellates, Nanoflagellates, Cyanobacteria
Important related indices
Shannon, Hulburt, Margalef, Menhinick
Property: Frequency
Phytoplankton: monthly/fortnightly
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station for phytoplankton, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
Phytoplankton: cells l-1 (abundance), mg C l-1 (biomass).

Mandatory meta data

Phytoplankton: survey date and time, location, site depth, sampling depths, frequency of observations, method reference.

Method applied (key phrases)

Water column sampling (Niskin bottles), different levels (depths) for phytoplankton;

Net samples collected at the same dates;

Macrophytes: transect mapping, for microphytobenthos selected sites along the transect, representative for the respective substrate available at the depth stages

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Hillebrand, H., Durselen, C. D., Kirschtel, D., Pollingher, U., & Zohary, T. (1999). Biovolume calculation for pelagic and benthic microalgae. Journal of Phycology, 35(2), 403-424;

Intergovernmental Oceanographic Commission of UNESCO. (2010). Microscopic and molecular methods for quantitative phytoplankton analysis. In B. Karlson, C. Cusack & E. Bresnan (Eds.)pp. 110). Available from http://www.mbari.org/ESP/pdfs/Marin%20and%20Scholin_2010.pdf

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.3 Flora Diversity ⇨ Seagrasses: number of species and abundance

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Seagrasses: (1) presence, (2) cover, (3) shoot density
Important related indices
Seagrasses: density classes and G/N for genetic diversity. Epiphytes: Shannon-Wiener, R/O
Property: Frequency
Seagrass density: once in a year Seasonal for the other parameters
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Several sampling stations according to the depth gradient
Property: Base Units
Seagrass: density = no. of shoots m-2 Macroepiphytes: cover = % of leaf area. Diatoms: no. of cells in 1.25 mm².

Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Seagrasses: shoot density. 10 shoot counts are performed by trained operators each within 1600cm2 quadrats; mean value is reported to 1 squre meter.

Macroalgal epiphytes: 20 shoots are sampled in areas of the meadow with homogeneous characteristics. The covering of individual species or of groups of species is assessed in terms of leaf area covered by the orthogonal projection of the alga onto the leaf.

Microepiphytes: 5 shoots are sampled, 3 fragments of 1 cm2 in the basal, central and distal part of the blade are selected and a total surface of 1.25 mm2 is observed by SEM. Genomic DNA is extracted from each single shoot

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.4 Flora Diversity ⇨ Seagrasses: Genetic diversity

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Seagrasses: Genetic diversity
Important related indices
Seagrasses: density classes and G/N for genetic diversity. Epiphytes: Shannon-Wiener, R/O
Property: Frequency
Seagrass density: once in a year Seasonal for the other parameters
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Several sampling stations according to the depth gradient
Property: Base Units
Seagrass: density = no. of shoots m-2 Macroepiphytes: cover = % of leaf area. Diatoms: no. of cells in 1.25 mm².

Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Seagrasses: shoot density. 10 shoot counts are performed by trained operators each within 1600cm2 quadrats; mean value is reported to 1 squre meter.

Macroalgal epiphytes: 20 shoots are sampled in areas of the meadow with homogeneous characteristics. The covering of individual species or of groups of species is assessed in terms of leaf area covered by the orthogonal projection of the alga onto the leaf.

Microepiphytes: 5 shoots are sampled, 3 fragments of 1 cm2 in the basal, central and distal part of the blade are selected and a total surface of 1.25 mm2 is observed by SEM. Genomic DNA is extracted from each single shoot

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.5 Flora Diversity ⇨ Macro and microphytobenthos

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Macro and microphytobenthos: presence and cover of Rhodophyta, Ochrophyta, Chlorophyta, R/O, Diatoms
Important related indices
Seagrasses: density classes and G/N for genetic diversity; Epiphytes: Shannon-Wiener, R/O
Property: Frequency
Seagrass density: once in a year Seasonal for the other parameters
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Several sampling stations according to the depth gradient
Property: Base Units
Seagrass: density = no. of shoots m-2 Macroepiphytes: cover = % of leaf area.

Diatoms: no. of cells in 1.25 mm².

Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Seagrasses: shoot density. 10 shoot counts are performed by trained operators each within 1600cm2 quadrats; mean value is reported to 1 squre meter.

Macroalgal epiphytes: 20 shoots are sampled in areas of the meadow with homogeneous characteristics. The covering of individual species or of groups of species is assessed in terms of leaf area covered by the orthogonal projection of the alga onto the leaf.

Microepiphytes: 5 shoots are sampled, 3 fragments of 1 cm2 in the basal, central and distal part of the blade are selected and a total surface of 1.25 mm2 is observed by SEM. Genomic DNA is extracted from each single shoot

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.6 Flora Diversity ⇨ Macro and microphytobenthos

Definition of *Flora Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Macro and microphytobenthos: Morpho-functional groups
Important related indices
Seagrasses: density classes and G/N for genetic diversity; Epiphytes: Shannon-Wiener, R/O
Property: Frequency
Seagrass density: once in a year Seasonal for the other parameters
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Several sampling stations according to the depth gradient
Property: Base Units
Seagrass: density = no. of shoots m-2 Macroepiphytes: cover = % of leaf area. Diatoms: no. of cells in 1.25 mm².

Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Seagrasses: shoot density. 10 shoot counts are performed by trained operators each within 1600cm2 quadrats; mean value is reported to 1 squre meter.

Macroalgal epiphytes: 20 shoots are sampled in areas of the meadow with homogeneous characteristics. The covering of individual species or of groups of species is assessed in terms of leaf area covered by the orthogonal projection of the alga onto the leaf.

Microepiphytes: 5 shoots are sampled, 3 fragments of 1 cm2 in the basal, central and distal part of the blade are selected and a total surface of 1.25 mm2 is observed by SEM. Genomic DNA is extracted from each single shoot

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.7 Fauna Diversity ⇨ Micro and mesozooplankton: List of species, diversity indices

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Micro and mesozooplankton: species richness
Important related indices
Shannon, Margalef, Pielou, Simpson
Property: Frequency
Zooplankton: monthly / fortnightly As above for macrozoobenthos, Nekton needs to be investigated by a different approach, it cannot be taken at "points" and recruitement as well as population age structure must be taken into account
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station for zooplankton, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
Zooplankton: ind m-3

Mandatory meta data

Zooplankton: survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Mesozooplankton: integrated water column net sampling;

Microzooplankton: discrete sampling

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICES Zooplankton Methodology Manual. (2000). In R. Harris, P. Wiebe, J. Lenz, H.-R. Skjoldal & M. Huntley (Eds.) Available from http://www.sciencedirect.com/science/book/9780123276452

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.8 Fauna Diversity ⇨ Micro and mesozooplankton: abundance, diversity indices

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Micro and mesozooplankton: abundance
Important related indices
Shannon, Margalef, Pielou, Simpson
Property: Frequency
Zooplankton: monthly / fortnightly As above for macrozoobenthos, Nekton needs to be investigated by a different approach, it cannot be taken at "points" and recruitement as well as population age structure must be taken into account
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station for zooplankton, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
Zooplankton: ind m-3

Mandatory meta data

Zooplankton: survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Mesozooplankton: integrated water column net sampling;

Microzooplankton: discrete sampling

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

ICES Zooplankton Methodology Manual. (2000). In R. Harris, P. Wiebe, J. Lenz, H.-R. Skjoldal & M. Huntley (Eds.) Available from http://www.sciencedirect.com/science/book/9780123276452

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.9 Fauna Diversity ⇨ Fauna: List of species, diversity indices

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Species list of selected groups within Annelida, Mollusca, Crustacea
Important related indices
Shannon-Wiener, Equitability, Index of Borers (IB)
Property: Frequency
Seasonal
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Several sampling stations along the depth gradient of the seagrass bed
Property: Base Units
Ind m-2
Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

The sampling of the motile macro-invertebrates is conducted with a quantitative method: a suction device (air lift) in a fixed standardized area (1m2). A semi-quantitative method is represented by the hand-towed net but it has to be used on largewr areas.

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.10 Fauna Diversity ⇨ Fauna: abundance, diversity indices

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Abundance of selected groups within Annelida, Mollusca, Crustacea
Important related indices
Shannon-Wiener, Equitability, Index of Borers (IB)
Property: Frequency
Seasonal
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Several sampling stations along the depth gradient of the seagrass bed
Property: Base Units
Ind m-2
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

The sampling of the motile macro-invertebrates is conducted with a quantitative method: a suction device (air lift) in a fixed standardized area (1m2). A semi-quantitative method is represented by the hand-towed net but it has to be used on largewr areas.

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.11 Fauna Diversity ⇨ Fish: List of species, abundance, diversity indices

Definition of *Fauna Diversity*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Abundance: Fish
Important related indices
Shannon-Wiener, Equitability, Index of Borers (IB)
Property: Frequency
Seasonal
Property: Precision
Up to species level, at least genus
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Several sampling stations along the depth gradient of the seagrass bed
Property: Base Units
Ind m-2
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

The sampling of the motile macro-invertebrates is conducted with a quantitative method: a suction device (air lift) in a fixed standardized area (1m2). A semi-quantitative method is represented by the hand-towed net but it has to be used on largewr areas.

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.12 Within Habitat Structure ⇨ Habitat builders

Definition of *Within Habitat Structure*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Habitat builders: Seagrass: (1) shoot density, (2) biomass, (3) leaf standing crop, (4) leaf formation and senescence, (5) flowering
Important related indices
Density classes, plastochrone intervals, Co A
Property: Frequency
Annual, seasonal and monthly
Property: Precision
Shoot density and LSC: measures are performed in 1600 cm2 areas
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Shoot density: ten random replicates for each sampling depth. Plant biomass and phenology: 20 random replicates for sampling depth.
Property: Base Units
No. of shoots m-2 for density; grams per m-2 for LSC

Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Density: 10 shoot counts are performed by trained operators each within 1600cm2 quadrats; the mean value is reported to 1 m².

LSC: 20 shoots are collected, dried and weighed to gram, the mean dw per shoot is multiplied for the mean density m-2.

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Biotic Diversity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.13 Within community structure ⇨ Structure of plankton compartment

Definition of *Within community structure*: *The presence and absence of selected species, (functional) groups of species, biotic habitat components or species composition.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Structure of the whole plankton compartment: abundance and biomass of each plankton compartment
Important related indices
Autotrophic/heterotrophic ratio
Property: Frequency
Monthly/fortnightly
Property: Precision
Up to pico level, all the size fractions of both auto and heterotrophic components
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
Cells l-1 (abundance), mg C l-1 (biomass).
Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)

Water column sampling (Niskin bottles), different levels (depths)

Method references: specific to sites, not internationally applied

Krause-Jensen, D., Sagert, S., Schubert, H., & Bostrom, C. (2008). Empirical relationships linking distribution and abundance of marine vegetation to eutrophication. [Review]. Ecological Indicators, 8(5), 515-529;

Steinhardt, T., Karez, R., Selig, U., & S

Method references: established, internationally applied

Orfanidis, S., Panayotidis, P., & Stamatis, N. (2001). Ecological evaluation of transitional and coastal waters: A marine benthic macrophytes-based model. Mediterranean Marine Science, 2(2), 20

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.14 Soil ⇨ Sediment characterization

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: SEDIMENT: (1) Porosity (water content), (2) density
Important related indices
Granulometry
Property: Frequency
Yearly
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
oOne
Property: Basic spatial scale
Generally two replicates per station
Property: Base Units
% in weighth of each grain size fraction (measured in phi)
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)
Corer or just a box-corer in case of sandy bottom, for hard bottom mapping is necessary anyway
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.15 Soil ⇨ Sediment characterization

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: SEDIMENT: Colour of sediments
Important related indices
Granulometry
Property: Frequency
Yearly
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
oOne
Property: Basic spatial scale
Generally two replicates per station
Property: Base Units
% in weighth of each grain size fraction (measured in phi)
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)
Corer or just a box-corer in case of sandy bottom, for hard bottom mapping is necessary anyway
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.16 Soil ⇨ Sediment characterization

Definition of *Soil*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: SEDIMENT: Granulometric fractions (% in weight of each grain size fraction)
Important related indices
Granulometry
Property: Frequency
Yearly
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Generally 3 replicates per sampling site
Property: Base Units
% in weighth of each grain size fraction (measured in phi)
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)
Hand corers
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Lorenti, M., & De Falco, G. (2004). Measurement and characterization of abiotic variables Biologica Marina Mediterranea (Vol. 11, pp. 38)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.17 Water ⇨ Water: Temperature

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: WATER: Temperature
Important related indices
Water density, Brunt-Vasala frequency, Oxygen % saturation
Property: Frequency
Monthly
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station , considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
International Standard Units
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference

Method applied (key phrases)

Water column sampling (Niskin bottles), different levels (depths) and or CTD probes

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Hansen, H. P., & Koroleff, F. (2007). Determination of nutrients. In K. Grasshoff, K. Kremling & M. Ehrhardt (Eds.), Methods of Seawater Analysis (3. ed.). Weinheim: Wiley-VCH Verlag GmbH;

Strickland, J. D., & Parsons, T. R. (1972). A manual of seawater analysis. Canada Fisheries Research Board Bulletin

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.18 Water ⇨ Water: Salinity

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: WATER: Salinity
Important related indices
Water density, Brunt-Vasala frequency, Oxygen % saturation
Property: Frequency
Monthly
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station , considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
International Standard Units
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference

Method applied (key phrases)

Water column sampling (Niskin bottles), different levels (depths) and or CTD probes

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Hansen, H. P., & Koroleff, F. (2007). Determination of nutrients. In K. Grasshoff, K. Kremling & M. Ehrhardt (Eds.), Methods of Seawater Analysis (3. ed.). Weinheim: Wiley-VCH Verlag GmbH;

Strickland, J. D., & Parsons, T. R. (1972). A manual of seawater analysis. Canada Fisheries Research Board Bulletin

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.19 Water ⇨ Water: (1) Oxygen, (2) pH

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: WATER: (1) Oxygen, (2) pH
Important related indices
Water density, Brunt-Vasala frequency, Oxygen % saturation
Property: Frequency
Monthly
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station , considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
International Standard Units
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference

Method applied (key phrases)

Water column sampling (Niskin bottles), different levels (depths) and or CTD probes

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Hansen, H. P., & Koroleff, F. (2007). Determination of nutrients. In K. Grasshoff, K. Kremling & M. Ehrhardt (Eds.), Methods of Seawater Analysis (3. ed.). Weinheim: Wiley-VCH Verlag GmbH;

Strickland, J. D., & Parsons, T. R. (1972). A manual of seawater analysis. Canada Fisheries Research Board Bulletin

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.20 Water ⇨ Water: Transparency

Definition of *Water*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: WATER: (1) Secchi depth, (2) light extinction coefficient, (3) euphotic depth
Important related indices
Property: Frequency
Fortnightly / weekly
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point
Property: Base Units
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method reference

Method applied (key phrases)
Underwater measurement of photosynthetically active radiation; Secchi disk visibility or photometer
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
ISO (International Organization for Standardization). (1999). ISO 7027:1999; Water quality -- Determination of turbidity (pp. 10)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.21 Air ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Air*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: AIR: Temperature
Important related indices
Temperature wind speed
Property: Frequency
Continuous/daily
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
International Standard Units
Mandatory meta data

Date, Time, location, elevation, method reference
Method applied (key phrases)
Meteo stations
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Structures* ⇨ *Abiotic Heterogeneity*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.22 Air ⇨ Basic climate of the site (ranges, interannual variability, extremes, etc.)

Definition of *Air*: *The capacity of an ecosystem to provide suitable habitats for different species, for functional groups of species and for processes. This is essential for the functioning of ecosystems.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: AIR: Wind speed and direction
Important related indices
Temperature wind speed
Property: Frequency
Continuous/daily
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
Continuous/daily
Property: Basic spatial scale
Site
Property: Base Units
International Standard Units
Mandatory meta data

Date, Time, location, elevation, method reference
Method applied (key phrases)
Meteo stations
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.23 E_input ⇨ Total irradiance

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Water temperature
Important related indices
Surface irradiance/depth irradiance
Property: Frequency
Continuous/daily
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
International Standard Units
Mandatory meta data

Date, Time, location, elevation, method reference
Method applied (key phrases)
Meteo stations and in situ automatic continuous measurements
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.24 E_input ⇨ Total irradiance

Definition of *E_input*: *The capacity of ecosystems to enhance the input of usable energy. The term "exergy" is derived from thermodynamics and measures the energy fraction that can be transformed into mechanical work. In ecosystems, the captured exergy is used to build up biomas*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Radiation (direct, diffuse, PAR)
Important related indices
Surface irradiance/depth irradiance
Property: Frequency
Continuous/daily
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
International Standard Units
Mandatory meta data

Date, Time, location, elevation, method reference
Method applied (key phrases)
Meteo stations and in situ automatic continuous measurements
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.25 E_storage ⇨ Primary production (seagrass)

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Seagrass: (1) leaf elongation, (2) leaf production, (3) photosynthetical active leaf area, (4) P/E relationships
Important related indices
LAI
Property: Frequency
Monthly
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Local
Property: Base Units
mm/shoot/day, mg/shoot/day, m2/m2
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference

Method applied (key phrases)

Leaf punching method has been used to valuate the plant production.

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Buia, M. C., Gambi, M., & Dappiano, M. (2004). Seagrass Systems Biologia Marina Mediterranea (Vol. 11, pp. 133-183);

Lopez y Royo, C., Pergent, G., Alcoverro, T., Buia, M. C., Casazza, G., Martínez-Crego, B., et al. (2010). The seagrass Posidonia oceanica as indicator of coastal water quality: Experimental intercalibration of classification systems. Ecological Indicators, 7

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.26 E_storage ⇨ Biomass

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Chlorophyll a
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C l-1, mg Chl l-1
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water column sampling , different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.27 E_storage ⇨ Biomass

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Phytoplankton biomass, (2) zooplankton biomass
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C l-1, mg Chl l-1
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water column sampling , different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.28 E_storage ⇨ Organic matter

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Dissolved organic matter (DOM), (2) particulate organic matter (POM)
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C l-1, mg Chl l-1
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water column sampling , different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.29 E_storage ⇨ Biomass

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Macrophytes: (1) Leaf biomass, (2) rhizome biomass
Important related indices
Property: Frequency
Monthly and seasonal
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Local
Property: Base Units
Gram per shoot, mg per shoot; Nitrogen content: percent of dry weight of leaf tissue
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Shoot are sampled at different depths, freeze-dried and ground to fine powder in an analytical mill. Subsamplesof 2–3 mg were analyzed for total N.
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Lorenti, M., & De Falco, G. (2004). Measurement and characterization of abiotic variables Biologica Marina Mediterranea (Vol. 11, pp. 38)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.30 E_storage ⇨ Biomass

Definition of *E_storage*: *The capacity of an ecosystem to store energy when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Macrophytes: Epiphyte biomass
Important related indices
Property: Frequency
Monthly and seasonal
Property: Precision
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Local
Property: Base Units
Gram per shoot, mg per shoot; Nitrogen content: percent of dry weight of leaf tissue
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Shoot are sampled at different depths, freeze-dried and ground to fine powder in an analytical mill. Subsamplesof 2–3 mg were analyzed for total N.
Method references: specific to sites, not internationally applied
Method references: established, internationally applied
Lorenti, M., & De Falco, G. (2004). Measurement and characterization of abiotic variables Biologica Marina Mediterranea (Vol. 11, pp. 38)

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.31 E_output ⇨ Reflectivity

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Albedo (diffuse reflectivity of a surface)
Important related indices
Property: Frequency
Seasonal
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C l-1-h
Mandatory meta data
Date, Time, location, elevation, method reference

Method applied (key phrases)

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Carpente, J. H. (1966). New measurements of oxygen solubility in pure and natural water. Limnology and Oceanography, 11(2), 264-&;

Kirchman, D., Knees, E., & Hodson, R. (1985). Leucine incorporation and its potential as a measure of protein-synthesis by bacteria in natural aquatic systems. [Article]. Applied and Environmental Microbiology, 49(3), 599-607;

Robinson, C., & Williams, P. l. B. (2005). Respiration and its measurement in surface marine waters. In P. A. del Giorgio & P. l. B. Williams (Eds.), Respiration in Aquatic Ecosystems (pp. 147-180). Oxford (UK): Oxford University Press;

Winkler, W., Beyer, J., & Gnauck, A. (1980). Improvement of the accuracy of prediction of stochastic models of the oxygen concentration in flowing waters. [Article]. Acta Hydrochimica Et Hydrobiologica, 8(1), 107-110

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.32 E_output ⇨ Respiration

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Respiration (production of carbon dioxide by living organisms)
Important related indices
Property: Frequency
Seasonal
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C l-1-h
Mandatory meta data
Date, Time, location, elevation, method reference

Method applied (key phrases)

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Carpente, J. H. (1966). New measurements of oxygen solubility in pure and natural water. Limnology and Oceanography, 11(2), 264-&;

Kirchman, D., Knees, E., & Hodson, R. (1985). Leucine incorporation and its potential as a measure of protein-synthesis by bacteria in natural aquatic systems. [Article]. Applied and Environmental Microbiology, 49(3), 599-607;

Robinson, C., & Williams, P. l. B. (2005). Respiration and its measurement in surface marine waters. In P. A. del Giorgio & P. l. B. Williams (Eds.), Respiration in Aquatic Ecosystems (pp. 147-180). Oxford (UK): Oxford University Press;

Winkler, W., Beyer, J., & Gnauck, A. (1980). Improvement of the accuracy of prediction of stochastic models of the oxygen concentration in flowing waters. [Article]. Acta Hydrochimica Et Hydrobiologica, 8(1), 107-110

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Energy Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.33 E_output ⇨ Heat fluxes

Definition of *E_output*: *Non-convertible energy fractions which are exported into the environment of the system*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Heat fluxes
Important related indices
Property: Frequency
Seasonal
Property: Precision
See methods
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C l-1-h
Mandatory meta data
Date, Time, location, elevation, method reference

Method applied (key phrases)

Method references: specific to sites, not internationally applied

Method references: established, internationally applied

Carpente, J. H. (1966). New measurements of oxygen solubility in pure and natural water. Limnology and Oceanography, 11(2), 264-&;

Kirchman, D., Knees, E., & Hodson, R. (1985). Leucine incorporation and its potential as a measure of protein-synthesis by bacteria in natural aquatic systems. [Article]. Applied and Environmental Microbiology, 49(3), 599-607;

Robinson, C., & Williams, P. l. B. (2005). Respiration and its measurement in surface marine waters. In P. A. del Giorgio & P. l. B. Williams (Eds.), Respiration in Aquatic Ecosystems (pp. 147-180). Oxford (UK): Oxford University Press;

Winkler, W., Beyer, J., & Gnauck, A. (1980). Improvement of the accuracy of prediction of stochastic models of the oxygen concentration in flowing waters. [Article]. Acta Hydrochimica Et Hydrobiologica, 8(1), 107-110

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.34 M_input ⇨ Nutrients (input fluxes (rivers, atmospheric deposition)

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) total N, (2) NO3-N, NH4-N
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, representative of the loads actually coming from the watershed to the ecosystem
Property: Base Units
tons/years
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water sampling devices (e.g Niskin bottles); Deposimeter
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.35 M_input ⇨ Nutrients input fluxes (rivers, atmospheric deposition)

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Nutrient input: (1) total P, (2) soluble reactive phosphorus (SPR)
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, representative of the loads actually coming from the watershed to the ecosystem
Property: Base Units
tons/years
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water sampling devices (e.g Niskin bottles); Deposimeter
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.36 M_input ⇨ Organic carbon

Definition of *M_input*: *The capacity of ecosystems to enhance the input of matter with special focus on nutrients, needed to build up biomass and to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Dissolved organic carbon (DOC), (2) particulate organic carbon (POC)
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C m-3, mg Chl m-3
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water column sampling (Niskin bottles), different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.37 M_storage ⇨ Organic carbon

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Dissolved organic carbon (DOC), (2) particulate organic carbon (POC)
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C m-3, mg Chl m-3
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water column sampling (Niskin bottles), different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.38 M_storage ⇨ Chlorophyll

Definition of *M_storage*: *The capacity of an ecosystem to store matter when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Chlorophyll
Important related indices
Property: Frequency
Monthly
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C m-3, mg Chl m-3
Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method

reference
Method applied (key phrases)
Water column sampling (Niskin bottles), different levels (depths)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.39 M_output ⇨ Sediment mass and contents

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Sediment mass and contents
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C m-2 d-1
Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference
Method applied (key phrases)
Sedimentation traps (for vertical fluxes and outputs), geostrophic currents for advection estimates
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.40 M_output ⇨ Total Carbon Flux

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: (1) Dissolved organic carbon (DOC), (2) particulate organic carbon (POC)
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C m-2 d-1
Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference
Method applied (key phrases)
Sedimentation traps (for vertical fluxes and outputs), geostrophic currents for advection estimates
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.41 M_output ⇨ Harvesting

Definition of *M_output*: *Matter components which are not taken up and "used" by the ecosystem and therefore are exported into the environment of the system (e.g. as suspended matter, sediment loads, erosion)*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Fishing yields
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
One single sampling station, considering the best fit with vertical (water column) and horizontal (site gradients) variability
Property: Base Units
mg C m-2 d-1
Mandatory meta data

Survey date and time, location, site depth, sampling depths, frequency of observations, method reference
Method applied (key phrases)
Sedimentation traps (for vertical fluxes and outputs), geostrophic currents for advection estimates
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Matter Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.42 M_efficiency measures ⇨ Sedimentation: Accumulation rates

Definition of *M_efficiency measures*: *Cycling & nutrient loss reduction: The capacity of an ecosystem to prevent the irreversible output of elements from the system; referring also to nutrient and matter cycling.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: MATTER CYCLING: Increase of sediments accumulated / year in (cm) or weight (g) per cm²
Important related indices
Property: Frequency
Yearly integrated
Property: Precision
To characterise the site
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Single point
Property: Base Units
cm/y g/cm2xy

Mandatory meta data
Survey date and time, location, site depth, sampling depths, frequency of observations, method reference
Method applied (key phrases)
Sediment core isotopic analysis (expensive, to discuss for budget allocation)
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.43 W_input ⇨ Precipitation

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Precipitation
Important related indices
Property: Frequency
Continuous/daily
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
m3 s-1, m s-1
Mandatory meta data
Date, Time, location, method reference

Method applied (key phrases)
Instrumental
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.44 W_input ⇨ River discharge

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: River discharge
Important related indices
Property: Frequency
Continuous/daily
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
m3 s-1, m s-1
Mandatory meta data
Date, Time, location, method reference

Method applied (key phrases)
Instrumental
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.45 W_input ⇨ Marine currents

Definition of *W_input*: *The capacity of ecosystems to enhance the input of water needed to maintain ecosystem functioning.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Marine currents
Important related indices
Property: Frequency
Continuous/daily
Property: Precision
See methods and instruments
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
m3 s-1, m s-1
Mandatory meta data
Date, Time, location, method reference

Method applied (key phrases)
Instrumental
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.46 W_storage ⇨ Residence time of marine currents

Definition of *W_storage*: *The capacity of an ecosystem to store water when available and to release it when needed.*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Residence time of marine currents
Important related indices
Property: Frequency
Seasonal
Property: Precision
See model used
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
days
Mandatory meta data
Date, Time, location, model reference

Method applied (key phrases)
Instrumental and modelling
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.47 W_output ⇨ Evaporation

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Evaporation
Important related indices
Property: Frequency
Seasonal
Property: Precision
See instruments and models
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
m3 s-1
Mandatory meta data

Date, Time, location, instrument and model reference
Method applied (key phrases)
Instrumental and modelling
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.48 W_output ⇨ Advection

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Advection (Advective transport describes the movement of some quantity via the bulk flow of a fluid)
Important related indices
Property: Frequency
Seasonal
Property: Precision
See instruments and models
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
m3 s-1
Mandatory meta data

Date, Time, location, instrument and model reference
Method applied (key phrases)
Instrumental and modelling
Method references: specific to sites, not internationally applied
Method references: established, internationally applied

MAPPING OF PARAMETERS TO THE CONCEPT OF ECOLOGICAL INTEGRITY (EI; see Table 1, p. 7)

EI Component ⇨ EI Indicator ⇨ Manageable Indicator ⇨ Parameter

(I) EI component: *Ecosystem Processes* ⇨ *Water Budget*

(II) Following headline: *Basic EI Indicator* (Table 1) ⇨ *Manageable Indicator*

10.4.49 W_output ⇨ Outflow

Definition of *W_output*: *Water which is not taken up or not "used" (anymore) by the ecosystem and therefore is exported into the environment of the system (e.g. by evaporation, transpiration, interception, runoff).*

FACTSHEET FOR PARAMETER(S) targeting at the manageable indicator
PARAMETER: Outflow (marine currents)
Important related indices
Property: Frequency
Seasonal
Property: Precision
See instruments and models
Property: Time scale (incl. seasonality), temporal resolution
All
Property: Basic spatial scale
Basin scale
Property: Base Units
m3 s-1
Mandatory meta data

Date, Time, location, instrument and model reference
Method applied (key phrases)
Instrumental and modelling
Method references: specific to sites, not internationally applied
Method references: established, internationally applied