PROJECT FINAL REPORT

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1 Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.
[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

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4.1 Final publishable summary report

4.1.1 Executive summary

WISER stands for "Water bodies in Europe: Integrative Systems to assess Ecological status and Recovery' and supported the implementation of the Water Framework Directive (WFD) by developing tools for integrated ecological status assessment of European surface waters, with a focus on lakes and transitional/coastal waters. Further, it evaluated and predicted the effects of restoration and management on recovery processes in rivers, lakes and transitional/coastal waters. Both themes, assessment and management/restoration, considered the potential impacts and implications of global and climate change.

Altogether 118 existing databases from previous research and monitoring initiatives were compiled and provided an excellent basis for the analysis of pressure-impact relationships and of management-recovery relationships. This data source was supplemented by an extensive field campaign to generate data from 33 lakes and eight transitional/coastal waters addressing assemblages of the aquatic flora and fauna in these waters, together with accompanying environmental variables. The field campaign thereby allowed of sampling different locations at different times of the year, thus enabling the estimation of uncertainty of assessment due to spatial and temporal variability within the ecosystems. This approach also allowed for an estimation of the researcher-dependent component of uncertainty, for instance due to methodological issues or varying determination skills.

Extensive reviews of the existing restoration/management literature supplemented the few existing databases on the effects of restoration and management in all ecosystem types. This data was used to identify environmental implications of pressure reduction (e.g. reduced nutrient loads in lakes) and restoration (e.g. hydromorphological enhancement in rivers), and to estimate biological recovery. Time series from selected case study catchments finally provided the basis for the estimation of the effects of climate warming in all ecosystem types.

With regard to biological assessment of lakes and transitional/coastal waters, WISER refined existing and developed new indicators for all biological assemblages addressing two main stressors: eutrophication (including hypoxia in coastal waters) and hydromorphological degradation (including water level fluctuations in lakes). The new indicators were subject to an uncertainty analysis based on a new software WISERbugs (WISER Bioassessment Uncertainty Guidance Software). WISER supported the Intercalibration Exercise and developed a series of common intercalibration metrics for different assemblages, in particular for the intercalibration of lakes. WISER experts also assisted intercalibration on meetings of all related Geographical Intercalibration Groups during the lifetime of the project, to advise intercalibration and to ensure the development of practical metrics and approaches.

Based on literature reviews and meta analysis of >700 research studies, conceptual models were developed to structure and summarise the existing knowledge about pressure-impact and management/restoration-recovery effects in rivers, lakes and transitional coastal waters. These models will help river basin managers to estimate the effects of restoration and mitigation measures, but also help identify potentially ineffective measures that have been rarely proven to be ecologically successful. Models of the impact of global warming were developed to inform water management practitioners about the potential implications of water temperature increase on the structural (taxonomic) and functional composition of assemblages. The results can help estimate the species' losses and gains in particular regions as well as the effects on the reference conditions of assessment indices and metrics (e.g. feeding types).

All WISER results have been made available through the project website www.wiser.eu, which, amongst other products, provides access to 88 deliverables, detailed animated lists of all lake and marine waters sampled for the field campaign, several software tools for taxa data entry and uncertainty analysis, a methods database comprising information of >300 European water body assessment systems, a meta database with information about 118 existing project and monitoring databases, and a book of abstracts to the Final WISER Conference in Tallinn (Jan. 2012). Almost 150 publications resulted from WISER or are in an advanced stage of preparation. The main outcome of the project has been summarised as key messages, which can be viewed on the project's homepage.

4.1.2 Summary description of project context and objectives

Europe is rich in aquatic ecosystems, which have been impacted in the past decades by an equally variable range of environmental pressures, such as pollution and modification of the physical habitats. Recent European policies target a good ecological status for all surface waters, i.e. water bodies need to be assessed by comparison with a reference quality target. If the quality is below the target, which is the case for the majority of water bodies in Europe, they need to be restored until the target status is being achieved. For many aquatic ecosystem types, ecological assessment systems have been developed already and River Basin Management Plans outline the required restoration and management measures to achieve the target.

In spite of these requirements, many countries, however, had not completed the development of new WFD-compliant systems for assessing ecological status. Classification systems for several relevant combinations of BQEs, ecosystem type and stressor were missing in 2009 and the impact of some stressors (in particular hydromorphological degradation) on the biota was widely unknown, in particular for lakes and transitional/coastal waters. There was also very little information on the uncertainty associated with most assessment systems and the comparability of status assessments between Member States. Furthermore, there was insufficient knowledge on how biological assemblages ("Biological Quality Elements", BQEs) recover from degradation and respond to climate change, thus limiting the predictability of the success of future restoration endeavours.

These obvious gaps in assessment techniques and guidance were addressed by the WISER consortium, whose partner institutions covered all major regions of Europe and provided profound expertise in lake, river, transitional and coastal water ecological research. In particular, WISER scientists applied a variety of analytical and modelling techniques to addressed the following research questions:

- Which biological indicators are best suited for the assessment of aquatic ecosystems? Which are most reliable? Which are redundant? This aim is limited to lakes (with a special focus on hydromorphological degradation) and coastal and transitional waters.
- How can assessment results obtained with different BQEs or from different sites best be compared, intercalibrated and combined into an integrated appraisal of ecological status?
- How do BQEs recover from degradation, in particular hydromorphological degradation and eutrophication, and how is assessment and restoration affected by climate change?
- How (un)certain are ecological status assessment results and predictions of the outcome of management measures? How can uncertainty be quantified and consequently minimised?

WISER was composed of five scientific modules, plus two modules on coordination and dissemination. The module 'data and guidelines' (Module 2) was mainly a supporting module, compiling all the data accessible to the project, closing gaps in the data sources, storing the data generated in the project's field campaigns, providing tools for data queries and data entry, evaluating and comparing existing assessment methods, and developing common guidelines for indicator development. Workpackage 2.1 developed the WISER central database to store all data from the field campaigns in 2009 and 2010 in a standard format. The Workpackage assisted the analytical Workpackages with tailor-made queries to generate specific sub-sets of data for analysis. Workpackage 2.2 provided guidance on the development of new indicators. This Workpackage also reviewed the state-of-the-art of bioassessment in European countries.

Two modules addressed 'Ecological indicators for assessment and intercalibration' in lakes and transitional/coastal waters. The lake module (Module 3) was dealing with four BQEs used for lake assessment: phytoplankton, macrophytes, benthic invertebrates and fish. It developed and improved state-of-the-art assessment methodologies, taking into account the remaining needs to complete intercalibration of assessment systems. As each BQE was investigated within an own workpackage, concerted effort was spent on in-depth evaluation of this BQE, its various relationships to environmental stressors and its sensitivity to spatial and temporal variation. The latter was subject to an extended uncertainty analysis, with strong support by an own Workpackage dedicated to the analysis of the impacts of various sources of uncertainty in aquatic assessment (see below). Among the stressors, hydromorphological degradation was in focus, as knowledge about the effects of this stressor was very sparse. Furthermore, Modules 3 and 4 also aimed to fill the remaining gaps in the assessment of eutrophication.

A similar approach was followed in Module 4 targeting transitional and coastal waters. It addressed four BQEs (phytoplankton, macroalgae/angiosperms, benthic invertebrates and fish) and aimed to fill the existing gaps in assessment methodologies for this water body category. In addition to analyzing existing data, a field campaign was run in 2009 and 2010 to generate the data required to develop new assessment metrics and to estimate their uncertainty due to their sensitivity to spatial and temporal variation.

The results of both assessment modules not only assisted water body assessment and monitoring in Europe, but also supported the comparison of assessment results within the intercalibration exercise. Thus, Module 3 and 4 worked in close collaboration with the Geographical Intercalibration Groups (GIGs). In particular, WISER partners attended all relevant GIG meetings to present the status of WISER results. In return, GIG experts were invited to WISER Workpackage and general assembly meetings, to ensure a high level of applicability of WISER results.

The impacts of pressure reduction (i.e. management and restoration) and climate change on the ecological status in all water categories were addressed by Module 5. The module explored recovery processes of the biota in rivers (Workpackage 5.1), lakes (WP5.2) and coastal/transitional waters (WP5.3) and analysed the potential effects of different climatic conditions on ecological status and recovery. For lakes and marine ecosystems the focus was on (re-) oligotrophication, whereas the effects of hydromorphological degradation were analyzed for rivers, and additionally considered for lakes. All Workpackages in Module 5 also developed conceptual models of the effects of management/restoration on assemblages and their characteristics (functions, e.g. feeding types). In concert, Module 5 provided guidance for river basin management, on the ecological effectiveness of management and rehabilitation measures and on the potential positive/negative affects of climate change on ecological status and recovery from degradation.

Module 6 synthesized the results on water body assessment, restoration and climate change. The Workpackages focused on uncertainty (Workpackage 6.1), the comparison of different BQEs (WP6.2), the comparison of stressor-response relationships (WP6.3) and the comparison of management/restoration-recovery relationships (WP6.4). Workpackage 6.1 not only provided individual guidance on uncertainty estimation for all partners in Modules 3 and 4, but also produced uncertainty estimation software. A particular focus in Workpackage 6.2 was to estimate the consequences of the application of the 'one-out-all-out' rule in water body assessment (i.e. applying the worst case scenario and take the worst of several assemblage results as the final result). The remaining Workpackages 6.3 and 6.4 compared the responses of different biological quality elements to different stressors and stressor reductions (management/restoration) in different water categories. Module 6 provided scientific support to the design of monitoring programmes and tested methods on how to best integrate results for single BQEs into a holistic assessment of water bodies.

Finally, a module on 'dissemination' (Module 7) was responsible for maintaining the project website www.wiser.eu and for providing concise and up-to-date information on the project for water managers, scientists and the general public. Workpackage 7.1 was responsible for the communication within the WISER consortium, which was implemented by setting up an Intranet and video-conferencing tools. The Intranet provided the platform for internal communication and the exchange of data and documents. Furthermore, Workpackage 7.1 aimed to establish and maintain a vital communication with WISER end users, i.e. river basin managers and members of Geographical Intercalibration Groups. Another Workpackage (7.2) was specifically dedicated to the organisation of the final WISER conference, which took place in January 2012 in Tallinn.

This structure of WISER into Modules and Workpackages not only ensured an effective and timely elaboration of tasks, but also helped achieve a large degree of integration of the results. This process was coordinated within Module 1 (Coordination), but largely organised within the WISER Steering Group composed of two members of the coordinating organisation (University of Duisburg Essen) and of all leaders of Modules 2–7. Monthly electronic meetings and bi-annual physical meetings of the steering group ensured an effective organisation of the workflow, a timely and adequate response to problems reported by consortium members and a democratic process to take important decisions.

All WISER results were presented to the end users during the final conference and were made available on the public part of the website.

In terms of products, WISER resulted in:

- 88 deliverables (some of which are currently subject to a peer-review process at various scientific journals and, thus, available only with restricted access to stay in line with the publication policies of the journals; this will be changed to full access in due time after approval)
- 108 publications until the termination of the project; further publications are planned in course of two more journal special issues (one has already appeared), amongst others a special issue in Hydrobiologia comprising about 25 papers on the main WISER results (release probably in late 2012/early 2013
- biological and environmental data from two field campaigns (2009, 2010) in 33 lakes and 8 transitional/coastal waters
- a large project data base with environmental and biological records of all kinds of surface waters in Europe
- a meta database with metadata of 118 recent European research projects (FP5–FP7) and national monitoring activities
- a methods database with metadata of >300 surface water classification systems from 29 European countries (covering all BQEs and water categories)
- conceptual models of pressure reduction and recovery in rivers, to help practitioners estimate effects and non-effects of restoration
- a taxa entry tool to generate taxonomically correct taxa lists of all aquatic assemblages
- common metrics and metric fact sheets to inform and guide end users about the suitability of metrics for intercalibration of individual national assessment results at the large scale
- a LakeLoadResponse software tool to estimate effects of nutrient reduction in lakes (LLR)
- a software tool to estimate the uncertainty in water body assessment due to spatio-temporal and methodological variability (WISERBUGS)
- a Book of Abstracts of the WISER Final Conference in Tallinn (25–26 January 2012)
- an interactive web-tool to derive existing knowledge about cause effect chains in river restoration
- a series of key messages to the water managers to translate the major WISER outcome and provide guidance for water management
- a series of public newsletters to disseminate WISER's achievements among the general public

4.1.3 Description of the main S & T results and foregrounds

Data and guidelines (Module 2)

<u>Intercalibration is a fundamental prerequisite to compare the results of hundreds of bio-indicator systems in Europe</u>

European countries currently use nearly 300 different methods to classify the ecological status of their surface waters. The methods mainly consider species abundance and sensitivity and focus on the impacts of organic pollution and eutrophication. The intercalibration exercise aimed at harmonising the national classifications in order to provide common denominators for the comparison of individual national results within a European context of ecological status classification. The WISER project reviewed 297 assessment methods, based on a questionnaire survey sent to water authorities in all Member States and additional countries, which are being implementing the Water Framework Directive (Figure 1).

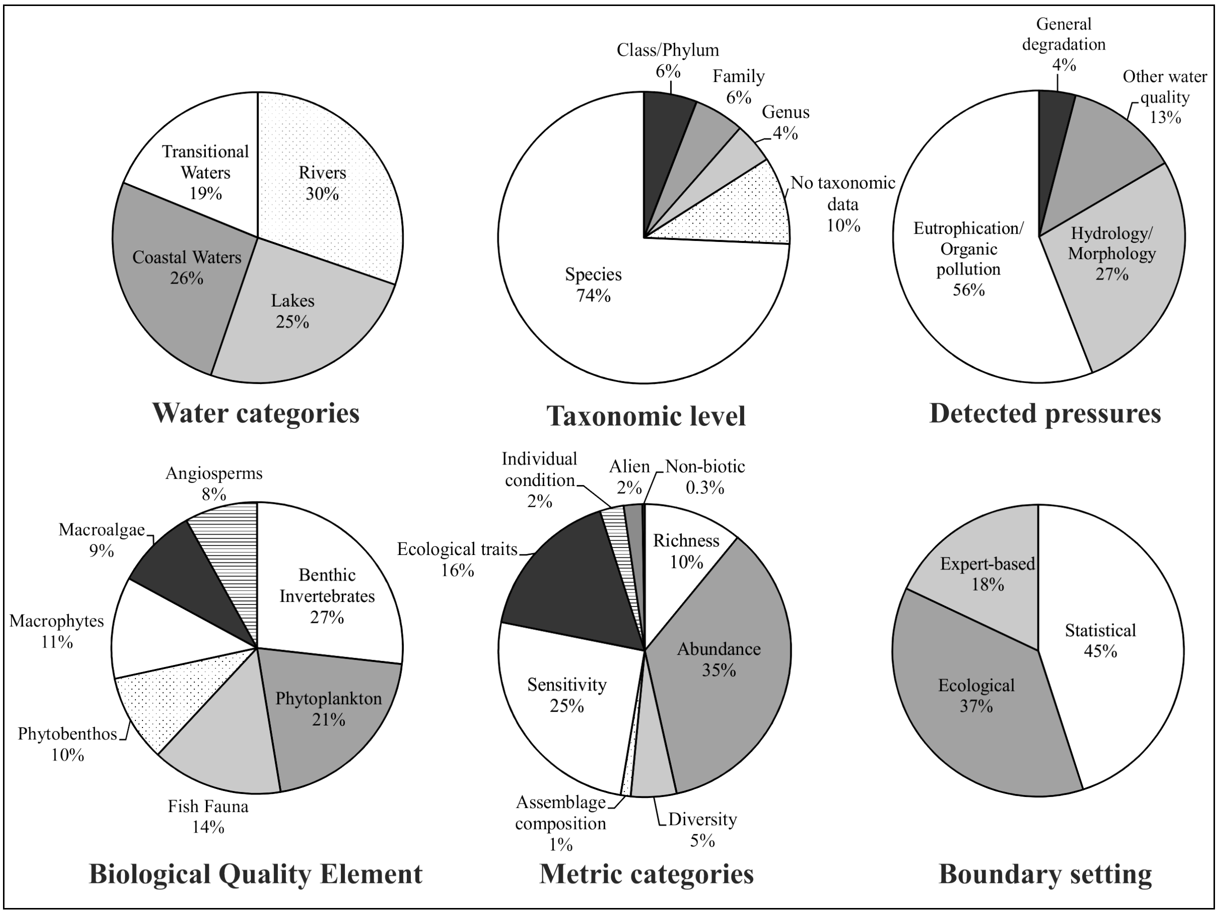

Figure 1: Results and distribution of the characteristics of the 297 national assessment methods reported by 28 countries and reviewed by the WISER project (based on a questionnaire survey sent to water authorities in all countries implementing the Water Framework Directive).

The pressure-impact relationships were tested empirically for two-third of the methods, mostly for rivers, lakes and coastal waters, while the methods for transitional waters were least validated. The strength of the relationships differed significantly between organism groups and water categories. The correlation coefficients generally covered a broad range (<0.4 to >0.8). The strength of the relationship decreased in order: Phytoplankton > macroscopic plants > benthic invertebrates > phytobenthos and fish fauna, and for the water categories in order: Coastal waters > lakes > transitional waters > rivers. Status boundaries were mostly defined using statistical approaches.

The overview of the WFD intercalibration exercise revealed that the assessment methods for the following biological elements are almost fully intercalibrated: Phytoplankton and macrophytes in lakes, and benthic invertebrates, phytobenthos and fish fauna in rivers. Intercalibration has not been fully completed for the remaining biological elements / surface water types.

The multitude of aquatic bioassessment methods used for the assessment of the European surface waters is perplexing. It is questionable if the methodological patchwork allows for comparable ecological status classification across Europe. Nevertheless, the WFD intercalibration exercise has provided methodology to check the comparability of results and consistency in classifications. However, despite of more than 10 years of development, there are not fully set of methods for all quality elements in all categories of surface waters. Also the intercalibration still need to be continued in the future to ensure comparability of new methods and improvements of the existing methods.

The outcomes of the pressure-impact analyses conducted to test the national methods are promising, but more effort is needed in order to develop a comprehensive understanding of the human pressures detected by the individual methods. In particular there is a need to better understand cause (human pressure) - effect (metrics or indicators) relationships for highly integrative biological elements such as fish or plants. Such models would help to choose the right management actions to improve the quality of the vegetation and fish fauna that are important for people using lakes, rivers and coastal waters for recreation and fishing.

The boundaries in the ecological classifications were not often based on ecological principles. The ecological targets are generally based on statistical distributions rather than on meaningful ecological changes in ecosystem functions and in the biological communities. The challenge remains to incorporate ecological components and functions into the national systems of ecological water quality classifications.

Birk, S., Bonne, W., Borja, A., Brucet, S., Courrat, A., Poikane, S., Solimini, A. G., van de Bund, W., Zampoukas, N., Hering, D. (2012). Three hundred ways to assess Europe's surface waters: an almost complete overview of biological methods to implement the Water Framework Directive. Ecological Indicators, 18, 31-41.

Birk, S., Bonne, W., van de Bund, W., Poikane, S., Zampoukas, N. (2012). Europe's quest for common management objectives of aquatic ecosystems. In: Schmidt-Kloiber, A., Hartmann, A., Strackbein, J., Feld, C.K., Hering, D.: Current questions in water management. Book of abstracts to the WISER final conference - Tallinn, Estonia, 25-26 January 2012: 28-29. (Downloadable file available at http://www.wiser.eu/meetings-and-events/final-conference/abstracts/)

The WISER Central Database as a tool for future research

A large number of datasets from rivers, lakes and coastal waters have been compiled and stored in the WISER Central Database (CDB). Data for all biological quality elements and all water categories are available from the CDB in a harmonised format. More specifically, the CDB can be used to combine (1) biological data with environmental pressure data (chemistry etc.), (2) data for different biological quality elements, (3) data from different water categories. These data are accessible both for WISER partners and for other scientists. The conditions for use of WISER data depend on the intellectual property rights (IPRs) stated by each data owner. Detailed information on all WISER datasets, including IPR information, is available in the WISER metadatabase.

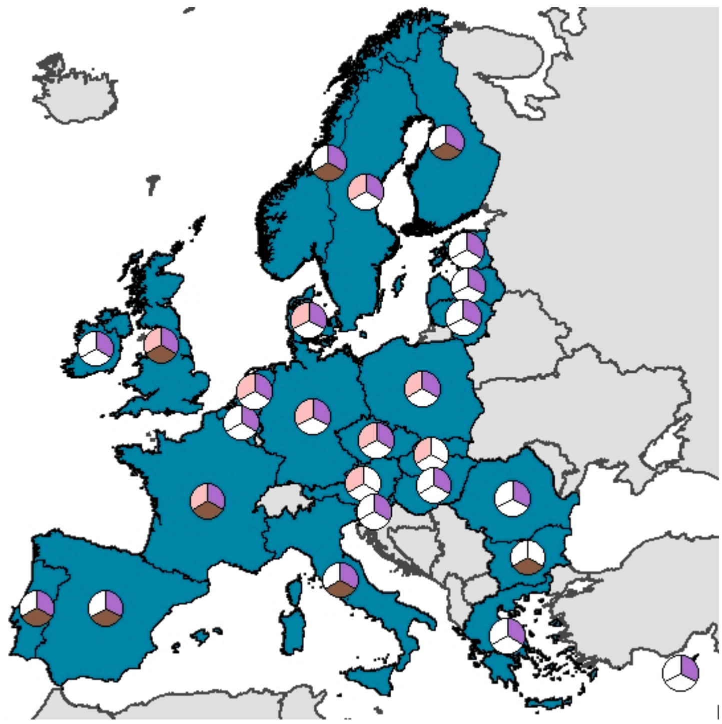

Figure 2: Geographical coverage of the WISER Central Database (CDB). Countries represented in the CDB are coloured blue. Coloured pie sectors indicate data from lakes (lilac), coastal/transitional waters (brown) and rivers (pink) (white = not available).

The WISER Central Database contains biological and other environmental data from 26 European countries (Figure 2). The WISER field campaign in 2009/2010 resulted in ca. 8000 biological samples from ca. 1000 sampling stations in lakes and coastal/transitional waters from 14 countries, containing altogether 40 000 records of species abundance. In addition, the CDB contains existing datasets from previous research projects, national monitoring etc., containing more than 1 500 000 records of species abundance and 900 000 other environmental observations from ca. 75 000 sampling stations in rivers, lakes and coastal/transitional waters. This extensive database can be very useful also for future research related to river basin management, as well as more general research in e.g. aquatic ecology, biodiversity and environmental stressors.

Information on the WISER Central Database:

Moe, S.J., R. Brænden, B. Dudley, A. Schmidt-Kloiber, J. Strackbein. The WISER way of organising ecological data from European rivers, lakes and coastal waters. Hydrobiologia (in prep).

Schmidt-Kloiber, A, B. Dudley, J. Strackbein, R. Vogl, S.J. Data about data – the WISER metadatabase. Hydrobiologia (in prep.).

Angeler D.G, R. K. Johnson, D. Hering, S. J. Moe. Cross-taxon responses to stress gradients in streams and lakes. Hydrobiologia (submitted).

Ecological indicators for assessment and intercalibration: lakes (Module 3)

The reliable assessment of the impact of different lake stressors requires the use of different Biological Quality Elements

Different Biological Quality Elements (BQEs) are being used to assess the ecological status of lakes in Europe: fish, benthic invertebrates, macrophytes/phytobenthos and phytoplankton. The different responses of these BQEs to different stressors require the use of several BQEs in order to assess the multiple impacts by multiple stressors. In brief:

- Phytoplankton and macrophytes show strong responses to eutrophication pressure.
- Littoral benthic invertebrates clearly respond to morphological shoreline degradation, and macrophytes to water level fluctuations.
- Fish assemblages show less clear signals to individual pressures, but may be good indicators of climate warming.

Table 1: Overview of general stressor-response relationships of lake Biological Quality Elements as a result of the WISER lake module (indicated as correlations according to Pearson's R2 or Spearman's rho).

BQE	Pressure and indicators	Best common metrics	R^2	Rho
Phytoplankton	Eutrophication (TP)	Chlorophyll-a	0.63	
		PTI (taxonomic composition)	0.67	
Macrophytes	Eutrophication (TP)	ICM (taxonomic composition)		
	HyMo (water level fluctuations)	WLi (taxonomic composition) (NO+FI)	0.77	
Benthic fauna (littoral)	Eutrophication	MMI	0.40	
	HyMo (shore modifications)	MMI (LIMCO) (DE+DK)		0.70
		MMI (LIMHA) (DE+DK)		0.72
Fish fauna	Eutrophication	MMI (CPUE< BPUE, OMNI)	0.25	

Phytoplankton is highly sensitive to eutrophication pressure, based on the statistical analyses using all regional data sets (Table 1). The best common metric, with high sensitivity, is the Phytoplankton Trophic Index, which includes both taxonomic composition data as well as chlorophyll a. These two metrics have been combined into a common metric for the intercalibration of phytoplankton methods with successful results in both the Northern GIG and the Central-Baltic GIG. Cyanobacterial blooms are common in all eutrophied lakes across Europe. The risk that the WHO health alert threshold for cyanobacteria biovolume (1-2 mg/l) would be exceeded is 10% at a total-P concentration of 20 µg L^{-1}

and 30% at 40 µg L^{-1}. The best metric for macrophytes indicating eutrophication pressure is the intercalibration common metric for taxonomic composition (ICM; Table 1), which has also been used for intercalibrating macrophyte methods in the same GIGs.

Other metrics for phytoplankton and macrophytes responding to eutrophication have also been tested within WISER, such as cyanobacteria abundance and macrophyte growing depth. These metrics also show highly significant relationships with nutrient pressures and may be easier to communicate to the public and water managers. A shift from macrophytes to cyanobacteria highlights an important functional shift that can greatly affects the use of freshwaters for recreation, swimming or as a reservoir for potable water.

Table 2. Overview of metric sensitivity to pressures for biological quality elements in lakes resulting from the WISER lake module. GIG = Geographical Intercalibration Group. CB GIG = Central European and Baltic region, NGIG = Northern region, MGIG = Mediterranean region. GAM = generalised additive model. The other regressions are linear models. N = number of lake-years. Sensitivity has been assessed from regression analyses of dose-response curves along pressure gradients using large-scale pan-European datasets from > 1000 lakes from 21 countries.

Metric	Metric description	Pressure	r^2	GIG or country	p	N
Phytoplankton						
Chla	Chlorophyll a	Eutrophication (Total-P)	0.63	All, but mainly NGIG & CBGIG	<0.001	16949
PTI	Phytoplankton Trophic Index	Eutrophication (Total-P)	0.67 (GAM)	All, but mainly NGIG & CBGIG	<0.001	2287
Cyano bloom intensity	Cyanobacteria biovolume	Eutrophication (Total-P)	0.34 (GAM)	All, but mainly NGIG & CBGIG	<0.001	1710
SPI	Size Phytoplankton Index	Eutrophication (Total-P)	0.23 0.34 0.19	CB GIG N GIG M GIG	<0.0001 <0.0001 <0.05	122 77 29
MFGI	Morpho-Functional Group Index	Eutrophication (Total-P)	0.33 0.05 0.38	CB GIG N GIG M GIG	<0.0001 <0.05 <0.001	122 77 29
FTI	Functional Traits Index (mean of SPI and MFGI)	Eutrophication (Total-P)	0.39 0.22 0.50	CB GIG N GIG M GIG	<0.0001 <0.0001 <0.0001	122 77 29
J'	Evenness	Eutrophication (Total-P)	0.19 0.07	N GIG CB GIG	<0.001 <0.001	716 559
Macrophytes						
ICM	Intercalibration Common Metric	Eutrophication (Total-P)	0.52	All, but mainly NGIG & CBGIG		
EI	Ellenberg Index of taxonomic comp.	Eutrophication (Total-P)	0.47	All, but mainly NGIG & CBGIG		
Cmax	Maximum colonization depth (abundance proxy)	Eutrophication (Total-P) (Chlorophyll) (Secchi depth)	 0.31 0.31 0.58	All, but mainly NGIG & CBGIG	 <0.0001 <0.0001 <0.0001	 478 612 475
WIc	Water level Taxonomic comp index	Hydromorphological changes (water level fluctuations in ice-covered lakes)	0.77	NGIG (NO+FI)		26
Benthic fauna						

MMI	Multimetric Index	Eutrophication (Total-P)	0.40 (whole lakes)	CB-GIG	<0.001	161
MMI	Multimetric Index	Morphological alterations and Eutrophication (shore line modifications, land use and TP)	0.53	CB-GIG	<0. 001	161
MMI	Multimetric Index	Morphological alterations (shore line modifications)	0.49	All, mainly CBGIG	??	44
LIMCO	Littoral Invertebrate Multimetric Index based on Composite Sampling	Morphological changes of lake shore	0.70* 0.49* 0,44* 0.47*	DE+DK Italy SE+FI IE+UK		
LIMHA	LIMI based on Habitat-specific Sampling	Morphological changes of lake shore	0.72* 0.40* 0,44* 0.71*	DE+DK Italy SE+FI IE+UK		
Fish						
MMI	Multimetric Index consisting of BPUE, CPUE and OMNI	Eutrophication (non-natural land cover)	0.25	All	<0.001	445
BPUE	Biomass per unit effort	Eutrophication (non-natural land cover)	0.19	All	<0.001	445
CPUE	Catch per unit effort (number of individuals)	Eutrophication (non-natural land cover)	0.18	All	<0.001	445
OMNI	Relative number of omnivorous individuals	Eutrophication (nonnatural land cover) (Total-P)	0.16 0.18	All All	<0.001 <0.001	445 445

*Value represents Spearman's rank correlation coefficient Rho; in four bio-geographical regions where different metrics correlated best with the stressor index.

Macrophytes also responded clearly to hydromorphological pressure, in terms of water level fluctuations in regulated lakes in the Northern countries. The macrophytes water level fluctuation index (Wlc) has a clear threshold response concerning the indicator taxa e.g. *Isoetes* corresponding to ca. 3.5 m water level fluctuations. Thus, this metric is a very promising tool to define ecological potential in heavily modified water bodies.

Littoral macroinvertebrates respond clearly to modification and degradation of shoreline habitats in lakes. Two new multimetric indexes have been developed within WISER, including several single metrics, such as the number of taxa of mayflies, stoneflies, caddisflies, water beetles, mussels, dragon-flies, relative abundance of the functional groups like gatherers or collectors, or classes of chironomids, and Margalef diversity. Number of Macroinvertebrate species and fraction of individuals feeding on particulate organic matter were lower at both intermediately and strongly modified lake margins than at unmodified margins in 64% of 44 lakes. Another multimetric index based on littoral macroinvertebrates also responds to a combination of pressures from eutrophication and morphological modifications (Table 2).

For fish, the best metrics to assess eutrophication impacts are biomass per unit effort (BPUE) (r^2 = 0.19), catch per unit effort (CPUE) (r^2 = 0.18) and relative number of omnivorous individuals (OMNI) (r^2 = 0.18), but none of these have been used for intercalibration of national methods. Fish has however been shown to respond to climate warming with cold-water species like arctic char being pushed further north and towards higher altitudes, while warm-water species like many cyprinids increase in dominance and widen their bio-geographical range. Small-sized individuals dominated warm lakes, whereas in cold lakes the relative proportion of large-sized fish increased. The dominance of small fish in warm lakes was primarily the consequence of an increase in juvenile fish.

Operational monitoring and assessment of ecological status in lakes should be based on the most sensitive quality elements to different pressures. WISER evidence supports that the botanical BQEs (phytoplankton and macrophytes) are well suited to assess lake eutrophication impacts. Effects of measures to restore eutrophied lakes can only be seen when the total phosphorus concentration is reduced to less than 100 µg/l. For hydromorphological pressure, macrophytes respond well to water level fluctuations in northern regulated lakes and may thus be used as a tool to set environmental goals for heavily modified water bodies. Littoral macroinvertebrates have been shown to sensitively assess impacts of morphological alterations to lake shores. Fish should be monitored to assess impacts of climate warming.

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Emmrich, M., Brucet, S., Ritterbusch, D., Mehner, T., 2011. Size spectra of lake fish assemblages: responses along gradients of general environmental factors and intensity of lake-use. Freshwater Biology 56: 2316–2333

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Mischke U, Carvalho L, McDonald C, Skjelbred B, Lyche Solheim A, Phillips G, de Hoyos C, Borics G, Moe J & Pahissa J. 2011. WISER Deliverable D3.1-2: Report on phytoplankton bloom metrics, March 2011

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Jeppesen, E., Mariana Meerhoff, Kerstin Holmgren, Ivan Gonza´lez-Bergonzoni, Franco Teixeira-de Mello, Steven A. J. Declerck, Luc De Meester, Martin Søndergaard, Torben L. Lauridsen, Rikke Bjerring, Jose´ Maria Conde-Porcuna, Ne´stor Mazzeo, Carlos Iglesias, Maja Reizenstein, Hilmar J. Malmquist, Zhengwen Liu, David Balayla, Xavier Lazzaro, 2010. Impacts of climate warming on lake fish community structure and potential effects on ecosystem function. Hydrobiologia (2010) 646: 73–90.

Ecological indicators for assessment and intercalibration: coastal/transitional waters (Module 4)

A new phytoplankton size spectra index (SSI) for the assessment of transitional waters

A multi-metric index of the size spectra sensitivity of phytoplankton (ISS-phyto), which integrates the size structure metrics with metrics describing the sensitivity to anthropogenic disturbance, Chl *a* and species richness was developed. The index was found to produce significantly higher values at undisturbed than disturbed sites and thereby being a promising indicator to assess the status of phytoplankton communities.

Relatively few indices have been proposed for the assessment of the community structure changes of coastal and transitional water phytoplankton. Morphological-functional traits of phytoplankton with different cell size and size spectra show a specific response to different types of anthropogenic pressures. Nevertheless, very few attempts have been given so far to utilise functional traits such as body size, at the individual level, or size spectra, at the guild or community level, to develop multi-metric assessment tools compliant with the WFD.

We have developed, tested and validated a multi-metric index of size spectra sensitivity of phytoplankton (ISS-phyto), which integrates size structure metrics with metrics describing the sensitivity of size classes to anthropogenic disturbance, Chl *a* and species richness measures. The ISS-phyto was developed using phytoplankton data of 14 Mediterranean and Black Sea transitional water bodies (i.e. coastal lagoons), which were classified as either "disturbed" or "undisturbed" ecosystems based on expert quantitative analysis, evaluation of anthropogenic pressures in the catchment area and their current protection and conservation status. The index was found to discriminate between natural and anthropogenic pressures presenting significantly higher values at undisturbed than disturbed sites; it has then was also tested successfully to a different set of lagoon and coastal areas in the WISER field studies.

The new metric ISS-phyto is a promising tool for assessment of the response of the phytoplankton community on eutrophication pressure in transitional and coastal waters and is recommended for further testing as a WFD monitoring tool in coastal lagoons.

Lugoli F., Garmendia M. , Lehtinen S., Kauppila, P., Moncheva S., Revilla M., Roselli L., Slabakova N.,Valencia V. , Basset A., 2012. Application of a new multi-metric phytoplankton index to the assessment of ecological status in marine and transitional waters. Ecological Indicators (submitted)

Vadrucci, M.R., Stanca, E., Mazziotti, C., Fonda Umani, S., Reizopoulou, S., Moncheva, S., Basset A., 2012. Ability of phytoplankton trait sensitivity to highlight anthropogenic pressures in Mediterranean lagoons: a size spectra sensitivity index (ISS-phyto) (in preparation)

Benthic invertebrates respond consistently to human pressure gradients across transitional and coastal waters

Several different indices have been proposed and may be used to classify the status of benthic invertebrates in transitional and coastal waters, and in lagoons. However, the response of such methods to human pressure gradients is critical in accepting them as suitable tools in assessing the ecological status within the WFD. Until now, very few studies investigated such response of methods already accepted within the WFD.

We investigated 13 single metrics (abundance, species richness, Shannon's diversity, AMBI, five ecological groups, Margalef index, SN, ES100, and ES50) and eight multimetric methods (ISS, BAT, NQI, M-AMBI, BQI, BEQI, BITS, and IQI) to assess coastal and transitional benthic status along human pressure gradients in 5 distinct environments across Europe: Varna bay (Bulgaria), Lesina lagoon (Italy), Mondego estuary (Portugal), Basque coast (Spain) and Oslofjord (Norway). Within each system, sampling sites were ordered in an increasing pressure gradient according to a preliminary classification based on professional judgement, and the response of single metrics and assessment methods to different human pressure levels was evaluated. The different indices are largely consistent in their response to pressure gradient, except in some particular cases (i.e. BITS, or ISS, in some cases). Inconsistencies between indicator responses were mostly in transitional waters (i.e. IQI, BEQI), highlighting the difficulties of the generic application of indicators to all marine, estuarine and lagoon environments. However, some of the single (i.e. ecological groups approach, diversity, richness, SN) and multimetric methods (i.e. BAT, M-AMBI, NQI) were able to detect such gradients both in transitional and coastal environments.

The agreement observed between different methodologies and their ability to detect quality trends across distinct environments constitutes a promising result for the implementation of the WFD's monitoring plans.

Borja, A., E. Barbone, A. Basset, G. Borgersen, M. Brkljacic, M. Elliott, J. M. Garmendia, J. C. Marques, K. Mazik, I. Muxika, J. M. Neto, K. Norling, J. G. Rodríguez, I. Rosati, B. Rygg, H. Teixeira, A. Trayanova, 2011. Response of single benthic metrics and multi-metric methods to anthropogenic pressure gradients, in five distinct European coastal and transitional ecosystems. *Marine Pollution Bulletin*, 62: 499-513.

Zoobenthos species traits are useful and reliable for the assessment of transitional water ecosystems

Structural taxonomically-based components of the benthic macroinvertebrates communities have been used to assess ecological status (*sensu* WFD) of lagoon ecosystems. Few studies have utilised functional traits such as body size, at the individual level, or size spectra, at the guild or community level, to develop multimetric assessment tools compliant with the WFD.

We have developed, tested and validated a multi-metric Index of Size Spectra sensitivity (ISS), which integrates size structure metrics with metrics describing the sensitivity of size classes to anthropogenic disturbance and species richness measures. The ISS was developed using benthic macroinvertebrates data of 12 Mediterranean and Black Sea transitional water bodies (i.e. coastal lagoons), which were classified as either “disturbed” or “undisturbed” ecosystems based on expert quantitative analysis, evaluation of anthropogenic pressures in the catchment area and their current protection and conservation status. Data from a thirteenth Mediterranean lagoon, characterised by a very strong abiotic stress gradient, were used for validation purposes. The index is effective to discriminate between natural and anthropogenic pressures presenting significantly higher values at undisturbed than disturbed sites.

The new metric proposed for transitional waters is a precise and sensitive tool for discriminating various levels of ecosystem disturbance and easy to apply. The ISS has more practical advantages than disadvantages (Table 3), which favour its widespread use as a monitoring tool in coastal lagoons.

Basset, A., Barbone, E., Borja, A., Brucet, S., Pinna, M., Quintana, X.D., Reizopoulou, S., Rosati, I. Simboura, N., 2012. A benthic macroinvertebrate size spectra index for implementing the Water Framework Directive in coastal lagoons in Mediterranean and Black Sea. *Ecological Indicators,* 12: 72-83.

Table 3: List of advantages and disadvantages of the Index of Size Spectra Sensitivity (ISS).

Advantages	**Disadvantages**
A1. Strong theoretical background on body size responses to environmental stress	**D1.** Damages to individual body size during sampling and/or handling
A2. Strong theoretical background on size spectra	**D2.** Some taxa are particularly sensitive to sampling, fixation and handling
A3. Body size is easy to measure	**D3.** Sampling probability of large sizes is affected by the sampling effort
A4. Body size measurements do not require high level of expertise	**D4**. Size spectra are sensitive to size-selective predation pressures
A5. Inter-calibration of body size measures among laboratories is simple	**D5.** Taxonomic expertise is anyway required (but see also point A7.)
A6. Consistent pressure-impact relationships are available for the most common pressures	**D6.** Assessment of individual body size is time and cost-expensive
A7. Size spectra detect early signals of anthropogenic disturbances before responses are detectable at the taxonomic level -	
A8. High discrimination power of anthropogenic pressures, even without accounting for taxonomic richness	
A9. High robustness to natural variability, embodied in the size spectra	

Fish indicators respond consistently to human pressure gradients across transitional waters

Using a matching combination of fish index, reference values and local dataset, the transitional fish index (and metrics) can be sensitive to pressure gradients. There is a proven negative response of fish quality features to pressure gradients, which make them suitable for biological quality assessments of transitional waters.

A conceptual analysis, carried out on the strength of expected metrics responses to a set of human pressures, suggested chemical pollution and loss of habitat as the type of pressures more frequently and more strongly related to fish metrics. These pressures are often regarded as important indirect causes of alterations in transitional water fish assemblages. This preliminary analysis provided the conceptual basis for the ranking of human pressures in order of expected relevance to fish in transitional waters. In order to confirm further the relationship between fish-quality attributes and pressures, two WFD-compliant indices (the AFI and the EFAI in use for assessment in the Basque country (Spain) and Portuguese estuaries, respectively) were related to a set of pressures acting in these water bodies, while also considering their hydro-morphological descriptors. Stepwise linear multiple regression analysis indentified the following best model relating AFI index scores (as the dependent variable) to explanatory (independent) variables. The model identified a mixture of relevant pressure and hydromorphological covariates and indicates that, in this case, the deeper the estuary, and the shorter the residence time, the pressure index and the channelled ports within the estuary, then the higher the AFI values would be, indicating higher ecological quality. AFI clearly decreases with the increase of pressure proxies and morphological pressures. Similar analysis for the EFAI found comparable negative response of the index scores with increasing values of pressure proxies (see figure below). In this case, the EFAI responded to the overall anthropogenic pressure level.

Furthermore, the good results of the intercalibration (IC) exercise suggests that each fish tool included in that analysis is in fact reacting in a common manner to a same level of human pressures, and providing a good agreement between methods in the diagnosis of ES. This is the ultimate goal of using fish in ecological assessments and suggests that all inter-calibrated indices are relevant and valuable indicators of human pressures in their own right. That is, there are providing an indication of ES independently of the pressure proxies used in the development and calibration steps.

In addition to the regression approach, an alternative method to establish metric-pressure relationship using a Bayesian approach was test-trialled in Drouineau et al. (2012). The Bayesian method allows the ability both to select relevant fish metrics and to combine them taking into account their sensitivity to pressure, their variability or any other relevant feature. For example, the method can also be a way to integrate data from expert opinion and it finally gives an assessment of the uncertainty of the diagnostic tool. It was tested on a dataset composed of a sample of 14 French lagoons. The analysis suggests that the quality diagnostics are less variable at the level of the multi-metric indicator than at the level of the fish metrics considered individually.

Fish response to pressure fields in transitional waters provides a high level of ecological integration to the quality evaluation of transitional water systems. The Fish BQE is a sensitive indicator of ES and will be valuable to identify those specific pressures affecting fish assemblages providing targets for minimising the effects of stress in mitigation and restoration plans. Whole indices provide more consistent overall ES assessments but fish metrics considered individually may be more useful as a means to focus restoration measures.

Aubry A, Elliott M (2006) The use of environmental integrative indicators to assess seabed disturbance in estuaries and coasts: Application to the Humber Estuary, UK. Mar Pollut Bull 53:175-185

Drouineau H, Lobry J, Delpech C, Bouchoucha M, Mahevas S, Courrat A, Pasquaud S, Lepage M (2012) A Bayesian framework to objectively combine metrics when developing stressor specific multimetric indicator. Ecological Indicators 13:314-321

Borja A, Uriarte A, Muxika I, M. GJ, Uyarra MC, Courrat A, Lepage M, Elliott M, Pérez-Domínguez R, Alvarez MC, Franco A, Cabral H, Pasquaud S, Fonseca V, Neto JM (2012) Report detailing Multimetric fish-based indices sensitivity to anthropogenic and natural pressures, and to metrics' variation range. In: WISER Deliverable D44-3

Pérez-Domínguez R, Alvarez MC, Borja A, Cabral H, Courrat A, Elliott M, Fonseca V, Franco A, Gamito R, Garmendia JM, Lepage M, Muxika I, Neto JM, Pasquaud S, Raykov V, Uriarte A (2012) Precision and behaviour of fish-based ecological quality metrics in relation to natural and anthropogenic pressure gradients in European estuaries and lagoons. In: WISER Deliverable D4.4-5.

Impacts of pressure reduction and climate change on the ecological status (Module 5)

Catchment and riparian land use control local habitat conditions

The hierarchical order of landscapes and riverscape implies a hierarchical order of stressors. Stressors, such as land use or river regulation, are ubiquitous in large parts of the world because of the multifaceted land and water uses. Flood protection is usually linked to severe modifications of hydrological and morphological characteristics. Agriculture increasingly dominates entire regions due to society's growing demand for food, resources and energy.

Broad-scale stressors impose serious problems for restoration and recovery. Urban settlement and agriculture in the catchment upstream of a site largely influence and control the physical habitat conditions at the respective site (*low uncertainty*). Urban settlements can influence water retention and storage through the percent of impervious area in the catchment, which in turn affects the hydrograph and can lead to severe flash floods following stormwater release. Less than 10% urban settlements in the catchment are frequently reported to significantly reduce biological and ecological quality (Paul and Meyer 2011).

The major impact pathways of intensive agriculture are nutrient enrichment (eutrophication) and excessive fine sediment entries (habitat loss). While nutrient enrichment can directly affect algal and plant communities, the loss of coarse substrates affects fishes and invertebrates.

Naturally vegetated riparian buffer strips not only can buffer impacts from agriculture, but also provide habitat (woody debris, leaves), shelter (root wads, shade), food (wood, leaves, terrestrial insects) and energy (carbon and nitrogen) to the riverine assemblages (Allan 2004, Feld et al. 2011, *low uncertainty*).

Aquatic assemblages (e.g. fish and macroinvertebrates) significantly change their structural and functional composition, when the percent area as agriculture upstream exceeds 20% in mountain ecoregions (Figure 3) (*low uncertainty*). Lowland assemblages seem to respond less sharp to agriculture and significantly change values at 30–50% (*medium uncertainty*). These findings are in line with the thresholds reported by previous studies (e.g. Allan 2004).

Near-stream buffer areas along several kilometres upstream can help maintain biological diversity and functionality at a site, if a minimum of 40–50% within the buffer area is covered by forest (*medium uncertainty*). Ecological recovery may be promoted already by a minimum of 25% forested buffers upstream (*high uncertainty*). Yet it is important to note that the increase of forest cover alone is unlikely to mitigate the impacts of land use.

Intensive agriculture and other land uses characterise large parts of Europe and constitute potential broad-scale stressors for riverscapes and its ecology. This in particular applies to the agricultural lowlands of Eastern, Central and Western Europe. Without appropriate mitigation and management, the negative impacts of land uses are likely to continue to impact rivers and hence hinder recovery, irrespective of hydrological and morphological improvements. Consequently, restoration and river basin management *must* adequately address land use impacts. That is, restoration measures are required that i) are capable of mitigating land use impacts and that ii) address the appropriate scale of impact. Riparian buffers can be considered best practice. For instance, mixed riparian buffer strips (trees, shrubs, grass) have been proven to effectively retain nutrients and fine sediments from adjacent crop fields (see Feld et al. 2011 for a review). Buffer strips require several kilometres of length rather than tens or hundreds of metres.

Eventually, given the omnipresent character of agriculture, a re-organisation of land uses is needed and as a part of future river basin management. Conversion to less intensive land use forms in riparian areas will be most effective. This would require the reorganisation of agricultural policies in parallel.

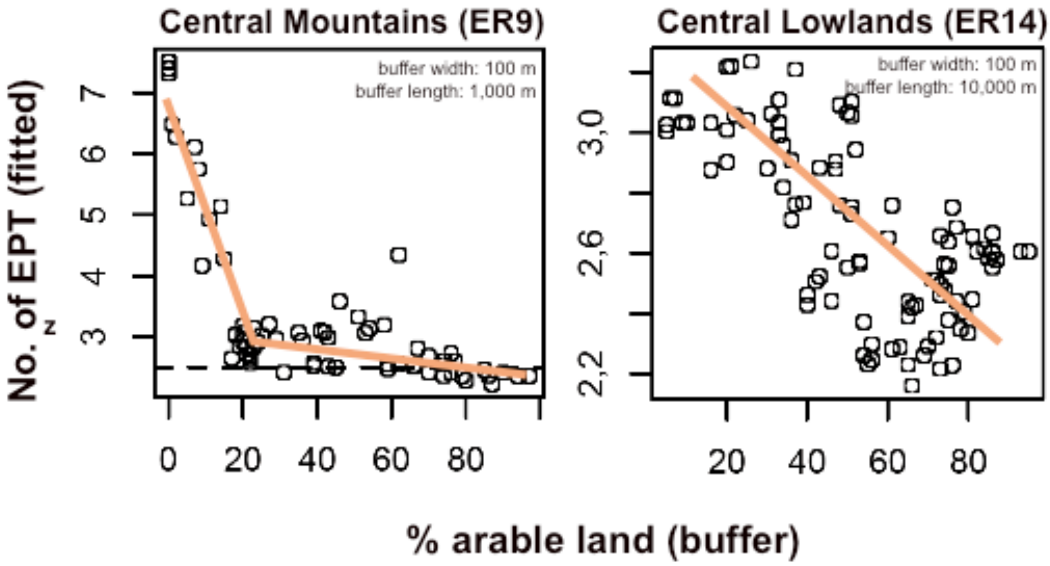


Figure 3: Boosted regression models identified the number of Ephemeroptera-Plecoptera-Trichoptera taxa (No. of EPT) to significantly decrease with increasing arable land in the riparian buffer of mountain rivers. A sharp decrease was obvious between 0 and 20% arable land. This decreasing trend is obvious too, although with less sharp the change, for lowland rivers. Note that the fitted values for EPT richness in lowland rivers mark a short gradient of one taxon difference only. The analysis was based on ca. 200 German macroinvertebrate samples in ecoregion (ER) 9 and 14. More in-depth results including fish and macrophytes are provided with WISER Deliverable D5.1-2.

Allan, J.D. (2004). Landscapes and riverscapes: The Influence of Land Use on Stream Ecosystems. Annu. Rev. Ecol. Evol. Syst. 35, 257–284.

Feld, C.K., Birk, S., Bradley, D.C., Hering, D., Kail, J., Marzin, A., Melcher, A., Nemitz, D., Petersen, M.L., Pletterbauer, F., Pont, D., Verdonschot, P.F.M. & Friberg, N. (2011) From natural to degraded rivers and back again: a test of restoration ecology theory and practice. Adv. Ecol. Res. 44, 119–209.

Paul, M.J., and Meyer, J.L. (2001). Streams in the urban landscape. Annu. Rev. Ecol. Syst. 32, 333–365.

Restoration is more likely to be successful, if upstream physical habitat degradation and land use impacts are low

Two previous statements address the predominant role of broad-scale stressors that may act at the scale of entire (sub-) catchments and consequently may impact any site within the catchment. Accordingly, river restoration is more likely to initiate and maintain biological recovery, if such broad-scale impacts are either completely missing or being mitigated in parallel to restoration at the fine (local) scale.

There is empirical evidence (*medium uncertainty*) from restoration monitoring that restoration measures can initiate biological recovery, if the physical habitat conditions several kilometres upstream of the restoration are only moderately modified or in better condition. In particular the fish and macrophyte assemblages were found to be strongly influenced by habitat quality up to 10 km upstream. Macroinvertebrate ecological quality was related to shorter stretches upstream (up to 2.5 km). Empirical analyses imply that about 1 km length upstream in a moderate or better physical habitat quality might suffice to promote biological recovery (*high uncertainty*).

Where broad-scale stressors impact ecological quality after restoration and may hinder recovery, such stressors require mitigation. Practitioners need to know the multiple stressors that may impact restoration candidate sites. They should prioritise those stretches that are least impacted by broad-scale stressors and thus may constitute stepping-stones within a broader restoration scheme. Local restoration measures need to be integrated into restoration schemes at the broad scale.

This broad-scale and integrated restoration is well referred to by the WFD and termed ‘River Basin Management’. Yet, it seems as if this broad-scale approach deserves more attention by scientists and practitioners in order to use the limited resources available most effectively for river restoration and management.

For a detailed analysis of the effects of upstream physical habitat quality and land use conditions on ecological quality assessment at restored and unrestored sites see Lorenz in WISER's Deliverable D5.1-2.

Climate change alters fish assemblage structure and function distribution in Europe

The Intergovernmental Panel on Climate Change predicted changes in temperature and precipitation in Europe for the periods 2020–2030 and 2050–2060. These changes are expected to greatly alter the distribution of fish, by providing more suitable habitats for species tolerating or preferring warm water, and by restricting species adapted to coldwater habitats. This implies that the reference condition baselines used to assess the ecological status of rivers based on fish would not be adequate in the future.

During the last three decades, the Alpine River Traun heated by on average 2.2 °C in August, which led to unsuitable thermal conditions for the grayling (*Thymallus thymallus*). The grayling population greatly decline in favour of more adapted species such as barbel (*Barbus barbus*, Figure 4). In lowland catchments (e.g. the Seine basin in France), the absence of possible thermal refugia in the upstream part of the catchment may amplify the risk of regional species extinctions (Figure 5).

Climate Change effects have to be taken into account in River Basin Management, for instance when using reference conditions as baselines for assessment or when designing restoration measures. If salmonid species, for example, go extinct in particular catchments, this requires consideration when setting the biological assessment reference in that catchment, or when defining the biological goals for restoration. Without consideration of Climate Change impacts, assessment runs the risk of misclassification. To evaluate such potential shifts, a monitoring network of reference sites in Europe may help inform the practitioners about potential consequences of global warming and its effects on both the biota and its abiotic environment.

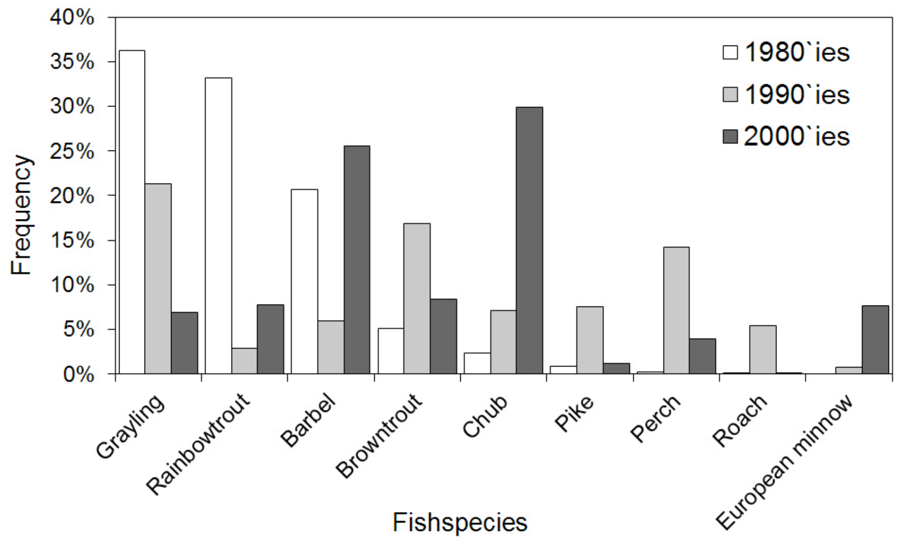


Figure 4: Shift of species composition from the 1980'ies until the 2000'ies in the River Traun in relation with an increase of water temperatures (on average +2.2°C).

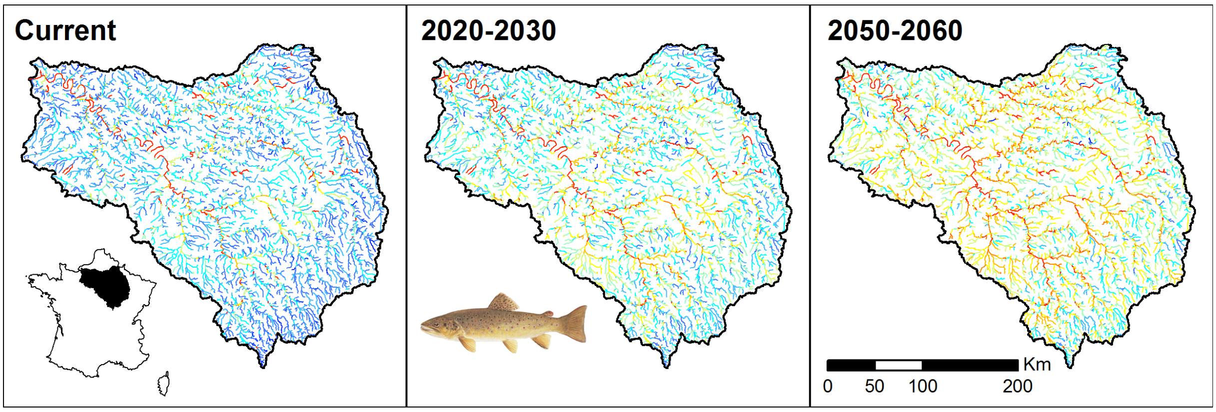


Figure 5. Probability of presence of the brown trout (Salmo trutta, L.) in the Seine river basin (France) derived from the species distribution models (Logez et al. 2011) for the (a) the current environment conditions, (b) projected climatic conditions for 2020-2030 and (c) for the projected climatic conditions for 2050-2060. Probabilities are computed for each stream reach of the CCM2 network (probabilities: — 0–0.1, — 0.1–0.2, — 0.2–0.3, — 0.3–0.4, — 0.4–0.5, — 0.5–0.6, — 0.6–0.7, — 0.7–0.8, — 0.8–0.9, — 0.9–1).

Logez, M., Bady, P. and Pont, D. (2011), Modelling the habitat requirement of riverine fish species at the European scale: sensitivity to temperature and precipitation and associated uncertainty. Ecology of Freshwater Fish 21: 266–282.

Climate warming causes profound changes in lake fish assemblages

Fish play a key role in the trophic dynamics of lakes. With climate warming, complex changes in fish assemblage structure may be expected owing to the direct effects of temperature and indirect effects of eutrophication, water level changes, stratification and salinisation. This means that warming will result in fish-mediated increase in eutrophication partly counteracting the effect of nutrient loading reduction. The response of fish to the warming in recent decades has been surprisingly strong, making fish ideal sentinels for detecting and documenting climate-induced modifications of freshwater ecosystems.

An analysis of the effect on fish assemblages to climate change and climate variability has been conducted based on long-term (10 to 100 years) data series from 24 European lakes. These lakes constitute an appropriate and tractable sample of the world's lakes since many of them have been monitored more intensively and for a longer period of time than have most lakes elsewhere. Profound changes in fish assemblage composition, size and age structure were found during the last decades and a shift towards higher dominance of eurythermal species. The shift has occurred despite an overall reduction in nutrient loading that should have benefited the fish species typically inhabiting cold-water low-nutrient lakes and larger-sized individuals.

The cold-stenothermic Arctic char has been particularly affected and its abundance has decreased in the majority of the lakes where its presence was recorded. The harvest of cool-stenothermal trout has decreased substantially in two southern lakes. Vendace (*Coregonus albula*), other whitefish and smelt have shown a different response depending on lake depth and latitude, with a drastic reduction in the Estonian Lake Peipsi. Perch was apparently stimulated in the north, with stronger year classes in warm years, but its abundance has declined in southern Lake Maggiore. Where introduced, roach now seems to take advantage of the higher temperature after years of low populations. Eurythermal species such as bream, pikeperch and shad are on the increase. The climate effects have overall been larger in shallow lakes.

The fish assemblage is not only affected directly by warming and changes in the thermal stability of the lakes. Numerous recent studies and reviews indicate that warming will exacerbate existing eutrophication problems and this will in a self-amplifying manner further stimulate a shift to dominance of eurythermal species. They typically tolerate low oxygen levels and high ammonia concentrations and prevalence of small fish. A reduced ice cover period will enhance fish survival, with potential cascading effects within the food web, also reinforcing eutrophication. Therefore, we can expect an allied attack by eutrophication and warming in lakes in the future and the shifts in abundance, size and composition will be reinforced and stimulated by this process.

Diatoms and macro invertebrates respond most strongly to general degradation already at low stress levels. This renders both organism groups weak indicators of local habitat improvement in degraded catchments, i.e. both groups are unlikely react to restoration unless broad-scale impacts are being remedied. Besides general and water quality degradation, fish and macro invertebrates respond most intensively to morphological degradation, structural modification and catchment land use. Fish respond strongly to hydrological degradation, too. Hence, river fauna reveals a more intense, but not necessarily more sensitive, responses to stress, compared to the flora. Overall, aquatic macrophytes were found to be comparatively weak indicators of the stressors considered.

The most obvious alterations encompass a decline in cold-stenothermal species, in particular in shallow lakes, an increase in eurythermal species even in deep, stratified lakes. Several case studies show a decrease in the average size of the dominant species roach and perch. This also means that warming will result in a fish-mediated increase in eutrophication partly counteracting the effect of nutrient loading reduction. It also implies that it will be more difficult to obtain the good ecological status required by the WFD in lakes facing temperature changes due to global warming. The way to (partly) counteract the effect of warming is to reduce the nutrient input to lakes even further than planned under the present-day climate. The response of fish to warming during recent decades has therefore been surprisingly strong, making fish ideal sentinels for detecting and documenting climate-induced modifications of freshwater ecosystems.

Jeppesen E., T. Mehner, I. J. Winfield, K. Kangur, J. Sarvala, D. Gerdeaux, M. Rask, H. J. Malmquist, K. Holmgren, P. Volta, S. Romo, R. Eckmann, A. Sandström, S. Blanco, A. Kangur, H. R. Stabo, M. Meerhoff, A.-M. Ventelä, M. Søndergaard, T. L. Lauridsen (submitted). Impacts of climate warming on lake fish assemblages: evidence from 24 European long-term data series.

A tool helps estimate effects of nutrient load reduction under a variety of climate scenarios

Nutrient assimilation capacities of European lakes were estimated using a large data. The effect of climate warming on eutrophication proved to be positive. Thus, in warmer climatic conditions, an effective reduction of nutrients is needed to achieve a good ecological condition. A model was developed and included in the LakeLoadResponse (LLR) Internet tool, which can be used by water managers to estimate the reduction of nutrient load required at present and under changing climate conditions.

The linear mixed effects model is based on chlorophyll a data from 351 European lakes. The effect of total phosphorus, total nitrogen and water temperature on chlorophyll a concentrations varied among lake types, individual lakes within a type and individual samples within a lake. The amount of variation was significantly reduced using a linear mixed effects model for nested data. The statistical inference was based on a Bayesian approach thus giving a more realistic assessment of the effect of model uncertainty. The model is implemented in an Internet tool and has been successfully used for the planning of restoration measures in Finland.

Using the LLR tool, it is possible to test how the changes in water temperature affect the nutrient reduction required to achieve good ecological status. The LLR delivers predictions on water quality status with statistical confidence intervals to give more insight for the management actions. If combined with a map-based web service, the model can help water managers illustrate the forecasted effects in maps. For instance, the effect of fisheries management will be analyzed using extensive data from Finnish lakes in the GisBloom project (Life+, duration 2010–2013).

A description of the mixed chlorophyll a model can be derived from WISER Deliverable 5.2-4: “Internet tool (model to assess target loads) for lake managers”. Further instructions of the LLR internet tool and descriptions of the underlying models are available at http://lakestate.vyh.fi.

Lake sediments provide insight into the history of the conditions of individual lakes and, hence may assist the definition of reference conditions

Throughout Europe the majority of lakes have been modified to some extent by human activity with agriculture and sewerage being the major contributors to eutrophication, most notably since the mid-twentieth century. As a consequence, higher algal productivity has lead to filtration problems for the water industry, oxygen depletion, recreational impairment, loss of biodiversity and an overall decline in habitat quality.

Lake sediment analysis provides unique insights into the history of lake ecosystems, including evidence for the nature and timing of ecosystem change resulting from human impact. Palaeoecological methods can reveal pre-impact conditions as well as identifying any signs of recovery and have played a key role in the WFD in determining pre-enrichment reference conditions. Diatom records have proved especially valuable in this respect, largely due to their sensitivity to shifts in trophic status. In the absence of long-term chemical monitoring analysis of lake sediments can provide evidence not only of the pre-eutrophication baseline conditions, but also help track degradation and recovery pathways and thus provide a valuable tool for informing restoration programmes.

By relating fossil diatom records to modern diatom assemblages collected across wide environmental gradients, very good estimates of past lake water chemistry can be inferred and an environmental history tracked down through the sediment record. With the application of radiometric dating, the timing and rate of changes can be determined and pre-impact (reference) conditions established. In many European lakes, diatoms have provided clear evidence that the onset of eutrophication was associated with changes in agricultural practice and urban development, particularly since the mid-twentieth century.

Furthermore, where restoration programmes are underway it might be expected that the diatom record would show a reversal in the degradation pathway, but instead, diatom-based metrics often exhibit an alternative recovery pathway. This demonstrates that a reduction in one or more environmental stressors may not ultimately return a lake to reference conditions, but instead other processes such as internal nutrient loadings and climate change may determine the rate and direction of recovery.

Lake sediments provide a valuable means by which reference conditions may be established in lakes. Furthermore, environmentally sensitive organisms such as diatoms may be used to determine both the degradation and the recovery process. In terms of lake management, while it is important to be able to identify baselines it should also be recognized that recovery may not simply be the reverse process of the degradation pathway and that the reference state may perhaps never be achievable in some lakes. The evidence suggests that recovery is more predictable in deep stratified lakes than shallow lakes, where top-down processes exert a major environmental control, but that in all cases the recovery process has a long way to go before reaching pre-impact conditions.

This work highlights the important role that paleolimnological approaches can play in establishing a benchmark against which managers can evaluate the degree to which their restoration efforts are successful. Diatoms are just one of many biological groups preserved in sediments and by extending this work to use multiple assemblages it is possible to evaluate wider ecosystem responses to environmental stressors. These multi-proxy palaeoecological techniques therefore have an important role to play in assessing degradation and recovery pathways and informing lake management in order to satisfy the aims of the Water Framework Directive.

Bennion, H. and Battarbee, R.W. (2007) The European Union Water Framework Directive: opportunities for palaeolimnology. Journal of Paleolimnology, 38, 285-295.

Bennion, H., Battarbee, R.W., Sayer, C.D., Simpson, G.L. and Davidson, T.A. (2011) Defining reference conditions and restoration targets for lake ecosystems using palaeolimnology: a synthesis. Journal of Paleolimnology, 45, 533-544.

Bennion, H., Simpson, G.L., Anderson, N.J., Dong, X., Hobaeck, A., Guilizzoni, P., Marchetto, A., Sayer, C.D., Thies, H. and Tolotti. M. (2011) Defining ecological and chemical reference conditions and restoration targets for nine European lakes. Journal of Paleolimnology, 45, 415-431.

Hypoxia renders ecosystem recovery more difficult

Coastal hypoxia is increasing in the global coastal zone, where it is recognized as a major threat to biota. Hypoxia is defined as oxygen concentrations below a certain value, typically 2 ml/l or 2 mg/l, but the deleterious effects on the ecosystem already start at higher oxygen concentrations. Knowing the thresholds that fundamentally lead to a change in ecosystem functioning is important to quantify for management. Moreover, these thresholds are not static but regulated by other processes, associated with both local and global pressures on the system, particularly warming. Exceeding the critical thresholds associated with hypoxia may require even further nutrient reductions to restore a well-functioning benthic community. However, recovery from hypoxia is possible.

The literature is populated with studies documenting decreasing oxygen concentrations associated with eutrophication, and how this affects the structure and functioning of the benthic community. Many coastal ecosystems in Europe and North America have now experienced decreasing inputs of nutrients, although the expected improvement of oxygen conditions and re-establishment of benthic fauna is only observed for a few systems, e.g. Delaware River and Stockholm Archipelago (Figure 6). In these systems the recovery took decades following drastic reductions in nutrient inputs. Many other coastal ecosystems show no signs of improvement, despite reduced levels of nutrients and chlorophyll.

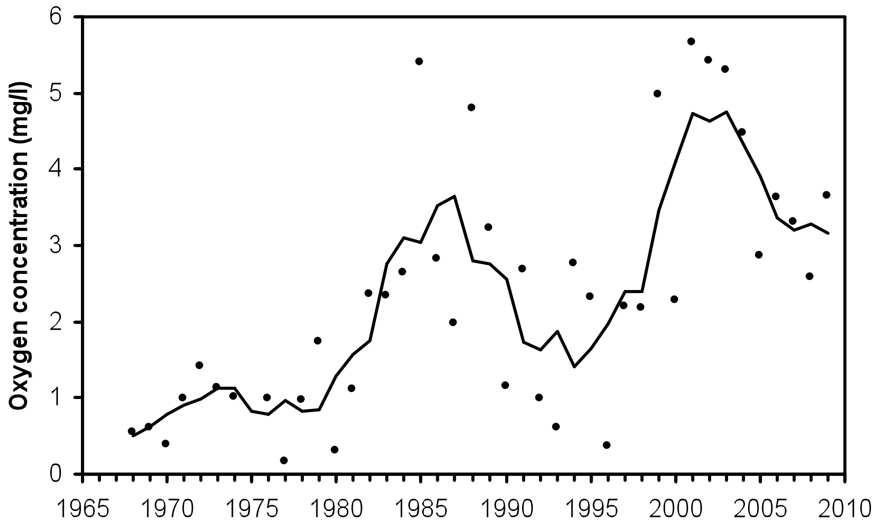


Figure 6: Annual mean bottom water oxygen concentrations from stations located in the Inner Stockholm Archipelago (compiled from data kindly provided by C. Lännergren, Stockholm Vatten).

Hypoxia is known to alter the biogeochemical processing of nutrients leading to feed-back mechanisms through reduced nitrification and releases of iron-bound phosphorus. Moreover, the loss of bioturbating macrofaunal organisms following hypoxia reduces the efficiency of nutrient removal processes. Therefore, hypoxia is a self-sustaining process and ecosystems should be managed to maintain oxygen levels about critical thresholds that imply a collapse of the benthic community. Coastal ecosystems can, however, recover from hypoxia, but so far this has only been observed for systems with large reductions in nutrient inputs and even so, still taking decades to recover. However, re-establishment of sound benthic communities can significantly enhance the recovery process. These experiences suggest that hypoxia introduces a hysteresis response to the nutrient pressure.

Steckbauer, A., Duarte, C.M., Carstensen, J., Vaquer-Sunyer, R., Conley, D.J. (2011) Ecosystem impacts of hypoxia: thresholds of hypoxia and pathways to recovery. Environmental Research Letters 6:025103, doi:10.1088/1748-9326/6/2/025003.

Ecological regime shifts affect seagrass pressure-indicator responses and delay recovery

Ecological regime shifts affect the response of seagrass indicators to pressures and may delay restoration of seagrass meadows upon release of pressure.

We quantified and compared benthic and pelagic gross primary production (GPP) along nutrient gradients in time and space in a shallow estuary. The estuary experienced a shift from a pristine, seagrass-dominated clear water regime with high total GPP in the early 20st century to a eutrophic, plankton-dominated regime still with high total GPP in the 1980s when nutrient loadings peaked. Recent reductions in nutrient loadings reduced pelagic GPP as expected, but the water remained unclear and seagrass abundance and GPP did not increase correspondingly. The results suggest that feedback mechanisms, such as increased resuspension of the seafloor and reduced trapping of particles and nutrients, resulting from the loss seagrasses and their associated ecosystem services delay or prevent restoration to a state with seagrass dominance.

Ecosystems do not necessarily respond linearly to changes in nutrient loadings and that the response to eutrophication and oligotrophication may follow different trajectories. Reductions in nutrient loadings to levels below those causing the decline in seagrasses may be necessary, along with initiatives to e.g. reduce the disturbance of the seafloor, in order to stimulate a return to a seagrass-dominated state.

Krause-Jensen D, Markager S, Dalsgaard T (2011) Benthic and pelagic primary production in different nutrient regimes. *Estuaries and coasts*. DOI 10.1007/s12237-011-9443-1

Integration and optimisation (Module 6)

Uncertainty may vary between different metrics calculated for the same BQE

Many different assemblage metrics (e.g. using various combinations of taxon tolerance values, richness, abundance, traits) can be calculated for a single BQE. The selection of candidate metrics for assessment should be informed by the residual sampling variance of individual metrics, as well as their indicator value for particular stressors. This variability can itself vary considerably among different metrics describing the same BQE.

Some comparisons could be made between alternate metrics based directly on taxonomic composition (including morpho-types) and metrics based on bio-physical (e.g. macrophyte maximum colonisation depth) or biochemical measures (e.g. chlorophyll a concentration). Results were mixed. Improved taxonomic resolution reduces uncertainty of taxonomy-based metrics: Phytoplankton PTI metric (taxonomic) showed clearly lower uncertainty than SPI metric (based on phytoplankton size groups). Replicate sampling uncertainty for chlorophyll a was low.

In general, metrics with low sampling uncertainty relative to their stressor response should be used. Metric specification is likely to need to include specification of sampling and laboratory protocols. Status assessment can be made more precise if it combines taxonomic and biophysical/biochemical measurements which show low sampling uncertainty, but metrics with high sampling uncertainty should not be used or combined.

Detailed descriptions of the data basis, analytical methods and results may be found in WISER's Deliverable D3.1-3 ('Report on uncertainty in phytoplankton metrics') and D3.2-2 ('Report on uncertainty in macrophyte metrics'). Both Deliverables are downloadable from www.wiser.eu/results/deliverables/.

Spatial heterogeneity is the main source of uncertainty when classifying ecological status using marine macrophyte indices

A wide variety of methods that use macrophyte communities for water body quality assessment fulfilling the complex requirements of the WFD have been developed by different Member States. Uncertainty analyses are a powerful tool to identify and quantify the factors contributing to the potential misclassification of the ecological status class of water bodies. When applied to different classification methods based on macrophytes, uncertainty analyses revealed that the factors related to the spatial scale of sampling (both horizontal and vertical) are the main source of uncertainty. On the contrary, the uncertainty associated to both temporal variability and surveyor is very low. In addition, the risk of misclassification also depends on the width of the status class in which the EQR score falls, with narrower range classes leading to greater probabilities of misclassification. Thus, indices which EQR range is not equally split into the 5 official quality status classes present different uncertainty levels along the EQR range.

We conducted uncertainty analyses on EQR datasets of monitoring programmes using different macrophyte-based classification methods developed by different European Member States (Norway, Denmark, Bulgaria, Spain, Croatia, Italia and Portugal). These datasets included factors representative of the key sources of variability associated with the design and implementation the monitoring programs: the spatial and temporal scales of sampling, as well as the human-associated source of error. The spatial scale of sampling accounted for an average proportion of 39±10.2% of total variance among the different indices, whilst the temporal scale and the human-associated source of error only 4.5 ± 1.5% and 2 ± 2% respectively (in mean ± SE).

This study identifies the elements of a sampling design constraining the reliability and robustness of the ecological status classification of coastal water bodies. Once the major sources of variability are known, they can potentially be minimised through the re-design of sampling schemes, through improved training by operating procedures, etc. Horizontal spatial heterogeneity must be captured by sampling at different scales, providing robust estimates of the ecological quality status classification at the water body level that minimize the risk of misclassification. Depth should remain fixed or be controlled in monitoring programs in order to minimise vertical heterogeneity, except for indices based in the depth limit of macrophyte communities. Those indices where the distance between boundary classes is not uniform across the EQR range may need to assign a greater sampling effort to water bodies whose EQR score falls within the narrower status classes, in order to reduce their associated variability and increase the confidence of the classification. In contrast, sampling frequency has little effect on the precision of ecological status estimates.

Oriol Mascaró, Teresa Alcoverro, Kristina Dencheva, Dorte Krause-Jensen, Núria Marbà, João Neto, Vedran Nikolić, Sotiris Orfanidis, Are Pedersen, Marta Pérez, Javier Romero. Exploring the robustness of different macrophyte-based classification methods to assess the ecological status of coastal and transitional ecosystems under the WFD. Hydrobiologia.

A smart sampling design helps reduce the uncertainty in lake assessment

The sources of uncertainty in water body assessment are manifold, but in part can be subjected to methodological issues. A smart sampling design may help reduce the level of uncertainty caused by, for instance, spatial and temporal variability or by individual researcher-dependent skills. In brief:

- Phytoplankton assessment should be based on at least 6 samples from the pelagic euphotic zone with higher frequency in eutrophic lakes, especially to catch harmful blooms. Standard methods and training should be used for sampling and analyses.
- Macrophyte field method should be based on transects covering all depth zones and different habitats.
- Macroinvertebrate assessment of shoreline modifications should be based on composite or habitat specific sampling (depending on region) at various stations representing the whole range of morphological shore modification.
- Fish assessment should be based on sampling of all depth strata with many gillnets. Hydroacoustic methods provide cost-effective assessment of fish abundance.

Within-lake variability of the various BQE metrics has been assessed from new WISER data sampled in ca. 21–51 lakes in 2009. 21 lakes were sampled for all four BQEs, while additional lakes were sampled for some BQEs. Within-lake variability caused by natural spatial variation, as well as variability related to sampling and analyses, was low for phytoplankton (Table 4 and 5), although this BQE revealed a higher temporal variability related to sampling frequency. To minimize the risk of misclassification lake phytoplankton should be sampled on several occasions, although the minimum recommended frequency may vary dependent on the metric and GIG. Sampling should be more frequent in eutrophic lakes to increase the probability of catching harmful blooms.

For lake macrophytes, the metrics tested for variability is on the average 25–30% with station as the major variance component (Dudley et al. 2011). Thus, to reduce misclassification of macrophyte metrics several stations should be sampled to cover all major habitat types in the littoral zone, and sampling at each station should also cover the whole vertical extension of the littoral zone. The latter is important as nutrient enrichment reduces the growing depth of macrophytes. Assessment methods based on real hydrophytes are most sensitive to eutrophication, whereas helophytes are less affected by water quality. Helophytes should be sampled if water level fluctuation or hydromorphological changes are assessed.

Table 4: Major sources and levels of uncertainty detected for the lake BQEs within the WISER project. (Taken from Mischke et al. 2012)

BQE	Major variance component	Overall natural + methodological variability
Phytoplankton	Temporal (seasonal)	Small (< 25%)
Macrophytes	Spatial	Medium (30%)
Benthic fauna	Spatial (station)	Medium (30–40%)
Fish fauna	Spatial (depth stratum)	Large (> 90%)

For littoral macroinvertebrates, the major sampled variability was between sites, but this was partly (8–12%) due to consistent effects of morphological habitat modification type. Thus habitat specific sampling at various stations for each level of morphological modifications of the habitat will probably reduce the metric variability.

Table 5: Metric precision given as proportion of the total variance (i.e. within- and between-lake variance) due to within-lake variability, and major within-lake variance components for four BQEs. Metrics with the lowest within-lake variance are the most precise whole-lake metrics. For benthic invertebrates, the in-lake variance incorporates variability associated with different levels of morphological pressure. See table 2 for explanation of metrics. (taken from Thackeray et al. 2012)

BQE	Metric	Within lake variance (excluding temporal variability*)	Major variance component (excluding temporal variability*)
Phytoplankton*	Chl-a	0.04	Sub-sampling
	PTI	0.12	Sub-sampling
	SPI	0.35	Analyst
	MFGI	0.14	Sub-sampling
	J' (Evenness)	0.31	Analyst
	Cyano blooms intensity	0.06	Sub-sampling
Macrophytes	ICM	0.28	Station
	EI	0.26	Station
	Cmax	0.30	Station
Benthic fauna	Evenness	0.73 **	Station
	NTaxa	0.37 **	Station
	NTaxa EPTCBO	0.44 **	Station
	%POM_HabPref	0.52 **	Station
Fish	BPUE (log10)	0.999	Depth stratum
	CPUE	0.962	Single gillnets

*Temporal variability in phytoplankton is estimated to ca. 14% (coefficient of variation) for monthly sampling in some UK lakes. For more info on temporal variation and recommendations of sampling frequency, please see Mischke et al. 2012.
** includes within-lake variance of 8-12% due to margin modification type (Undisturbed ,Soft modifications, Hard modifications)

For fish the major variance component is depth stratum, implying that fish metrics should not be assessed without sampling all the depth strata in a lake. Biomass estimated from hydroacoustic methods versus that estimated from gill nets are well correlated in most lakes, except in very deep lakes (mean depth >30m) where hydroacoustic methods give higher estimates than gill nets for the deeper strata. Different BQEs and metrics require different monitoring and sampling designs based on the dominant sources of uncertainty.

For phytoplankton, the greatest source of variability is seasonal variability and analytical variability. The former can be reduced by utilising metrics based on repeated sampling during specific seasons (e.g. growth season or summer months) with higher frequency in eutrophic lakes, especially to catch harmful blooms. Minimum sampling frequency varies by metric and GIG, but should always cover the late summer period. The analytical variability can be reduced by following standard counting guidance and consistent training within Member States and across Europe.

Macrophyte field method should be based on transects covering the whole depth zone and different littoral habitats. Sampling can be restricted to hydrophytes in lakes dominated by eutrophication pressure, whereas helophytes should be sampled if water level fluctuation or hydromorphological changes are assessed. More transects are needed at both ends of the trophic gradient to reduce uncertainty in status assessment.

Macroinvertebrate assessment of shoreline modifications should be based on composite or habitat specific sampling (depending on region) at various stations representing the whole range of morphological shore modification. The calculation of the whole-lake assessment score may be supported by conducting a physical habitat survey along the whole lake perimeter, relating this to the respective biological MMI, and then calculate a weighted average of site-specific MMI scores.

Fish assessment should be based on sampling of all depth strata with many gillnets. Hydroacoustic methods provide cost-effective assessment of fish abundance.

Dudley B, Dunbar M, Penning E, Kolada A, Hellsten S, & Kanninen A. 2011. WISER Deliverable D3.2-2: Report on uncertainty in macrophyte metrics

Mischke, U., Stephen Thackeray, Michael Dunbar, Claire McDonald, Laurence Carvalho, Caridad de Hoyos, Marko Jarvinen, Christophe Laplace-Treyture, Giuseppe Morabito, Birger Skjelbred, Anne Lyche Solheim, Bill Brierley and Bernard Dudley 2012. Deliverable D3.1-4: Guidance document on sampling, analysis and counting standards for phytoplankton in lakes.

Thackeray S, Nõges P, Dunbar M, Dudley B, Skjelbred B, Morabito G, Carvalho L, Phillips G, Mischke U. 2011. WISER Deliverable D3.1-3: Uncertainty in Lake Phytoplankton Metrics, June 2011.

Winfield, I. J., Emmrich, M., Guillard, J., Mehner, T., Rustadbakken, A., 2011. Guidelines for standardisation of hydroacoustic methods. WISER deliverable 3.4-3.

The 'one-out all-out' principle for combining multiple BQEs into an integrated classification must be applied with caution

Although the WFD requires the use of the 'one-out all-out' rule in classifying the biological status of a water body, its strict application is not always recommended because of the risk of downgrading sites too easily. The 'one-out all-out' rule works best if the redundancy between BQEs is as low as possible.

The 'one-out all-out' (OOAO) is the required principle by the WFD, classifying the biological status of a water body on the basis of the biological quality element (BQE) with the worst class score. This rule is very precautionary, based on the assumption that different BQEs respond to pressures in different ways and that there is a need to protect the most vulnerable biological group. However, its strict application is not always recommended because there is a risk of downgrading sites too easily.

Simulations with artificial data demonstrated that, when combining multiple BQEs that are sensitive to the same pressures or combination of pressures, the OOAO rule produced unbiased results and good class agreement only when metrics had a low level of uncertainty (SD ≤0.01), which in practice is very difficult to achieve. The reliability of the classification was already very sensitive at a moderate level of metric uncertainty (SD >0.05). An alternative rule tested for combining the same set of BQEs was the average rule, producing better results for high uncertainty metrics. However this is not in accordance with the WFD guidance, as averaging among BQEs is not recommended.

The uncritical application of the 'one-out all-out' (OOAO) principle could pose the danger of downgrading status class of water bodies too easily. In particular, water managers should be careful when multiple BQEs that are redundant for detecting the same pressure, or combination of pressures, need to be combined into a water body assessment. It has been demonstrated that the OOAO approach only gives acceptable and comparable results if the different BQEs are complementary, showing the effects of different pressures, on different temporal and/or spatial scales, on different aspects of ecosystem functioning. Also the level of uncertainty in the biological metrics and in the BQEs used in the assessment should not be too high and not too different between BQEs.

Restoration can only be successful when all pressures are tackled simultaneously

Multiple pressures often simultaneously affect aquatic ecosystems, so consequently restoration must address these stressors simultaneously in order to be successful. For example, both the decrease in pH and increase in ammonium concentrations are associated with acid deposition. Phosphorus and nitrogen concentrations usually increase as a result of fertiliser run-off and the reduction of current speed coupled with an increase in siltation rate are associated with river canalisation. However, pressures are often water category specific. In general, rivers integrate the adverse effects of various human activities and associated pressures within a catchment, with hydromorphological degradation predominating, lake ecosystems are mainly affected by eutrophication and shoreline modification (at the global scale) and acidification (at the regional scale), while estuaries and coastal waters comprise the ultimate sink for nutrients, contaminants and other sources of pollution originating from entire river basins and are being physically.

In most restoration projects measures are taken to reduce the primary stressor, but secondary stressors often confound recovery (see Figure 7). Confounding factors such as water quality, with particular emphasis on nutrient enrichment, large-scale hydrological change such as floods and droughts and catchment management/land use and multiple pressures cause delays or failures in aquatic system recovery.

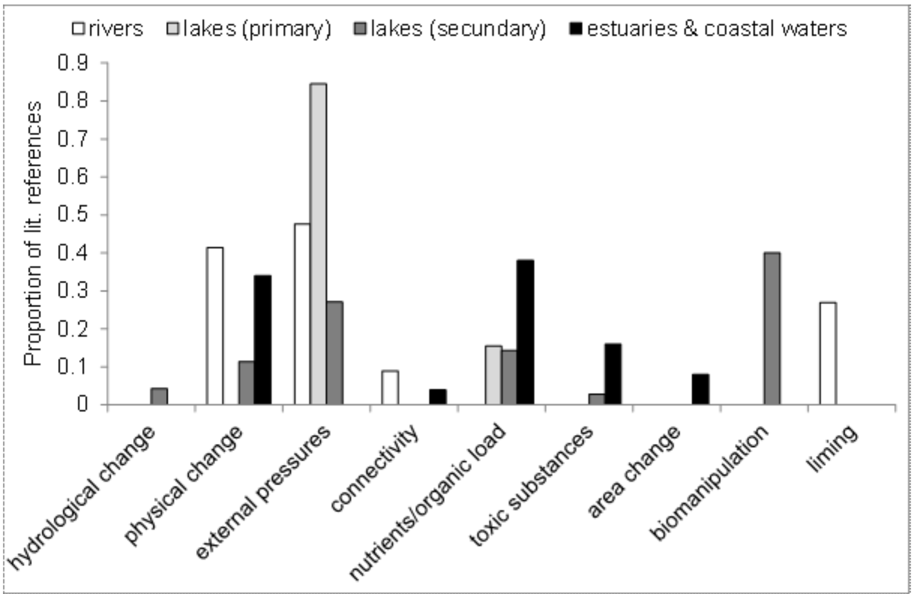


Figure 7: Proportion of literature references relating to restoration measures taken in rivers, lakes, estuarine and coastal waters, respectively.

Recovery has not necessarily failed, but the presence of secondary pressures may have pushed response times beyond those over which monitoring is typically performed. Acidification, fisheries management, industrial pollution, non-native species and climate change were the main secondary pressures impacting de-eutrophication projects in aquatic systems. Especially, internal P loading slows down recovery in many eutrophied lakes.

Recovery depends on the type and magnitude of the pressures, especially if some are still present, and on the organism group(s) used to assess recovery. Delays in recovery can be attributed to several factors, and different water types are exposed to different combinations of pressures resulting in differences in response times.

What restoration ecology more in general, needs is:

- Definition of clear goals for restoration at catchment scale that are based on recent biological monitoring results and the actual distribution of targeted species or communities.
- Identification of best-practice restoration measures to address the specific pressures.
- Balancing all measures within a catchment in order to reach the best possible synergy effects of single component measures, and ultimately to achieve recovery of the entire catchment.

Borja, A., Dauer, D.M., Elliott, M. and Simenstad, C.A. 2010. Medium- and long-term recovery of estuarine and coastal ecosystems: patterns, rates and restoration effectiveness. Estuaries and Coasts 33: 1249–1260.

Feld, C.K., Birk, S., Bradley, D.C., Hering, D., Marzin, A., Melcher, A., Nemitz, D., Pedersen, M.L., Pont, D., Verdonschot, P.F.M., Friberg, N., Natural, F., Feld, C.K., Birk, S., Bradley, D.C., Hering, D., Kail, J., Marzin, A., Pletterbauer, F. & Pont, D. (2011) From natural to degraded rivers and back again : a test of restoration ecology theory and practice. Advances in Ecological Research, 44, 119–209.Søndergaard, M., Jeppesen, E., Lauridsen,T.L., Skov, C., Van Nes, E.H., Roijackers, R., Lammens, E. and Portielje, R. 2007. Lake restoration: successes, failures and long-term effects. Journal of Applied Ecology 44: 1095-1105.

Jowett, I.G., Richardson, J. and Boubée, J.A. 2009. Effects of riparian manipulation on stream communities in small streams: Two case studies. New Zealand Journal of Marine and Freshwater Research 43: 763–774.

Spears, B, Gunn, I., Meis, S. and May, L. 2011. Analysis of cause-effect-recovery chains for lakes recovering from eutrophication. CEH-report. Contribution to Deliverable D6.4-2.

Recovery takes time, long time

Long-term studies of recovery in rivers, lakes and estuarine and coastal waters are scarce (Figure 8). One important question before comparing time spans of recovery between water categories is the definition of 'full recovery'. 'Full recovery' refers to an optimal functioning of the aquatic ecosystem under the given environmental circumstances that are not or only slightly changed by human activity. Literature for both riverine and marine systems addresses this issue (Table 6), while for many lakes in lowland areas focus is more on a shift from turbid to clear water states.

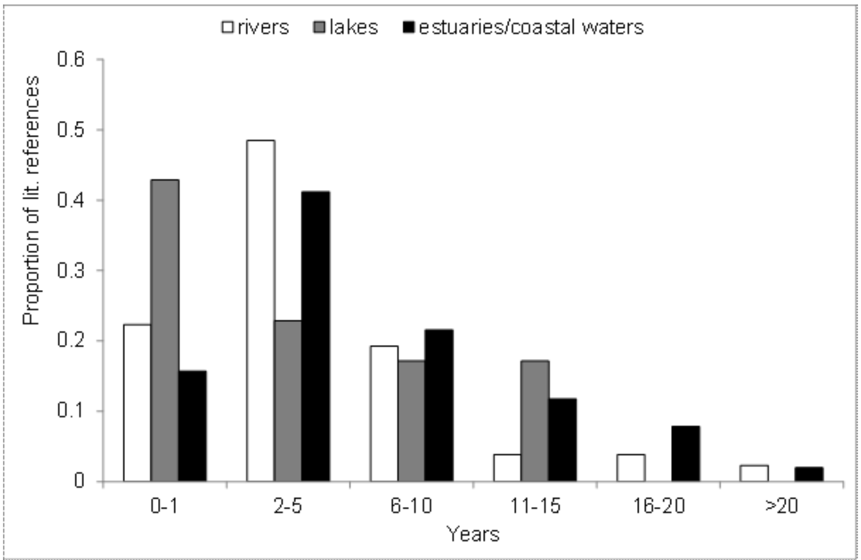


Figure 8: Proportion of literature references that reported on specific biological quality elements in river, lake and estuarine and coastal water restoration studies.

Monitoring for a large proportion of studies was < 5 to 10 years, and only a few studies (one each) in rivers and estuarine and coastal waters extended >20 years.

Table 6: Summary of time for recovery, for different biological elements and substrata, under different pressures. (Taken from Borja et al. 2010)

Pressure	Substrata	Intertidal/subtidal	Biological elements	Time for recovery
Sediment disposal	Soft	Intertidal	Meio and macrofauna	3-18 months
Marsh restoration	Soft	Subtidal	Fishes	1-2 yr
Oxygen depletion	Soft	Subtidal	Macroinvertebrates	2 yr
Land claim	Soft	Intertidal	Macroinvertebrates	2 yr
Oil-refinery discharge	Soft/Hard	Intertidal/Subtidal	Macroinvertebrates, fishes	2-3 yr
Dyke and marina construction	Soft	Intertidal/Subtidal	Macroinvertebrates, fishes	2-3 yr
Lagoon isolation	Soft	Subtidal	Molluscs	>3 yr
Aggregate dredging	Soft	Subtidal	Macroinvertebrates, epifauna	2-4 yr
TBT	Soft	Subtidal	Macroinvertebrates	3-5 yr
Dredging	Soft	Intertidal/subtidal	Seagrasses, macroinvertebrates, fishes	2->5 yr
Sediment disposal	Soft	Subtidal	Seagrass, Macroinvertebrates, fishes	>5 yr
Eutrophication	Soft	Subtidal	Macroinvertebrates	>3->6 yr
Realignment of coastal defences	Soft	Intertidal	Marshes and macroinvertebrates	>6 yr
Fish farm	Soft	Subtidal	Macroinvertebrates	2->7 yr
Physical disturbance	Soft/Hard	Intertidal/Deep-sea	Macroinvertebrates, megafauna	3->7 yr
Pulp mill	Soft	Subtidal	Macroinvertebrates	6-8 yr
Oil-spill	Soft/hard	Intertidal/subtidal	Various	2-10 yr
Fish trawling	Sand-gravel	Subtidal	Macroinvertebrates, fishes	2.5-10 yr
Wastewater discharge	Soft	Subtidal	Fishes	3-10 yr
Sewage sludge disposal	Soft	Subtidal	Macroinvertebrates	3->14 yr
Mine tailings	Soft	Subtidal	Macroinvertebrates	4->15 yr
Marsh and tidal restoration	Soft	Intertidal/subtidal	Vegetation, fishes, birds	5-20 yr
Wastewater discharge	Soft	Subtidal	Macroinvertebrates, seagrasses	7-20 yr
Land claim	Soft	Subtidal	*Zostera marina*	>20 yr
Wastewater discharge	Hard	Intertidal	Macroalgae	>6->22 yr

Large discrepancies exist between the length of monitoring programmes and the time needed for the ecosystem to reach 'full recovery'. Although most studies do not address 'full recovery', some estimates are available. Recovery after weir removal may take as long as 80 years. Recovery after riparian buffer instalment may take at least 30–40 years. In lakes, time for recovery from eutrophication varies from 10–20 years for macroinvertebrates, 2 to >40 years for macrophytes, 2 to >10 years for fish. Natural recovery from acidification takes much longer compared to recovery after liming, and like eutrophication, biological recovery is taxon specific and often decades are needed to achieve pre-disturbed conditions. Estuarine and coastal waters have long periods of recovery (>10 years), although macroinvertebrates have the potential to recover within months to <5 years though mostly take >6 years. Fish recover within one to three years, depending on the type and intensity of pressure. In general, after intense and large pressures, periods of 15–25 years for attainment of the original biotic composition, diversity and complete functioning may be needed in all three water categories.

In both rivers and lakes the success rate of restoration measures appears to be much higher for the abiotic conditions than for the biotic indicators, this is particular true for hydromorphological restoration and liming. Since eutrophication is considered also to be an important pressure in rivers and lakes, this might be a major cause of hampering recovery. In lakes internal nutrient loading often delays recovery. For rivers the response of macroinvertebrates to hydromorphological restoration is questionable; some studies have shown recovery while other studies do not possibility due to the still too high nutrient levels.

Only from monitoring of biological and environmental changes after restoration can new knowledge on recovery processes can be gained and implemented. Indeed, this information provides the opportunity for practitioners and scientists to evaluate the success and efficacy of the restoration measures. Restoration monitoring requires a tailor-made sampling design (preferably a BACI-design) that allows of sound statistical analysis according to state-of-the-art methods. Surprisingly, the BACI design is primarily applied to experimental studies. A Before-After-Control-Impact (BACI) monitoring design is considered the best approach for monitoring recovery, as only this approach is capable of detecting actual effects of restoration from other natural effects, such as seasonal or annual variability.

Bernhardt, E.S., Palmer, M.A., Allan, J.D., Alexander, G., Barnas, K., Brooks, S., Carr, J., Clayton, S., Dahm, C., Follstad-Shah, J., Galat, D., Gloss, S., Goodwin, P., Hart, D., Hassett, B., Jenkinson, R., Katz, S., Kondolf, G.M., Lake, P.S., Lave, R., Meyer, J.L., O'Donnell, T.K., Pagano, L., Powell, B. and Sudduth, E. 2005. Synthesizing U.S. River Restoration Efforts. Science 308: 636–637.

Borja, A., Dauer, D.M., Elliott, M. and Simenstad, C.A. 2010. Medium- and long-term recovery of estuarine and coastal ecosystems: patterns, rates and restoration effectiveness. Estuaries and Coasts 33: 1249–1260.

Gray, J.S. and Elliott M. 2009. Ecology of Marine Sediments: science to management. OUP, Oxford, 260 pp.

Reitberger, B., Matthews, J. , Feld, C.K., Davis, W. and Palmer, M.A. 2010. River monitoring and indication of restoration success: comparison of EU and BCG frameworks. University of Duisburg-Essen, Essen, 154 pp.

Smith, E.P., Orvos, D.R., and Cairns, J. 1993. Impact assessment using the before-after-control-impact model: concerns and comments. Can. J. Fish. Aquat. Sci. 50: 627–637.

4.1.4 Potential impact and main dissemination activities and exploitation of results

The main impact of the WISER project was achieved through strong support to the implementation of the WFD and other related European directives and policies. The project provided European countries in major regions (Scandinavia, Central and Eastern Europe, Mediterranean) with the scientific knowledge and tools necessary for a reliable assessment of the ecological status of all surface water categories, related to both direct human-induced pressures and the effects of global and climate change. These tools will facilitate planning and adjustment of the programme of measures in the river basin management plans to ensure that the WFD objective (good ecological status) is attained in as many water bodies as possible. Overall, WISER had impact on the implementation of European water policies by:

- Developing indicator for those biological quality elements and water categories (e.g. transitional waters) that were not sufficiently developed by national research programmes or by previous EU research projects on project start (Modules 3 and 4).
- Providing harmonised assessment methodologies for a large number of water categories and BQEs, including tools to estimate their uncertainty with regard to spatial and temporal variability.
- Supporting the intercalibration exercise with suggestions on both common metrics suitable for a comparison of national assessment results at the large scale and appropriate methodologies to compare the results.
- Identifying low cost monitoring methods (e.g. through pigment sensors) and approaches for monitoring ecological status and for intercalibration of member states' ecological status assessment systems (Modules 3 and 4).
- Guidance on restoration, by evaluating the ecological effectiveness of different alternative measures of mitigation, including impacts of climate change (Module 5).
- Linking assessment methodologies to recovery processes by analyzing, and where possible, predicting restoration success with regard to biological recovery.
- Evaluating the impact of global change (climate and land use) on the ecological status of surface waters (Module 5 and 6).
- Evaluation of the effects of different ways of combining assessment results, and their implications for restoration needs using a wide variety of modelling and statistical techniques (Module 6).

The evaluation of existing and the development of new methods assisted Member States in the selection of robust indicator metrics and aided the comparisons of similar water body types among Member States. This analysis helped identify redundancy in classification and, thereby helped identify cost-effective assessment approaches.

WISER also provided an extensive evaluation of existing methods and their applicability for WFD implementation to allow of comparable assessment of ecological status of water bodies that are consistent with the normative definitions of the Directive. The most relevant methodologies for EU-wide application led to the proposal of common metrics for intercalibration, which have been widely adopted already by Member States and Geographical Intercalibration Groups, respectively. New metrics were proposed for national assessment programmes, which are ready for application in Member States.

Many of these steps lend substantial support to the ECOSTAT working group and helped identify metrics to be recommended for standardisation in the CEN framework and subsequently to be included in the Annex V of the Directive. Eventually, WISER assisted the compilation of comparable datasets across Europe, which greatly assisted both WFD implementation and the reporting on the 'State of the Environment' through EEA.

WISER provided scientific support to address some of the key questions identified under the WFD CIS ECOSTAT work programme in 2008–2011, including both evaluation and recommendation of options for the finalisation of the intercalibration exercise. In addition, ECOSTAT expressed several questions related to development of classification systems, such as (1) how to specify monitoring requirements for biological parameters that are cost-effective; (2) how to apply the one-out-all-out principle at the quality element level to obtain a water body level assessment of the ecological status; (3) how to combine metrics for different habitats for whole water body assessment; (4) how to assess the confidence in ecological status classification? WISER's outcome has provided the answers to these questions.

The Strategic Steering Group on Climate Change and Water developed approaches for climate change adaptation options for water resources management in the context of the WFD implementation. They are assisted by the ECOSTAT Working Group, particularly on issues such as climate change impacts on reference conditions and ecological quality classification of water bodies. In relation to these activities, WISER addressed the effects of climate change on overall ecological quality objectives and the assessment methodology. The WISER outcome informs water managers where adaptations to climate change impacts may require different approaches (e.g. adaptations of reference conditions) in different parts of Europe.

The development and identification of harmonised methodologies and common metrics for ecological assessment in WISER also benefited the WFD CIS working group on Reporting during the 2010 reporting guidance for River Basin Management Programmes, the guidance on the reporting of the State of the Environment.

Furthermore, the results and output of WISER had and have potential impact on several activities mandated under the WFD CIS, like the 'WFD and Hydromorphology', 'Environmental objectives, exemptions and related economic issues', and 'Biological and chemical monitoring', as well as the activity on 'Climate change and water' - all of which were considered as priorities under the WFD CIS process. WISER established the links to all of these on-going activities under the WFD CIS in 2008–2011.

The results of WP5, in particular on the impacts of land use of eutrophication and hydromorphological degradation in European rivers, lakes and coastal areas, revealed that intensive agriculture is the by far most relevant stressor for European aquatic ecosystems. This is of high relevance for the revision of the Common Agricultural Policy (CAP) and, in particular, for the CIS working group on "WFD and agriculture."

WISER provided input to the Second European Climate Change programme (ECCP II), particularly with respect to Working Group 2 dealing with impacts and adaptation, and the sectoral stakeholder group on 'Impacts on water cycle and water resources management, and prediction of extreme events' that is also focusing on issues related to management of water bodies and water quality. Further, WISER supported the implementation of the EU Biodiversity Strategy, by providing information on biological indicators that reflect changes in aquatic biodiversity, but which are not currently assessed in EU-wide context, i.e. reporting of biological monitoring data from aquatic ecosystems in the EU is not yet implemented as a part of the State-of-the-environment reporting for the EEA. The metrics and biodiversity indices developed and validated for WFD purposes, and biological databases collected by the WISER (Module 2) also supported the development of harmonised biological monitoring systems for EU surface waters, that were needed, too, for the estimation of progress towards the EU biodiversity objective 'Halting the biodiversity loss by 2010' with respect to the aquatic ecosystems in Europe. WISER contributed to the generation of aquatic species distribution maps in Europe within the Frame of the EU FP7 project 'BioFresh'.

WISER's outcome on the development, testing and validation of biological indicators for the assessment of European coastal and transitional waters were communicated to relevant expert groups involved in the implementation of the EU Marine Strategy. These results largely supported the definition of 'good environmental status' criteria for biological features and informed about appropriate methods for monitoring and assessment of the marine coastal regions, particularly concerning the biological quality elements that are common both for the WFD and the Marine Strategy Directive (e.g. macroinvertebrates, phytoplankton, macroalgae, and angiosperms, as well as fish for transitional waters, and now also required for the Marine Strategy Directive). The investigation of combined effects of management and global change in Module 5 promoted the setting of environmental objectives for the programme of measures, particularly concerning the potential effects of eutrophication and oligotrophication on coastal ecosystems. Thereby, WISER provided a broad basis and starting point for the implementation of the Marine Strategy Directive. WISER also established links to other relevant FP7 projects addressing marine ecosystem functioning in response to the research needs of the proposed Marine Strategy (e.g. THRESHOLDS).

WISER assisted the establishment of catchment management measures and the subsequent assessment of these measures in the following ways: Firstly, the project provided guidance for planning restoration measures and goals to achieve good ecological status, while, at the same time, it was accounted for different scenarios of climate change. This was done within specific case study catchments. Secondly, the WISER provided recommendations on the optimisation of restoration and management strategies by assessing the ecological effectiveness and the suitable spatial scales of successful restoration and management.

WISER contributed to the establishment of programmes of (management/restoration) measures by compiling data on restoration success and by developing and applying models that can be used to assess the effects of restoration measures on ecological status, particularly linking the biological indicator metrics to changes in pressures (Module 5). Where possible, the costs for management and restoration were assessed, and uncertainties and the risk of failing the restoration targets were assessed to formulate recommendations on how to design or adjust management strategies with best possible impact on the ecological status. The project output also provides information on the time scales required to achieve ecological target status after management/restoration, if the objectives are being achievable at all, given the climate change that may counteract management and restoration successes.

4.1.5 The address of the project public website and relevant contact details

The URL of the WISER project is: www.WISER.eu. It was designed to inform the educated public, and in particular the user groups addressed by WISER (water managers, environmental agencies, Common Implementation Strategy), about the progress of the project.

Figure 9: Front page of the www.wiser.eu.

Table 7: Index of www.wiser.eu.

- Home
- News
    - WISER Newsletter
    - Project flyer
- Meetings and events
    - Final conference in Estonia 2012
    - Final project meeting in Estonia 2012
    - Mid term meeting in Poland 2010
    - Kick-off meeting in Spain 2009
- Highlights
- Key messages
    - Lake management
    - River management
    - Transitional and coastal water assessment
    - Transitional and coastal water management
- Results
    - Deliverables
    - Publications
    - Conceptual models
    - Metadatabase
    - Method database
    - Common metrics
    - Software & tools
- Programme
    - Data and guidelines
        - Data services
        - Metadatabase
        - Method database
        - Review and guidelines
    - Lake assessment
        - Sampling sites
        - Phytoplankton
        - Macrophytes
        - Invertebrates
        - Fish

        - Common metrics
    - Transitional and coastal water assessment
        - Sampling sites
        - Phytoplankton
        - Angiosperms and macroalgae
        - Invertebrates
        - Fish
        - Common metrics
    - Management and restoration
        - Conceptual models
        - Rivers
        - Lakes
        - Transitional and coastal waters
    - Integration
        - Uncertainty
        - Combination of organism groups
        - Comparison of assessment methods
        - Comparison of recovery processes
    - Internal and external information sharing
- Background
    - Water Framework Directive
    - Intercalibration
    - Lakes
    - Rivers
    - Transitional waters
    - Coastal waters
- Who we are
- Glossary
- Contact / Imprint

The project beneficiaries are given in the table below (ordered by beneficiaries' number).

No.	Name	Acronym	Country	URL	Scientific contact
1	University of Duisburg-Essen	UDE	Germany	www.uni-due.de/hydrobiology	Daniel Hering
2	Norwegian Institute for Water Research	NIVA	Norway	www.niva.no	Anne Lyche Solheim
3	Natural Environment Research Council Centre for Ecology & Hydrology	NERC	UK	www.nerc.ac.uk	Laurence Carvalho
4	AZTI-Tecnalia Foundation	TECNALIA-AZTI	Spain	www.azti.es	Ángel Borja
5	University of Hull, Institute of Estuarine & Coastal Studies	UHULL	UK	www.hull.ac.uk	Mike Elliott
6	Aarhus University - National Environmental Research Institute	AU	Denmark	www.dmu.dk	Jacob Carstensen
7	Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture	IRSTEA (former CEMAGREF)	France	www.irstea.fr	Didier Pont
8	Swedish University of Agricultural Sciences	SLU	Sweden	www.slu.se	Richard Johnson
9	European Commission Joint Research Centre	EC-JRC	EU	www.jrc.ec.europa.eu	Wouter van de Bund
10	Institute of Environmental Protection	IEP	Poland	www.ios.edu.pl	Agnieszka Kolada
11	Leibniz-Institute of Freshwater Ecology and Inland Fisheries in Forschungsverbund Berlin	FVB	Germany	www.igb-berlin.de	Thomas Mehner, Ute Mischke, Martin Pusch
12	Finnish Environment Institute	SYKE	Finland	www.environment.fi/syke	Seppo Hellsten
13	Spanish National Research Council	CSIC	Spain	www.csic.es	Núria Marbà
14	ALTERRA Green World Research	ALTERRA	Netherlands	www.alterra.nl	Piet Verdonschot
15	University of Natural Resources and Applied Life Sciences Vienna	BOKU	Austria	www.boku.ac.at	Stefan Schmutz
16	Estonian University of Life Sciences	EMU	Estonia	www.emu.ee	Tiina Nõges
17	University College London	UCL	UK	www.ucl.ac.uk	Helen Bennion
18	Institute for Ecosystem Studies	CNR-ISE	Italy	www.cnr.it	Giuseppe Morabito
19	Deltares	DELFT	Netherlands	www.deltares.nl	Harm Duel

No.	Name	Acronym	Country	URL	Scientific contact
20	University of Coimbra, Institute of Marine Research	IMAR	Portugal	www.imar.pt	João Carlos Marques
21	Institute of Oceanology, Bulgarian Academy of Sciences	IO-BAS	Bulgaria	www.io-bas.bg	Snejana Moncheva
22	Trinity College Dublin	TCD	Ireland	www.tcd.ie	Kenneth Irvine
23	University of Salento	USALENTO	Italy	www.unile.it	Alberto Basset
24	University of Bournemouth	BourneU	UK	www.bournemouth.ac.uk	Ralph Clarke
25	La Sapienza University of Rome	UNIROMA1	Italy	www.uniroma1.it/	Angelo Solimini

4.2 Use and dissemination of foreground

The foreground generated by WISER (i.e. the results of the field sampling programme) has mainly been used by Modules 3 and 4 to produce their deliverables and publications. Once all planned publications have appeared, the foreground data will go into the public domain, e.g. through the data portal developed by the BIOFRESH project (www.freshwaterbiodiversity.eu). The foreground also includes a multitude of reports, publications and tools, which are accessible through the project's website and have been actively been promoted by Module 7.

For the dissemination of foreground, WISER took a new approach and established 'end user teams' in order to involve end users directly in the development of products. Hence, end users (e.g. national GIG representatives, ECOSTAT, river basin managers, EEA members) were provided direct access to the WISER progress and outcome. They were involved in the elaboration of tasks in the individual Workpackages, in particular in Modules 3, 4 and 5. This approach ensured bilateral interactions in both ways from end users WISER scientists (by expressing specific needs with respect to the implementation of the WFD) and by scientists to end users (by expression of basic requirements with respect to data quality and quantity to address the end user's needs). Altogether, >200 end users were addressed by email during the first six-months period of the project.

Each end user team was addressed to express their ideas, concerns, problems and needs in an early phase of the project. The regular meetings of ECOSTAT and the Geographical Intercalibration Groups provided the framework for these discussions. End users were also invited to Workpackage meetings and asked for collaboration. This procedure ensured that WISER products have immediate relevance to the work of the end users to assist the practical implementation of the WFD.

End users were also specifically addressed with the structure of the WISER website that provided easy access to all relevant information on sampling sites, data generation and preliminary results. Later during the project, the website was completely restructured to put focus on all kinds of end user-relevant products and outcome of the project. End users were also granted direct access to draft products and information through the Intranet. End users were regularly informed by the ongoing activities and relevant Deliverables through the news section on the website and through five public and three internal WISER Newsletters. They were invited to e-discussions and videoconferences to contribute to the progress of Workpackages in Module 3 and 4, and they were invited also to contribute to the writing of Deliverables and publications. IN order to maintain the dissemination of WISER after project termination, the website will be online for the next 24 month. Afterwards, the WISER outcome might be provided elsewhere, but royalty-free and continuous access will continue to be granted.

All WISER outcomes were translated into key messages to the end users, compiled in a booklet and released as Deliverable 7.2-6. This deliverable is meant to help decide water and river basin managers to take appropriate decisions with respect to water body assessment, cost-effective monitoring, restoration and management and the potential implications of climate change. These key messages are also suited to disseminate WISER's outcome and products among policy makers and the general public. Both groups were also addressed by public Newsletters, several project flyers and by individual national meetings with WISER beneficiaries (compare Table A2). The website, too, provides information about WISER digestible by the general public, in particular in the section on the key messages.

The scientific community was particularly addressed by altogether 199 oral and poster presentations during scientific symposia, conferences and meetings (compare Table A2). Until the finalisation of WISER, already 108 scientific publications were published or accepted for publication in peer-reviewed journals. The production of a WISER Special Issue in Hydrobiologia has been started already in December 2011. A release is planned for late 2012/early 2013. With more than 30 articles, this scientific journal issue will add to the Book of Abstracts that was prepared and published in course with the WISER final conference in Tallinn (Jan. 2012). The final conference mainly addressed the end users and scientific community and provided both groups with a concise overview of the WISER outcome. Besides, several invited talks bridged to related themes not addressed by WISER, such as the societal aspects of environmental policies and the role of ecosystem functions, processes and services in the assessment and management of the aquatic environment.

The final conference also provided the opportunity to demonstrate the use of WISER software tools, such as the various database queries, the uncertainty software 'WISERbugs' and the LakeLoadResponse model to estimate effects of nutrient reduction in lakes.

Section A

The full list of altogether 108 scientific publications in peer-reviewed journals and 199 other dissemination activities can be found in the Tables A1 and A2 below.

Section B

The main results produced by WISER are the publications, reports and tools, which are all publicly available or will be made available in the near future. In particular, this concerns publications (see screenshot below).

An overview of all publications produced by WISER is accessible on http://www.wiser.eu/results/publications/. The website will undergo frequent updates also after the termination of WISER.

Publications with WISER acknowledgements

Angeler, D.G., Drakare, S. & Johnson, R.K. (2011) Revealing the organization of complex adaptive systems through multivariate time series modeling. Ecology and Society, 16 (3), 5. [online] http://www.ecologyandsociety.org/vol16/iss3/art5/

Atkins, J.P., Burdon, D., Elliott, M. & Gregory, A.J. (2011) Management of the marine environment: Integrating ecosystem services and societal benefits with the DPSIR framework in a systems approach. Marine Pollution Bulletin, 62, 215-226.

Barbone, E., Rosati, I., Reizopoulou, S. & Basset, A. (2012) Linking classification boundaries to sources of natural variability in transitional waters: A case study of benthic macroinvertebrates. Ecological Indicators, 12, 105-122.

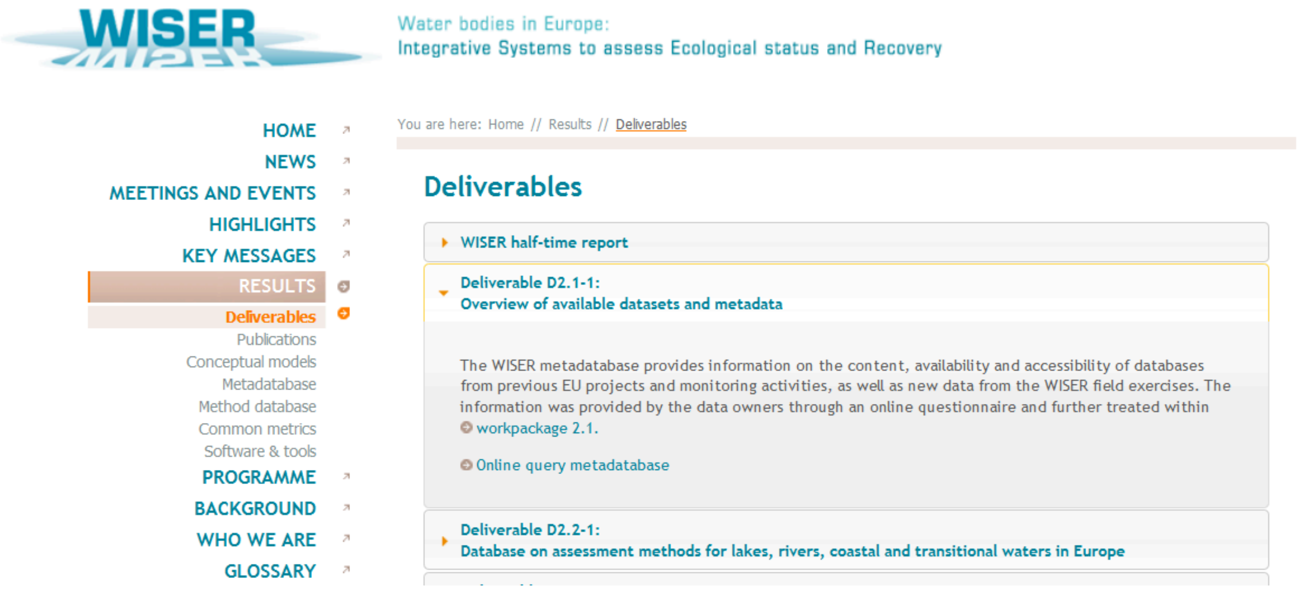
Basset, A. 2010. Aquatic science and the water framework directive: a still open challenge towards ecogovernance of aquatic ecosystems. Aquatic Conservation. Marine and Freshwater Ecosystems, 20, 245-249. (www.interscience.wiley.com). DOI: 10.1002/aqc.1117

Basset, A., Barbone, E., Borja, A., Brucet, S., Pinna, M., Quintana, X.D., Reizopoulou, S., Rosati, I. & Simboura, N., (2012) A benthic macroinvertebrate size spectra index for implementing the Water Framework Directive in coastal lagoons in Mediterranean and Black Sea ecoregions. Ecological Indicators, 12, 72-83.

Beklioglu, M., Meerfhoff, M. & Jeppesen, E. (2010) Eutrophication and Restoration of Shallow Lakes from a cold Temperate to a warm Mediterranean and a (Sub)Tropical climate. In Ansari, A.A., Singh Gill, S., Lanza, G.R. & Rast, W. (Editors) (in press). Eutrophication: Causes, Consequences and Control. Springer.

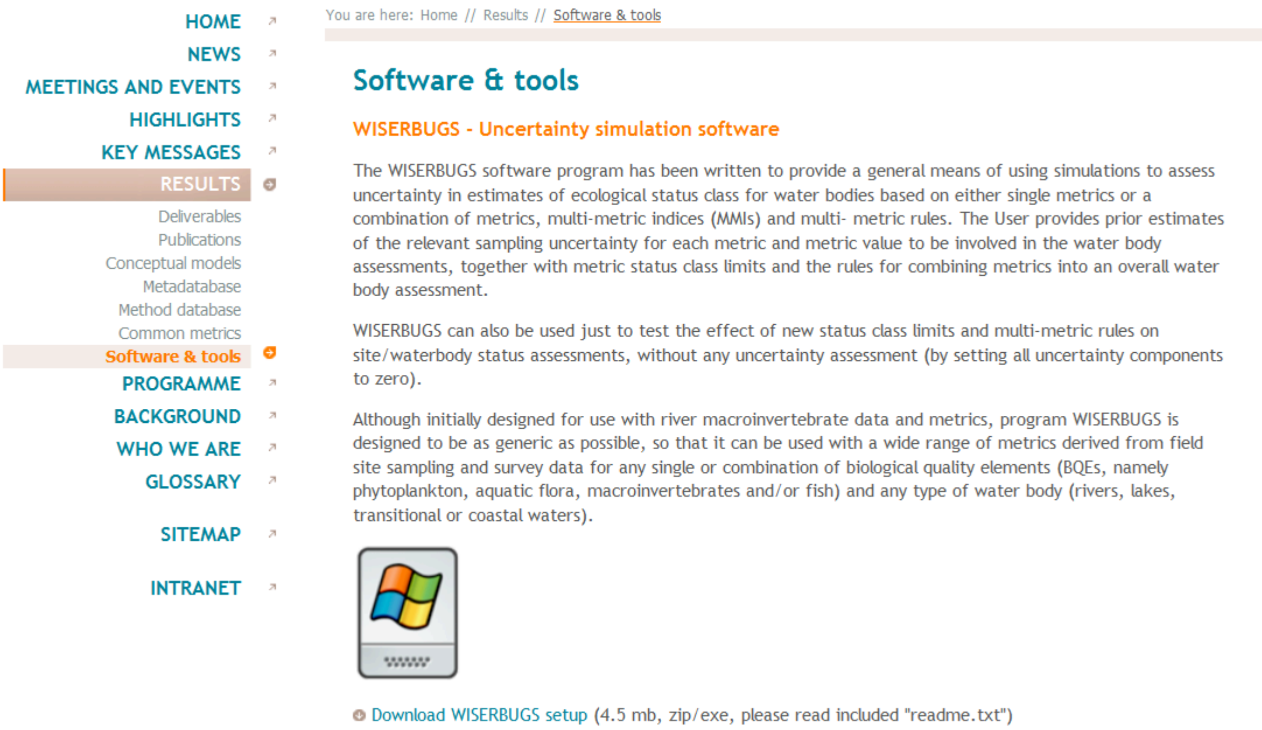
Reports

All WISER deliverables can be downloaded from http://www.wiser.eu/results/deliverables/.



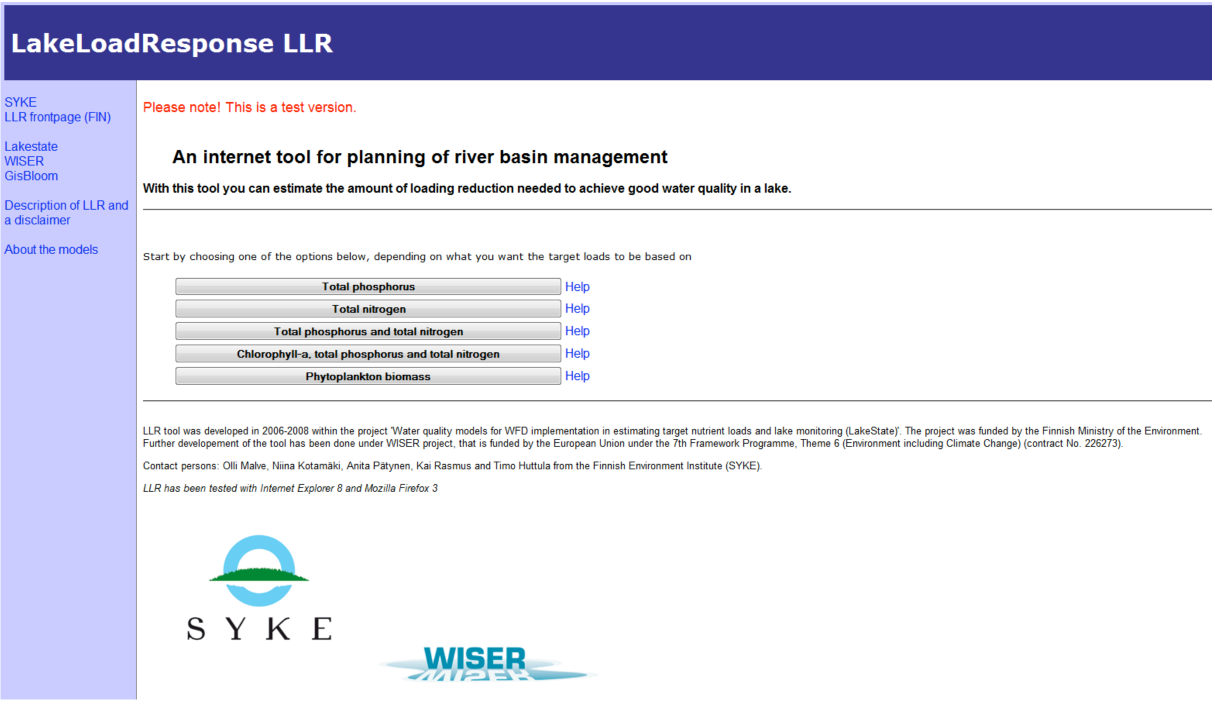
Software WISERbugs

The Software WISERbugs is available from http://www.wiser.eu/results/software/.



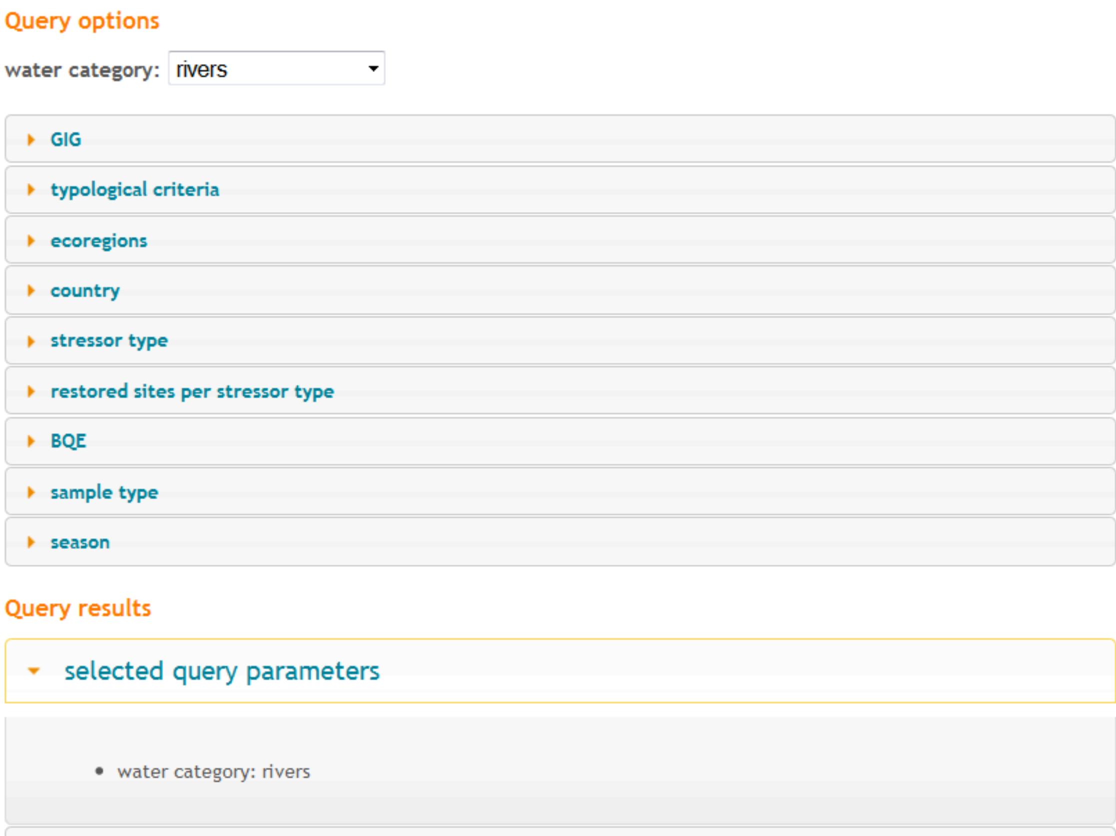
Software LakeLoadResponseTool

The LakeLoadResponse is available from http://www.wiser.eu/results/software/ or from http://lakestate.vyh.fi/cgi-bin/frontpage.cgi?kieli=ENG.



WISER meta database

The WISER meta database can be accessed an queried through http://www.wiser.eu/results/meta-database/



WISER method database

The WISER method database can be accessed and queried through http://www.wiser.eu/results/method-database/.

Methods database (workpackage 2.2)

This database contains information about the national assessment methods used to classify the ecological status of rivers, lakes, coastal and transitional waters. Member States of the European Union apply these methods in their monitoring programmes according to the EU Water Framework Directive.

The information in this database was provided by the Member States through a questionnaire survey and collated within workpackage 2.2.

If you have any questions concerning the information which is presented here contact Dr. Sebastian Birk.
For technical issues contact webmaster@wiser.eu

For the methods itself the persons or institutes which have developed the methods are responsible.

When using the data, please acknowledge our work as follows:
Birk, S., Strackbein, J. & Hering, D., 2010. WISER methods database.
Version: March 2011. Available at http://www.wiser.eu/results/method-database/.

Search for assessment methods:

Country [select all] [unselect all]

Austria	Belgium	Belgium (Flanders)	Belgium (Wallonia)	Bulgaria
Croatia	Cyprus	Czech Republic	Denmark	Estonia
Finland	France	Germany	Greece	Hungary
Ireland	Italy	Latvia	Lithuania	Luxembourg
Netherlands	Norway	Poland	Portugal	Romania
Slovakia	Slovenia	Spain	Sweden	United Kingdom

Water Category

Rivers	Lakes	Coastal Waters	Transitional Waters

GIG (Geographical Intercalibration Groups)

Alpine	Baltic	Black Sea	Central-Baltic	Eastern Continental
Mediterranean	Northern	North-East-Atlantic		

Biological Quality Element

WISER suite of assessment methods

An overview of the assessment methods developed by WISER is accessible through http://www.wiser.eu/results/common-metrics/.

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Common metrics

An important aim of the WISER project is to support the intercalibration process. One of the first steps required by the intercalibration guidance is to derive "common metrics", i.e. biological measures created for benchmarking and comparison of national assessment systems. The WISER workpackages addressing individual organism groups (Biological Quality Elements) and ecosystem types (lakes, coastal and transitional waters) develop common metrics according to a common "Guidelines for indicator development" (Deliverable D2.2-2.pdf). All common metrics are documented in a harmonized format.

A common metric is a yardstick for comparing national assessment systems and their classification of ecological status. They quantify the structural or functional attributes of biological communities, allowing for an assessment of ecological quality. Common metrics relate to the results of the national assessment methods used in the particular intercalibration exercise and respond to the stressor (or combination of stressors) addressed. Common metrics are not meant as pan-European assessment systems replacing national methods, which are usually much better adapted to the regional situation.

Here we present the common metrics developed in WISER. A first version was available in summer/autumn 2010; since then, most of the common metrics have been updated.

- Common metrics for lakes
- Common metrics for transitional and coastal waters

Section A (public), Table A1

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES NO.										
No.	**Title**	**Main author**	**Title of the periodical or the series**	**Number, date or frequency (Vol.)**	**Publisher**	**Place of publication**	**Year of publicatio n**	**Relevant pages**	**Permanent identifiers[13] (if available)**	**Is/Will open access[14] provided to this publication?**
1	Effects of temperature, salinity and fish in structuring the macroinvertebrate community in shallow lakes: implications for effects of climate change	Brucet, S.	PloS ONE Biology	7(2)	Elsevier		2012	e30877	doi:10.1371/journal.pon e.0030877	Yes
2	Coastal monitoring programs	Carstensen, J.	Treatise on Estuarine and Coastal Science	7	Elsevier		2012	175–206	ISBN9780123747112	No
3	Factors influencing zooplankton size structure at contrasting temperatures in coastal shallow lakes: implications for effects of climate change.	Brucet, S.	Limnology and Oceanograph y	55	ASLO		2010	1697–1711	10.4319/lo.2010.55.4.1 697	No
4	Sulfide exposure accelerates hypoxia-driven mortality	Vaquer-Sunyer, R.	Limnology and Oceanograph y	55	ASLO		2010	1075–1082	10.4319/lo.2010.55.3.1 075	Yes
5	From natural to degraded rivers and back again: a test of restoration ecology theory and practice	Feld, C.K.	Advances in Ecological Research	44	Academic Press		2011	119–209	ISBN 978-0-12-374794-5	Yes
6	Identifying from recent sediment records the effects of nutrients and climate on diatom dynamics in Loch Leven	Bennion, H.	Freshwater Biology		Wiley		Online early		10.1111/j.1365-2427.2011.02651.x	No
7	Submerged macrophytes as indicators of the ecological quality of lakes	Søndergaard M.	Freshwater Biology	55 (4)	Wiley		2010	893–908	DOI: 10.1111/j.1365-2427.2009.02331.x	No

8	Tracing recovery under changing climate: response of phytoplankton and invertebrate assemblages to decreased acidification.	Johnson, R.K.	Journal of the North American Benthological Society	29	The Society for Freshwater Science		2010	1472–1490	10.1899/09-171.1	No
9	The European Water Framework Directive at the age of 10: a critical review of the achievements with recommendations for the future	Hering, D.	The Science of the Total Environment	408	Elsevier		2010	4007–4019	10.1016/j.scitotenv.2010.05.031	No
10	Temporal scales and patterns of invertebrate biodiversity dynamics in boreal lakes recovering from acidification	Angeler, D.G.	Ecological Applications		ESA Publications		2012	In press	10.1890/11-1474.1	No
11	Using chlorophyll a and cyanobacteria in the ecological classification of lakes	Søndergaard, M.	Ecological Indicators	11	Elsevier		2011	1403–1412	10.1016/j.ecolind.2011.03.002,	No
12	Ability of benthic indicators to assess ecological quality in estuaries following management	Verisssimo, H.	Ecological Indicators	19	Elsevier		2011	130–143	10.1016/j.ecolind.2011.06.014)	No
13	Modelling the effects of eutrophication, mitigation measures and an extreme flood event on estuarine benthic food webs	Baeta, A.	Ecological Modelling	222	Elsevier		2011	1209–1221	10.1016/j.ecolmodel.2010.12.010	No
14	The importance of habitat-type for defining the reference conditions and the ecological quality status based on benthic invertebrates: The Ria Formosa coastal lagoon (Southern Portugal) case study	Gamito, S.	Ecological Indicators	19	Elsevier		2011	61–72	10.1016/j.ecolind.2011.08.004	No
15	Modelling the habitat requirement of riverine fish species at the European scale: sensitivity to temperature	Logez, M.	Ecology of Freshwater Fish	21 (2)	Wiley-Blackwell		2011	266–282	doi: 10.1111/j.1600-0633.2011.00545.x	No

	and precipitation and associated uncertainty									
16	Size spectra of lake fish assemblages: responses along gradients of general environmental factors and intensity of lake use	Emmrich, M.	Freshwater Biology	56	Wiley		2011	2316–2333	10.1111/j.1365-2427.2011.02658.x	No
17	Temperature effects on oxygen thresholds for hypoxia in marine benthic organisms	Vaquer-Sunyer, R.	Global Change Biology	17	Wiley		2011	1788–1797	10.1111/j.1365-2486.2010.02343.x	No
18	Zooplankton as indicators in lakes: a scientific-based plea for including zooplankton in the ecological quality assessment of lakes according to the European Water Framework Directive (WFD)	Jeppesen, E.	Hydrobiologia	676	Springer		2011	279–297	10.1007/s10750-011-0831-0	No
19	Sea bottom characteristics affect depth limits of eelgrass (Zostera marina L.)	Krause-Jensen, D.	Marine Ecology Progress Series	425	Inter-Research		2011	91–102	10.3354/meps09026	Yes
20	Aquatic science and the Water Framework Directive: a still open challenge towards ecogovernance of aquatic ecosystems	Basset, A.	Aquatic Conservation: Marine and Freshwater Ecosystems	20	John Wiley & Sons		2012	245–249	10.1002/aqc.1117	No
21	Response of single benthic metrics and multi-metric methods to anthropogenic pressure gradients, in five distinct European coastal and transitional ecosystems	Borja, A.	Marine Pollution Bulletin	62	Elsevier		2011	499–513	10.1016/j.marpolbul.2010.12.009	No
22	Linking classification boundaries to sources of natural variability in transitional waters: a case study of benthic macroinvertebrates	Barbone, E.	Ecological Indicators	12	Elsevier		2012	105–122	10.1016/j.ecolind.2011.04.014	No
23	A benthic macroinvertebrate size spectra index for	Basset, A.	Ecological Indicators	12	Elsevier		2012	72–83	10.1016/j.ecolind.2011.06.012	No

	implementing the Water Framework Directive in coastal lagoons in Mediterranean and Black Sea ecoregions									
24	Three hundred ways to assess Europe's surface waters: an almost complete overview of biological methods to implement the Water Framework Directive	Birk, S.	Ecological Indicators	18	Elsevier		2012	31–41	doi:10.1016/j.ecolind.2011.10.009	No
25	Ecological assessment of running waters: do macrophytes, macroinvertebrates, diatoms and fish show similar responses to human pressures?	Marzin, A.	Ecological Indicators	23	Elsevier		2012	56–65	10.1016/j.ecolind.2012.03.010,	No
26	Impacts of climate warming on lake fish community structure and potential effects on ecosystem function	Jeppesen, E.	Hydrobiologia	646	Springer		2010	73–90	10.1007/s10750-010-0171-5	No
27	Relationships between lake morphometry, geographic location and water quality parameters of European lakes	Nõges, T.	Hydrobiologia	633	Springer		2009	33–43	10.1007/s10750-009-9874-x	No
28	Climate change effects on runoff, catchment phosphorus loading and lake ecological state, and potential adaptations	Jeppesen, E.	Journal of Environmental Quality	38	Crop Science Society of America		2009	1931–1940	10.2134/jeq2008.0113	No
29	Challenges and opportunities for integrating lake ecosystem modelling approaches	Mooij, W.M.	Aquatic Ecology	44	Springer		2010	633–667	10.1007/s10452-010-9339-3	No
30	First record of oriental shrimp, Palaemon macrodactylus Rathbun, 1902 in Varna Lake, Bulgaria	Raykov, V.	Aquatic Invasions	5	Thomson Reuters		2010	91–95	10.3391/ai.2010.5.S1.019	yes
31	Eutrophication and Restoration of Shallow	Beklioglu, M.	Earth and Environmental		Springer		2010	91–108	10.1007/978-90-481-9625-8_4	No

	Lakes from a cold Temperate to a warm Mediterranean and a (Sub)Tropical climate		Science							
32	Assessing estuarine quality under the ecosystem services scope: ecological and socioeconomic aspects	Pinto, R.	Ecological Complexity	7	Elsevier		2010	389–402	10.1016/j.ecocom.2010.05.001	No
33	The influence of mesh size in environmental quality assessment of estuarine macrobenthic communities	Couto, T.	Ecological Indicators	10	Elsevier		2010	1162–1173	10.1016/j.ecolind.2010.03.019	No
34	Medium and long-term recovery of estuarine and coastal ecosystems: patterns, rates and restoration effectiveness	Borja, A.	Estuaries and Coasts	33	Springer		2010	1249–1260	10.1007/s12237-010-9347-5	No
35	The response of estuarine macrobenthic communities to natural- and human-induced changes: dynamics and ecological quality	Neto, J.M.	Estuaries and Coasts	33	Springer		2010	1327–1339	10.1007/s12237-010-9326-x	No
36	Hydroacoustic estimates of fish densities in comparison with stratified pelagic trawl sampling in two deep, coregonid-dominated lakes	Emmrich, M.	Fisheries Research	105	Elsevier		2010	178–186	10.1016/j.fishres.2010.05.001	No
37	Fast changes in community structure, abundance and habitat distribution of fish in a Danish lake following restoration by aluminium treatment	Lund, S.	Freshwater Biology	55	Wiley		2010	1036–1049	10.1111/j.1365-2427.2009.02300.x	No
38	Potential conflicts between environmental legislation and conservation exemplified by aquatic macrophytes	Ecke, F.	Hydrobiologia	656	Springer		2010	107–115	10.1007/s10750-010-0424-3	No
39	Analysis of changes over 44 years in the phytoplankton of Lake	Nõges, P.	Hydrobiologia	646	Springer		2010	33–48	10.1007/s10750-010-0178-y	No

	Võrtsjärv (Estonia): the effect of nutrients, climate and the investigator on phytoplankton-based water quality indices									
40	Effect of chlorophyll sampling design on water quality assessment in thermally stratified lakes	Nõges, P.	Hydrobiologia	649	Springer		2010	157–170	10.1007/s10750-010-0237-4	No
41	Larger zooplankton in Danish lakes after cold winters: are winter fish kills of importance?	Balayla, D.	Hydrobiologia	646	Springer		2010	159–172	10.1007/s10750-010-0164-4	No
42	Trophic cascade effects of Hoplias malabaricus (Characiformes, Eritrinidae) in (sub) tropical food webs: a mesocosm approach	Mazzeo, N.	Hydrobiologia	644	Springer		2010	325–335	10.1007/s10750-010-0197-8	No
43	Using invertebrate remains and pigments in the sediment to reconstruct past changes in trophic structure after fish introduction to Lake Fogo - a crater lake in the Azores	Skov, T.	Hydrobiologia	654	Springer		2010	13–25	10.1007/s10750-010-0325-5	No
44	Biotic indices for assessing the status of coastal waters: a review of strengths and weaknesses	Romero, J.	Journal of Environmental Monitoring	12	RSC Publishing		2010	1013–1028	10.1039/B920937A	No
45	Long- term records of trace metal content of western Mediterranean seagrass (Posidonia oceanica) meadows : Natural and anthropogenic contributions	Sánchez, A.T.	Journal of Geophysical Research	115	American Geophysical Union		2010	G02006	10.1029/2009JG001076	No
46	Censored data regression: Statistical methods for analyzing Secchi transparency in shallow systems	Carstensen, J.	Limnology and Oceanography: Methods	8	ASLO		2010	376–385	10.4319/lom.2010.8.376	No
47	Marine management –	Borja, A.	Marine	60	Elsevier		2010	2175–	10.1016/j.marpolbul.20	No

	towards an integrated implementation of the European Marine Strategy Framework and the Water Framework Directives		Pollution Bulletin					2186	10.09.026	
48	Problems associated with the 'one-out, all-out' principle, when using multiple ecosystem components in assessing the ecological status of marine waters	Borja, Á.	Marine Pollution Bulletin	60	Elsevier		2010	1143–1146	10.1016/j.marpolbul.2010.06.026	No
49	Bio-sedimentary indicators for estuaries: a critical review	Ducrotoy, J.P.			Union des océanographes de France	Paris	2011	1–77	ISBN 978-2-9510625-2-8	No
50	The invasion of Lake Orta (Italy) by the red swamp crayfish Procambarus clarkii (Girard 1852): a new threat to an unstable environment	Piscia, R.	Aquatic Invasions	6, suppl. 1	Thomson Reuters		2011	45–48	10.3391/ai.2011.6.S1.010	Yes
51	Changes in cycling of P, N, Si, and DOC upon aluminum treatment of Lake Nordborg, Denmark	Egemose, S.	Canadian Journal of Fisheries and Aquatic Sciences	68	NRC Research Press		2011	842–856	10.1139/f2011-016	No
52	Feeding diversity index as complementary information in the assessment of ecological quality status	Gamito, S.	Ecological Indicators	19	Elsevier		2011	73–78	10.1016/j.ecolind.2011.08.003	No
53	Revealing the Organization of Complex Adaptive Systems through Multivariate Time Series Modeling	Angeler, D.G.	Ecology and Society	16	Resilience Alliance		2011		10.5751/ES-04175-160305	Yes
54	Rapid ecological shift following piscivorous fish introduction to increasingly eutrophic Lake Furnas (Azores Archipelago, Portugal): a paleoecological approach	Buchaca, T.	Ecosystems	14	Springer		2011	458–477	10.1007/s10021-011-9423-0	No
55	Predicting the effects of climate change on trophic status of three	Trolle, D.	Environmental Modelling & Software	26	Elsevier		2011	354–370	10.1016/j.envsoft.2010.08.009	No

	morphologically varying lakes: Implications for lake restoration and management									
56	Ecosystem impacts on hypoxia: thresholds of hypoxia and pathways to recovery	Steckbauer, A.	Environmental Research Letters	6	IOPscience		2011	025003	10.1088/1748-9326/6/2/025003	Yes
57	Connecting the dots: downscaling responses of coastal ecosystems to changing nutrients concentrations	Carstensen, J.	Environmental Science and Technology	45	ACS Publications		2011	9122–9132	10.1021/es202351y	No
58	Long-term changes and controlling factors of phytoplankton community in the Gulf of Riga (Baltic Sea)	Jurgensone, I.	Estuaries and Coasts	34	Springer		2011	1205–1219	DOI 10.1007/s12237-011-9402-x	No
59	Challenging paradigms in estuarine ecology and management	Elliott, M.	Estuarine, Coastal & Shelf Science	94	Elsevier		2011	306–314	10.1016/j.ecss.2011.06.016	No
60	Population dynamics of Corbicula fluminea (Müller, 1774) in mesohaline and oligohaline habitats: invasion success in a Southern Europe estuary.	Franco, J.	Estuarine, Coastal & Shelf Science		Elsevier		2011		doi:10.1016/j.ecss.2011.07.014	No
61	Nutrients exert a stronger control than climate on recent diatom communities in Esthwaite Water: evidence from monitoring and palaeolimnological records	Dong, X.	Freshwater Biology		Wiley		2011 (on line)		10.1111/j.1365-2427.2011.02670.x	No
62	Ambiguous climate impacts on the stability of alternative states in shallow lakes	Kosten, S.	Freshwater Biology	56	Wiley		2011	1540–1553		No
63	Filamentous green algae inhibit phytoplankton with enhanced effects when lakes get warmer	Trochine, C.	Freshwater Biology	56	Wiley		2011	541–553	10.1111/j.1365-2427.2010.02521.x	No
64	Nutrients exert a stronger control than climate on	Dong, X.	Freshwater Biology		Wiley		2011 (on line)		10.1111/j.1365-2427.2011.02670.x	No

	recent diatom communities in Esthwaite Water: evidence from monitoring and palaeolimnological records.									
65	The role of cladocerans in tracking long-term change in shallow lake ecosystem structure and function	Davidson, T.A.	Hydrobiologia	676	Springer		2011	299–315	10.1007/s10750-011-0851-9	No
66	Climate change effect on nitrogen loading from catchment in Europe: implications for nitrogen retention and ecological state of lakes and adaptations	Jeppesen, E.	Hydrobiologia	663	Springer		2011	1–21	10.1007/s10750-010-0547-6	No
67	Historical changes in the external loading to Loch Leven in relation to anthropogenic activity in the catchment	May, L.	Hydrobiologia	681	Springer		2011	11–21	10.1007/s10750-011-0922-y	No
68	Managing ecosystem services at Loch Leven, Scotland, UK: actions, impacts and unintended consequences	May, L.	Hydrobiologia	681	Springer		2011	117–130	10.1007/s10750-011-0931-x	No
69	Increased nutrient loading and rapid changes in phytoplankton expected with climate change in stratified South European lakes: sensitivity of lakes with different trophic state and catchment properties	Nõges, P.	Hydrobiologia	667	Springer		2011	255–270	10.1007/s10750-011-0649-9	No
70	Morphometry and trophic state modify the thermal response of lakes to meteorological forcing	Nõges, P.	Hydrobiologia	667	Springer		2011	241–254	10.1007/s10750-011-0691-7	No
71	Long-term variation and regulation of internal phosphorus loading in Loch Leven	Spears, B.M.	Hydrobiologia	681	Springer		2011	23–33	10.1007/s10750-011-0921-z	No
72	High predation is of key importance for dominance of smallbodied	Iglesias, C.	Hydrobiologia	667	Springer		2011	133–147	10.1007/s10750-011-0645-0	No

	zooplankton in warm shallow lakes: evidence from lakes, fish exclosures and surface sediments									
73	Winter ecology of shallow lakes: strongest effect of fish on water clarity at high nutrient levels	Sørensen, T.	Hydrobiologia	664	Springer		2011	147–162	10.1007/s10750-010-0595-y	No
74	Assessing lake typologies and indicator fish species for Italian natural lakes using past fish richness and assemblages	Volta, P.	Hydrobiologia	671	Springer		2011	227–240	10.1007/s10750-011-0720-6	No
75	Marine science and management means tackling exogenic unmanaged pressures and endogenic managed pressures--a numbered guide.	Elliott, M.	Marine Pollution Bulletin	62	Elsevier		2011	651–655	10.1016/j.marpolbul.2010.11.033	No
76	Management of the marine environment: Integrating ecosystem services and societal benefits with the DPSIR framework in a systems approach	Atkins, J.P.	Marine Pollution Bulletin	62	Elsevier		2011	215–226	10.1016/j.marpolbul.2010.12.012	No
77	Ecological status of seagrass ecosystems: An uncertainty analysis of meadow classification based on the Posidonia multivariate index (POMI)	Bennett, S.	Marine Pollution Bulletin	62	Elsevier		2011	1616–1621	10.1016/j.marpolbul.2011.06.016	No
78	Assessment of estuarine macrobenthic assemblages and ecological quality status at a dredging site in a southern Europe estuary	Ceia, F.R.	Ocean & Coastal Management		Elsevier		2011	In press	10.1016/j.ocecoaman.2011.07.009	No
79	Towards a DPSIR driven integration of ecological value, water uses and ecosystem services for estuarine systems.	Pinto, R.	Ocean & Coastal Management		Elsevier		2011	1–16	10.1016/j.ocecoaman.2011.06.016	No
80	Lower biodiversity of	Menezes,	Biological		Springer		2012	Online	10.1007/s10530-011-	No

	native fish but only marginally altered plankton biomass in tropical lakes hosting introduced piscivorous *Cichla* cf. *ocellaris*	R.F.	Invasions					first	0159-8	
81	Loch Leven: 40 years of scientific research. Understanding the links between pollution, climate change and ecological response	May, L.	Developments in Hydrobiology	218	Springer		2012			No
82	Early life stages of fishes as indicators of estuarine ecosystem health	Ramos, S.	Ecological Indicators	19	Elsevier		2012	172–183	10.1016/j.ecolind.2011.08.024	No
83	The importance of setting targets and reference conditions in assessing marine ecosystems quality	Borja, A.	Ecological Indicators	12	Elsevier		2012	1–7	10.1016/j.ecolind.2011.06.018	No
84	Defining phytoplankton class boundaries in Portuguese transitional waters: An evalutation of the ecological quality status according to the water Framework Directive.	Brito, A.C.	Ecological Indicators	19	Elsevier		2012	5–14	10.1016/j.ecolind.2011.07.025	No
85	Development of a tool for assessing the ecological quality status of intertidal coastal rocky assemblages, within Atlantic Iberian coasts	Díez, I.	Ecological Indicators	12	Elsevier		2012	58–71	10.1016/j.ecolind.2011.05.014	No
86	A Bayesian framework to objectively combine metrics when developing stressor specific multimetric indicator	Drouineau, H.	Ecological Indicators	13	Elsevier		2012	314–321	10.1016/j.ecolind.2011.06.029	No
87	Taxonomic or ecological approaches? Searching for phytoplankton surrogates in the determination of richness and assemblage composition in ponds	Gallego, I.	Ecological Indicators	18	Elsevier		2012	575–585	10.1016/j.ecolind.2012.01.002	No

88	Influence of sampling effort on fish-based assessment of estuarine ecological quality	Gamito, R.	Ecological Indicators	23	Elsevier		2012	9–18	10.1016/j.ecolind.2012.03.009	No
89	Marine Macroalgae Assessment Tool (MarMAT) for intertidal rocky shores. Quality assessment under the scope of the European Water Framework Directive	Neto, J.M.	Ecological Indicators	19	Elsevier		2012	39–47	10.1016/j.ecolind.2011.09.006	No
90	Do nematode and macrofauna assemblages provide similar ecological assessment information?	Patricio, J.	Ecological Indicators	14	Elsevier		2012	124–137	10.1016/j.ecolind.2011.06.027	No
91	Current developments on fish-based indices to assess ecological-quality status of estuaries and lagoons	Pérez-Domínguez, R.	Ecological Indicators	23	Elsevier		2012		10.1016/j.ecolind.2012.03.006	No
92	Calibration and Validation of the AZTI's Marine Biotic Index (AMBI) for Southern California Marine Bays.	Teixeira, H.	Ecological Indicators	12	Elsevier		2012	84–95	10.1016/j.ecolind.2011.05.025	No
93	A biological trait approach to assess the functional composition of subtidal benthic communities in an estuarine ecosystem.	van der Linden, P.	Ecological Indicators	20	Elsevier		2012	121–133	10.1016/j.ecolind.2012.02.004	No
94	A unifying approach to allometric scaling of resource ingestion rates under limiting conditions	Basset, A.	Ecosphere	3	ESA Publications		2012	Art. 2	10.1890/ES11-00249.1	Yes
95	Meta-analysis shows a consistent and strong latitudinal pattern in fish herbivory across ecosystems	González-Bergonzoni, I.	Ecosystems	3	Springer		2012	492–503	10.1007/s10021-012-9524-4	No
96	Benthic and pelagic primary production in different nutrient regimes	Krause-Jensen, D.	Estuaries and Coasts	35	Springer		2012	527–545	10.1007/s12237-011-9443-1	No
97	Assessment of fish assemblages in coastal lagoon habitats: Effect of sampling method.	Franco, A.	Estuarine, Coastal & Shelf Science		Elsevier		2012	in press	doi:10.1016/j.ecss.2011.08.015	No

	Estuarine									
98	Persistent internal phosphorus loading during summer in shallow eutrophic lakes	Søndergaard, M.	Hydrobiologia		Springer		2012	Online first	10.1007/s10750-012-1091-3	No
99	Changes in the fish community of Loch Leven: untangling anthropogenic pressures	Winfield, I.J.	Hydrobiologia	681	Springer		2012	73–84	10.1007/s10750-011-0925-8	No
100	Can artificial plant beds be used to enhance macroinvertebrate food resources for perch (Perca fluviatilis L.) during the initial phase of lake restoration by cyprinid removal?	Boll, T.	Hydrobiologia	679	Springer		2012	175–186	10.1007/s10750-011-0867-1	No
101	Water quality responses to enrichment, restoration and climate change	Carvalho, L.	Hydrobiologia	681	Springer		2012	35–47	10.1007/s10750-011-0923-x	No
102	Variation in fish community structure, richness, and diversity in 56 Danish lakes with contrasting depth, size and trophic state: does the method matter?	Menezes, R.	Hydrobiologia		Springer		2012	Online first	10.1007/s10750-012-1025-0	No
103	Nitrogen, macrophytes, shallow lakes and nutrient limitation: resolution of a current controversy?	Moss, B.	Hydrobiologia		Springer		2012	Online first	DOI 10.1007/s10750-012-1033-0	No
104	Recent climate induced changes in freshwaters in Denmark	Jeppesen, E.	In Goldman CR, M. Kumagari & R.D. Robarts, Global impacts of climate change on inland waters (Book chapter)		Wiley		2012			No
105	Discrimination of freshwater fish species by Matrix-Assisted Laser Desorption/Ionization-	Volta, P.	Journal of Limnology	71 (1)	Pagepress		2012	164–169	DOI: 10.4081/jlimnol.2012.e17	Yes

	Time Of Flight Mass Spectrometry (MALDI-TOF MS): a pilot study									
106	Water quality assessment using satellite-derived chlorophyll-a within the European directives, in the southeastern Bay of Biscay	Novoa, S.	Marine Pollution Bulletin	64	Elsevier		2012	739–750	10.1016/j.marpolbul.2012.01.020	No
107	What are the costs and benefits of biodiversity recovery in a highly polluted estuary?	Pascual, M.	Water Research	46	Elsevier		2012	205–217	doi:10.1016/j.watres.2011.10.053	No
108	Uncertainty analysis along the ecological quality status of water bodies: the response of the Posidonia oceanica multivariate index (POMI) in three Mediterranean regions	Mascaro, O.	Marine Pollution Bulletin		Elsevier		In press Available online 30 March 2012		10.1016/j.marpolbul.2012.03.007	No

Section a (public), Table A2

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
No.	**Type of activities[15]**	**Main leader**	**Title**	**Date**	**Place**	**Type of audience16**	**Size of audience[16]**	**Countries addressed**
1	Presentation	AU	Climate effects on freshwaters	5–7 Mar 2009	Aarhus, Denmark	Scientific and Water managers	150	Denmark
2	Conference	AU	Climate effects on freshwaters	5–7 Mar 2009	Aarhus, Denmark	Scientific and Water managers	150	Denmark
3	Workshop	UDE	Meeting of the Working Group of the Federal States on Water Problems	25 Mar 2009	Nürnberg, Germany	Water managers	25	Germany
4	Presentation	AU	Water Network Meeting	1 Apr 2009	Odense, Denmark	Water managers	30	Denmark
5	Presentation	AZTI	Presentation of WISER project	21 Apr 2009	ICES BEWG meeting Sweden	Scientific	18	Sweden
6	Presentation	FVB	CB GIG Lake-Macroinvertebrate Group	28–29 Apr 2009	Enkhuizen, Netherlands	Water managers	10	Europe
7	Presentation	UDE	Presentation of WISER and discussion of links to ECOSTAT and GIGs	20–21 Apr 2009	Brussels, Belgium	Policy makers	60	Europe
8	Presentation	AU	Baltic GIG meeting	6–7 May 2009	Stockholm Sweden	Scientific and Water managers	-	Europe
9	Conference	AU	Climate change and manipulating productivity in freshwater ecosystems – a global perspective'	12–13 May 2009	Roskilde, Denmark	Scientific	130	Denmark
10	Presentation	AU	Climate change and manipulating productivity in freshwater ecosystems – a global perspective'	12–13 May 2009	Roskilde, Denmark	Scientific	-	Worldwide
11	Workshop	AU	Fish as an indicator of water quality	25–27 May 2009	Siljan, Sweden	Scientific	17	Nordic countries
12	Presentation	AZTI	Presentation of WISER project	8 May 2009	Prevecma meeting Vigo (Spain)	Scientific and Water managers	15	Spain
13	Presentation	FVB, UDE	LAWA Meeting	May 2009	Magdeburg, Germany	Water managers	30	Germany
14	Presentation	AZTI	Presentation of WISER project	15 Jun 2009	Lisbon GIG meeting	Scientific and Water managers	60	Europe

15	Briefing	AZTI	Presenting WISER WP4.4	Jul 2009	London (UK)	Scientific and Water managers	60	Europe
16	Briefing	UDE, BOKU	distributed among project partners	Jul 2009	Essen	Scientific and general public	50	Europe
17	Web	UDE, BOKU	Information about WISER, invitation to a workshop	Jul 2009	Essen	Scientific and Water managers	20	Europe
18	Workshop	AU	Monitoring of large lakes	10–14 Aug 2009	Norrtälje, Sweden	Scientific and Water managers	-	Nordic countries
19	Presentation	AU	Monitoring of large lakes	10–14 Aug 2009	Norrtälje, Sweden	Scientific and Water managers	-	Nordic countries
20	Conference	AU	Shallow lakes in a changing climate	17–21 Aug 2009	Sinaia, Romania,	Scientific	100	Europe
21	Workshop	All	Phytoplankton counter workshops	Sep 2009	Helsinki, Madrid and Berlin	Scientific	10	Europe
22	Presentation	AZTI	Meeting from the Spanish benthic IC group	21 Sep 2009	Derio, ES	Scientific and Water managers	6	Spain
23	Presentation	AU	Presentation WISER plans	2 Sep 2009	Baltic GIG meeting, Berlin	Scientific and Water managers	13	Europe
24	Presentation	AU	Present the project objectives and the implementation of the results at national level	16 Oct 2009	Stakeholders Forum, Varna Bulgaria	Scientific, Water managers, NGOs, Stakeholders	50	Bulgaria
25	Workshop	AU	Lake responses to global warming and consequences for lake restoration	16–18 Oct 2009	Jinan University, Guangzhou, China	Scientific	80	China
26	Workshop	AU	Fish removal as a lake restoration tool	16–18 Oct 2009	Jinan University, Guangzhou, China	Scientific	80	China
27	Presentation	AU	Lakes responses to global warming and consequences for lake restoration	16–18 Oct 2009	Jinan University, Guangzhou, China	Scientific	80	China
28	Presentation	NIVA	Introduction of WISER to Northern WFD authorities	29 Oct 2009	Helsinki, FI	Water managers	30	Nordic countries
29	Presentation	UDE	Introduction of WISER to EURAQUA	23 Oct 2009	Lyon, FR	Policy makers	25	Europe
30	Presentation	UDE, NIVA, JRC	Discussion on how to involve WISER into the IC exercise	1 Oct 2009	Brussels	Policy makers	60	Europe
31	Conference	AU	Coastal Estuarine Research Federation	5 Nov 2009	Portland, Oregon	Scientific	150	Worldwide
32	Presentation	AU	Discussion on plankton variability in the Mediterranean Sea	12 Nov 2009	Master Program on Global Change	Scientific	12	Worldwide
33	Presentation	AU, AZTI	Presentation WISER plans	19 Nov 2009	NEA GIG meeting, Edinburgh	Scientific and Water managers	15	Europe

34	Presentation	AZTI	Presentation of the 'One out, all out' problematic	Nov 2009	Portland (USA), CERF meeting	Scientific and Water managers	1500	Worldwide
35	Presentation	FVB	GIG IC leaders	5–9 Nov 2009	Ispra, JRC IC meeting	Water managers	20	Europe
36	Presentation	FVB	Lake assessment using macroinvertebrates	26–27 Nov 2009	Lake assessment workshop, Berlin, DE	Scientific and Water managers	20	Germany
37	Web	UDE, BOKU, ALTERRA, CEMAGREF	Dissemination of Workshop minutes	15–18 Nov 2009	Wageningen, NL	Water managers	80	Europe
38	Conference	AU	Agricultural congress	13 Jan 2010	Herning, Denmark	Industry, Policy makers	100	Denmark
39	Presentation	AU	Discussion on common metrics for the BS-GIG	14 Jan 2010	Black Sea Basin directorate Varna, Bulgaria	Scientific and Water managers	15	Bulgaria, Romania
40	Workshop	AU	Consequences of climate change in lakes	18–19 Jan 2010	Southern Danish University, Denmark	Scientific	25	Denmark
41	Presentation	AU	Consequences of climate change in lakes	18–19 Jan 2010	Southern Danish University, DK	Scientific	25	Worldwide
42	Presentation	AZTI, USALENTO, IMAR	Presentation of WISER project	21 Jan 2010	COAST meeting, Ispra, IT	Scientific and Water managers	70	Europe
43	Presentation	FVB	CB-GIG Lake Macroinvertebrate Group	20–21 Jan 2010	Vilnius, LT	Water managers	10	Europe
44	Presentation	FVB	Lake Macroinvertebrate Intercalibration	27–28 Jan 2010	LAWA meeting, Mainz, DE	Water managers	20	Germany
45	Briefing	NERC	Updated all GIG contacts on approaches to be taken for common metrics	19 Jan 2010	N/A	Scientific and Water managers	17	Europe
46	Workshop	SYKE	Internal 1-day on phytoplankton indicator development	8 Jan 2010	Helsinki, Finland	Scientific	-	Europe
47	Presentation	UCL, SYKE	Presentation and discussion on intercalibration methods	18–19 Jan 2010	UCL, UK	Scientific	15	UK
48	Poster	UniRoma1	Lakes assessment using benthic invertebrate metrics	29–31 Jan 2010	Lake littoral Symposium, Konstanz, DE	Scientific	100	Worldwide
49	Presentation	AZTI, IMAR	Presentation of WISER project	8 Feb 2010	San Sebastian, ES, NEA-GIG	Scientific	15	Europe

50	Presentation	UDE	The WISER project status	Feb 2010	River Fish GIG Meeting, Duesseldorf, DE	Scientific and Water managers	20	Europe
51	Presentation	UDE	The WISER project status	Feb 2010	All COAST/ GIG Meeting, Ispra, IT	Scientific and Water managers	70	Europe
52	Conference	AU	Macrophytes as ecological indicators (in Danish)	Mar 2010	Roskilde, Denmark	Scientific and Water managers	150	Denmark
53	Conference	AU	EUTRO2010	16 Jun 2010	Nyborg, Denmark	Scientific	150	Worldwide
54	Conference	AU	EUTRO 2010, Third international symposium on research and management of eutrophication in coastal ecosystems	15–18 Jun 2010	Nyborg, Denmark	Scientific and Water managers	-	Europe
55	Workshop	NIVA	“Transitional Waters in Norway (WFD)”	15 Jun 2010	Oslo, Norway	Scientific	10	Norway
56	Presentation	SYKE	European Marine Biology Symposium (EMBS)	23–27 Aug 2010	Scotland	Scientific	-	Europe
57	Presentation	AZTI	The Estuarine and Coastal Science Association (ECSA) 47 Annual Symposium	14–19 Sep 2010	Figueira da Foz, Portugal	Scientific	200	Worldwide
58	Conference	AZTI	Estuarine and Coastal Science Association (ECSA 47)	Sep 2010	Figueira da Foz (Portugal)	Scientific	250	Europe
59	Conference	AZTI, USalento, IMAR	ICES Annual Science Conference	20–24 Sep 2010	Nantes, France	Scientific	768	Worldwide
60	Conference	CEMAGREF	Assessing contamination levels in transitional waters using fish-based core metrics: an original approach based on Bayesian framework.	14–19 Sep 2010	Figueira da Foz (Portugal)	Scientific	250	Europe
61	Conference	CSIC	ECSA 47 Symposium,	14–19 Sep 2010	Figueira da Foz, Portugal	Scientific	180	Europe
62	Conference	FVB	Fish sampling with active methods	8–11 Sep 2010	Ceske Budejovice, Czech Republic	Scientific	108	Worldwide
63	Conference	IO-BAS	International Symposium, ECSA 47	16–22 Sep 2010	Figueira da Foz, Portugal	Scientific, Policy makers	150	Europe
64	Poster	NIVA	“Response of single benthic metrics and multimetric methods to an enthropogenic pressure gradient in the Oslofjord, Norway”	13–16 Sep 2010	Strömstad, Sweden	Scientific	260	Nordic countries

65	Conference	UHULL	The application of fish-based indices to assess the ecological quality condition in estuarine systems	14–19 Sep 2010	Figueira da Foz (Portugal)	Scientific	250	Europe
66	Conference	UHULL, CEMAGREF	Intercalibration of criteria for the assessment of fish fauna BQE in Mediterranean Transitional Waters	14–19 Sep 2010	Figueira da Foz (Portugal)	Scientific	250	Europe
67	Conference	USalento, AZTI, IMAR, UHULL	ECSA Integrative tools and methods in assessing ecological quality in estuarine and coastal systems worldwide	14–19 Sep 2010	Figueira da Foz, Portugal	Scientific	200	Europe
68	Conference	AU	Eelgrass targets applicability to WFD	13 Oct 2010	Egholm, Denmark	Industry, Policy makers	50	Denmark
69	Workshop	AU	Global patterns of phytoplankton	17 Oct 2010	Hangzhou, China	Scientific	30	Worldwide
70	Poster	NERC	Standard WISER Project poster	29 Oct 2010	Scottish Freshwater Group, Stirling, UK	Water managers, researchers, students and government	80	UK
71	Conference	UHULL	Using early stages of estuarine-dependent fish species to define habitat quality: the case of larval red drum (Sciaenops ocellatus)	Oct 2010	Portsmouth (UK)	Scientific and Water managers	150	Europe
72	Workshop	AU	How to use macrophytes in the ecological classification of lakes? (in Danish)	Nov 2010	Copenhagen, Denmark	Water managers	50	Denmark
73	Conference	IMAR	IMMR2010 - International Meeting on Marine Resources,	16–17 Nov 2010	Peniche, Portugal	Scientific	150	Worldwide
74	Conference	AU	Agricultural congress	13 Jan 2011	Herning, Denmark	Industry, Policy makers	100	Denmark
75	Presentation	UDE	Bioassessment in line with the WFD	5 Jan 2011	Santiago de Chile, Chile	Scientific, Policy, Management	65	Chile, Germany
76	Presentation	ALTERRA	Beekdalbreed Hermeanderen en enkele andere lopende projecten	10 Feb 2011	Arnhem	-	-	The Netherlands
77	Presentation	CSIC	Mediterranean intercalibration group (MED-GIG)	Feb 2011	Rome, Italy	Scientific and Water managers	-	Europe
78	Presentation	UDE	ECOSTAT meeting	30 Feb 2011	Ispra, Italy	Scientific and Water managers	100	Europe
79	Workshop	UHULL	Determination of variance in metrics (R) & uncertainty with WISERBUGS	Feb 2011	Hull (UK)	Scientific	20	Europe

80	Presentation	AU, SYKE	Intercalibration Group Meeting	1–2 Mar 2011	Baltic GIG meeting in Copenhagen	Scientific and Water managers	15	Europe
81	Presentation	IEP	Taxonomic composition macrophyte metrics for eutrophication	Mar 2011	Berlin, Germany	Scientific and Water managers	20	Europe
82	Presentation	IEP	Intercalibration Group Meeting	Mar 2011	CB-GIG macrophyte expert meeting, Berlin, IGB	Scientific and Water managers	20	Europe
83	Presentation	FVB	Intercalibration Group Meeting	8–9 Mar 2011	CB GIG Lake-Macroinvertebrate Group Meeting, London, UK	Water managers	7	Europe
84	Presentation	NERC	Seminar on "Lake phytoplankton research for the WFD"	31 Mar 2011	CNR, Milan	Scientific and Water managers	20	Italy
85	Presentation	NIVA	Tax. comp. and bloom metrics presented at National WFD conference (annual event)	16 Mar 2011	Oslo, Norway	Water managers	100	Norway
86	Presentation	NIVA	Intercalibration meeting with Norwegian EPA to prepare for Ecostat in late March	25 Mar 2011	Oslo, Norway	Water managers	10	Norway
87	Conference	SLU	Resilience 2011	Mar 2011	Phoenix, AZ, USA	Scientific	500	Worldwide
88	Presentation	AZTI	Opening talk on benthic responses to pressures	Apr 2011	49th ECSA International Conference, South Africa	Scientific	400	Worldwide
89	Conference	AZTI, UHULL	South African Marine Science Symposium (SAMSS) and 49th Estuarine and Coastal Sciences Association (ECSA-48)	Apr 2011	Rhodes University, South Africa	Scientific	200	Worldwide
90	Conference	NERC	Session topic: control of internal and external P loading and ecological recovery in lakes.	Apr 2011	Wuxi, China	Scientific	100	Worldwide
91	Conference	NERC	Session topic: control of internal loading to speed up ecological recovery in lakes.	Apr 2011	Wuxi, China	Scientific	100	Worldwide
92	Conference	NERC	Session topic: control of internal and external P loading and ecological recovery in lakes	Apr 2011	Wuxi, China	Scientific	100	Worldwide

93	Conference	NERC	Session topic: control of internal loading to speed up ecological recovery in lakes	Apr 2011	Wuxi, China	Scientific	100	Worldwide
94	Presentation	NERC	Presentation on nitrogen-and algal blooms in European lakes	12 Apr 2011	"Nitrogen & Global Change" conference, Edinburgh	Scientific and Water managers	60	Worldwide
95	Web	UDE, BOKU	WISER Newsletter	9 Apr 2011	Essen	Scientific and general public	-	Europe
96	Workshop	UHULL	Development in estuarine and coastal science and management, collaborative research	13 Apr 2011	Pretoria, (South Africa)	Scientific	3	Worldwide
97	Workshop	UHULL	Hydromorphological assessments in TraC waters for WFD	21 Apr 2011	Birmingham, (UK)	Scientific and Water managers	10	Europe
98	Conference	UHULL	Paradigms in TraC ecology and management	4–8 Apr 2011	Grahamstown (South Africa)	Scientific and Water managers	350	Worldwide
99	Conference	UHULL	TraC integrated assessments and research priorities	26–28 Apr 2011	Hull (UK)	Scientific and Water managers	100	Europe
100	Presentation	BOKU	Exchange and standardisation of evidence based approaches in environmental research between Australia, USA and Europe	21 May 2011	Providence, Rhode Island. USA	Scientific	50	Worldwide
101	Presentation	BOKU	Melcher A. together with: US EPA, UNI Melbourne, UNI Canberra, E-water	21–22 May 2011	Causal Analysis Meeting. Providence, Rhode Island, USA	Scientific	50	Worldwide
102	Conference	BOKU	Responding to the global water crisis	22–26 May 2011	Providence, Rhode Island. USA	Scientific	120	Worldwide
103	Presentation	BOKU	Meta-analyses of rehabilitation projects to improve riverine fish populations.	22–26 May 2011	Providence, Rhode Island. USA	Scientific	600	Worldwide
104	Presentation	BOKU	Melcher, A. and co-authors	22–26 May 2011	NABS 2011, Providence, Rhode Island, USA	Scientific	400	Worldwide
105	Workshop	NIVA, SLU, SYKE	WISER metrics used for IC	10–11 May 2011	Oslo, Norway	Scientific and Water managers	5	Europe
106	Conference	SLU	NABS meeting	May 2011	Rhode Island, USA	Scientific	150	Worldwide
107	Conference	UHULL	Overlap and implementation of EU Directives	7 May 2011	London (UK)	Scientific and Water managers	150	Europe
108	Presentation	AZTI	Benthic responses to pressures and management	1 Jun 2011	Banyuls sur Mer (France)	Scientific	20	Worldwide

109	Presentation	AZTI	Benthic tools for assessing the status	23–24 Jun 2011	University of Fribourg (Switzerland)	Scientific	50	Worldwide
110	Presentation	CEMAGREF	Ecological assessment of running waters: do macrophytes, macroinvertebrates, diatoms and fish show similar responses to human pressures?	27 Jun 2011	Girona	Scientific	400	Europe
111	Presentation	CEMAGREF	Modeling ecological niche of fish species at the European scale: effects of climatic condition and potential consequences on future local species richness	27 Jun 2011	Girona	Scientific	400	Europe
112	Presentation	CEMAGREF	Logez M., Pont D. & Bady P.	27 Jun 2011	7th Symposium for European Freshwater Sciences. Girona, Spain	Scientific	400	Worldwide
113	Presentation	CEMAGREF	Marzin A., Belliard J. & Pont D.	27 Jun 2011	7th Symposium for European Freshwater Sciences. Girona, Spain	Scientific	400	Worldwide
114	Presentation	IEP	Testing the taxonomic composition macrophyte metrics for assessment of eutrophication – searching for the intercalibration common metric	Jun 2011	Girona, Spain	Scientific	50	Europe
115	Presentation	FVB	Intercalibration Group Meeting	6–7 Jun 2011	CB GIG Lake-Macroinvertebrate Group Meeting, Berlin, Germany	Water managers	7	Europe
116	Conference	SLU	European Society of Freshwater Scientists	Jun 2011	Girona (Spain)	Scientific	200	Europe
117	Conference	UCL	Acid Rain in the UK	16 Jun 2011	Beijing	Scientific	50	Worldwide
118	Presentation	UCL	Presentation on WP6.4 work - Recovery of acid and acidified lakes and streams in the UK: 1988-2009	16 Jun 2011	Acid Rain 2011, Beijing	Scientific	50	Worldwide
119	Presentation	UDE	WISER and Intercalibration	28 Jun 2011	Ispra, Italy	Scientific and Water managers	80	Europe

120	Conference	USalento	Coastal Lagoons in a Changing Environment: Understanding, Evaluating and Responding	25–30 Jul 2011	Aveiro, Portugal	Scientific	200	Europe
121	Conference	UHULL, AZTI	Spatial planning and protected areas, TraC and marine areas	4–5 Jul 2011	San Sebastian (Spain)	Scientific and Water managers	90	Europe
122	Workshop	UHULL, IMAR	Features of TraC waters, ecosystem services for restored areas	25–29 Jul 2011	Aveiro, (Portugal)	Scientific and Water managers	120	Europe
123	Conference	USalento	EUROLAG Coastal Lagoons in a Changing Environment: Understanding, Evaluating and Responding	25–30 Jul 2011	Aveiro, Portugal	Scientific	200	Europe
124	Conference	AU	Baltic Sea Science Conference	27 Aug 2011	St. Petersburg, Russia	Scientific	300	Worldwide
125	Presentation	CEMAGREF	Ecological assessment of running waters: do macrophytes, macroinvertebrates, diatoms and fish show similar responses to human pressures?	8 Aug 2011	Berlin	Scientific	250	Europe
126	Presentation	CEMAGREF	Marzin A., Belliard J. & Pont D. (Poster price for A. Marzin!)	8–11 Aug 2011	2nd Biennial Symposium of the International Society for River Science (ISRS), Berlin	Scientific	200	Europe
127	Presentation	NERC, FVB	2 oral presentations on algal bloom metrics by Laurence Carvalho & Ute Mischke	24 Aug 2011	International Association of Phytoplankton Taxonomy and Ecology, Trento, Italy	Scientific and Water managers	80	Worldwide
128	Workshop	UHULL	Sensitivity analysis using UK WFD compliant transitional fish classification index (TFCI)	Aug 2011	York (UK)	Scientific and Water managers	4	Europe
129	Presentation	CSIC	Seagrass chlorophyll fluorescence	9 Sep 2011	Croatia	Scientific	-	Europe
130	Presentation	IO-BAS	GIG-Black Sea	20–21 Sep 2011	Constanta, Romania	Scientific, Policy makers	20	Bulgaria, Romania
131	Conference	NERC	American Fisheries Society Annual Meeting	8 Sep 2011	Seattle, U.S.A.	Scientific	100	USA

132	Presentation	NERC		8 Sep 2011	American Fisheries Society, Seattle, U.S.A.	Scientific	100	Worldwide
133	Workshop	NERC	Meeting of Windermere Arctic charr anglers	20 Sep 2011	Windermere, U.K.	Stakeholders	30	UK
134	Workshop	NIVA	WISER-status on fish as indicators in eutrophicated lakes	7 Sep 2011	Kongsvoll, Norway	Scientific, Stakeholders	20	Norway
135	Presentation	UDE	Impact of land use and physical structure on restoration success	14 Sep 2011	Weihenstephan, Germany	Scientific	50	Germany
136	Presentation	UDE	Impact of land use at different spatial scales	14 Sep 2011	Weihenstephan, Germany	Scientific	50	Germany
137	Presentation	UDE	The role of the catchment-scale for ecological river management	15 Sep 2011	Weihenstephan, Germany	Scientific and Water managers	35	Germany, Austria
138	Workshop	UHULL, CEMAGREF	Field methods training for IO-BAS	9 Sep 2011	Varna (Bulgaria)	Scientific	4	Europe
139	Conference	USalento	TIES Spatial Data Methods for Environmental and Ecological Processes	1–2 Sep 2011	Foggia, Italy	Scientific	150	Europe
140	Conference	AZTI	ECSA “Ecosystem trajectories in transitional waters”	24–28 Oct 2011	Bordeaux, France	Scientific	100	Europe
141	Conference	AZTI	Estuarine and Coastal Science Association (ECSA 49)	24–28 Oct 2011	Bordeaux (France)	Scientific	110	Worldwide
142	Conference	CEMAGREF	Adaptability, behaviour, comparability and sensitivity of transitional waters fish-based assessment tools in Europe	24–28 Oct 2011	Bordeaux (France)	Scientific and Water managers	110	Worldwide
143	Conference	CEMAGREF	Including uncertainties and expert knowledge quantifications in a multimetric fish based index of ecological quality of French estuaries using a Bayesian approach	24–28 Oct 2011	Bordeaux (France)	Scientific and Water managers	110	Worldwide
144	Conference	CEMAGREF	Cause-effect relationships strength and time lag in response to human pressures of metrics used to assess water quality of estuarine systems based on fish assemblages	24–28 Oct 2011	Bordeaux (France)	Scientific and Water managers	110	Worldwide
145	Conference	CEMAGREF	Influence of sampling effort on fish-based assessment of estuarine ecological quality	24–28 Oct 2011	Bordeaux (France)	Scientific and Water managers	110	Worldwide

146	Conference	CSIC-IMEDEA	Ocean deoxygenation conference	24–26 Oct 2011	Toulouse, France	Scientific	100	Worldwide
147	Conference	IO-BAS	3rd Bi-annual Black Sea Scientific Conference "Black sea OUTLOOK"	1–4 Oct 2011	Odessa	Scientific, Policy makers, Media	180	Europe
148	Workshop	SYKE	Demonstration of Helsinki Bay modelling results	4 Oct 2011	Helsinki, Finland	Scientific, Policy makers	4	Finland
149	Others	UCL	ICP Task Force Meeting	19–21 Oct 2011	Sochi	Scientific	32	Europe
150	Conference	USalento	I limiti dello sviluppo: beni e servizi eco sistemici, impatti e gestione	3–6 Oct 2011	Palermo, Italy	Scientific	200	Italy
151	Conference	USalento	SITE I limiti dello sviluppo: beni e servizi eco sistemici, impatti e gestione	3–6 Oct 2011	Palermo, Italy	Scientific	200	Italy
152	Conference	USalento	LaguNet Interazioni tra le aree di transizione e gli ambienti adiacenti (aree marino-costiere e terrestri)	19–21 Oct 2011	Lesina, Italy	Scientific	100	Italy
153	Conference	USalento	Interazioni tra le aree di transizione e gli ambienti adiacenti (aree marino-costiere e terrestri)	19–21 Oct 2011	Lesina, Italy	Scientific	100	Italy
154	Conference	AZTI, UHULL	CERF Coastal and Estuarine Research Federation conference	6–10 Nov 2011	Daytona Beach, FL, USA	Scientific	1500	Worldwide
155	Workshop	CEH	Providing advice on ecological restoration and diagnostic data screening tools	Nov 2011	UK	Policy makers	10	UK
156	Presentation	CEH	Talk topic: control of internal loading to speed up ecological recovery in lakes	Nov 2011	Perth	Water managers and policy makers	100	UK
157	Others	IO-BAS	Meeting with the Deputy Minister of Ministry of Environment and Water-Bulgaria	15 Nov 2011	Sofia, Bulgaria	Policy makers	12	Bulgaria
158	Workshop	IO-BAS	JRC /ECOSTAT Coastal and Transitional Waters Intercalibration Workshop	17–18 Nov 2011	Ispra, Italy	Scientific, Policy makers	50	Europe
159	Presentation	NERC	Overview of fish assessment research	4 Nov 2011	Lancaster, U.K.	Policy makers	1	UK
160	Presentation	UDE	D5.1-2: DPSIRR chains: Observed and expected effects	7 Nov 2011	Essen, Germany	Scientific	20	Germany
161	Conference	UHULL	Seasonal and spatial dynamics of late larvae and juvenile flatfishes along the Dutch coast, southern north sea. Oral presentation.,	5–10 Nov 2011	Ijmuiden, (The Netherlands)	Scientific	90	Worldwide

162	Presentation	ALTERRA	Gevangen, ballingschap of vrijheid. 30 jaar beekherstel in Nederland	14 Dec 2011	Wageningen.	Water managers	125	The Netherlands
163	Presentation	ALTERRA	Restoring habitat heterogeneity, use conceptual models, looking for progress in stream restoration	15 Dec 2011	Wageningen	Scientific	120	The Netherlands, Belgium
164	Thesis	IMAR	Fitoplâncton do Estuário do Mondego Segundo a Diretiva-Quadro da Água.	Dec 2011	University of Aveiro, Portugal	Scientific	-	Portugal
165	Presentation	NERC	Overview of fish assessment research	1 Dec 2011	Lancaster, U.K.	Policy makers	1	UK
166	Presentation	NIVA	"Harmonization of sampling and classification of macroinvertebrate communities in environmental monitoring according to MOM C and WFD methods".	2 Dec 2011	Oslo, Norway	Scientific	25	Norway
167	Workshop	AU	Fish as indicators in lakes	24 Jan 2012	Tallin, Estonia	Scientific	100	Europe
168	Conference	AU	Lake management, restoration and the impact of global and climate change	25 Jan 2012	Tallin, Estonia	Scientific, Stakeholders	100	Worldwide
169	Poster	AU	Quantification of Sources of Uncertainty in Assessment of Phytoplankton Communities	25–26 Jan 2012	WISER final conference Tallinn, Estonia	Scientific	180	Worldwide
170	Conference	AU	WISER conference	Jan 2012	Tallin, Estonia	Scientific and Water managers	180	Europe
171	Conference	AZTI	WISER 4.4 Marine module results Oral presentation	25–26 Jan 2012	Tallinn (Estonia)	Scientific and Water managers	150	Worldwide
172	Poster	AZTI	WISER Final Conference	25–26 Jan 2012	Tallinn, Estonia	Scientific, Policy makers	170	Worldwide
173	Poster	BOKU	Data about data – the WISER metadatabase	21 Jan 2012	Tallinn, Estonia	Scientific, Policy makers	200	Europe
174	Conference	CEMAGREF	The ecological status assessment of transitional waters: an uncertainty analysis for the most commonly used fish metrics in Europe	23–26 Jan 2012	Tallinn (Estonia)	Scientific and Water managers	150	Worldwide
175	Conference	CSIC	WISER conference	Jan 2012	Tallin, Estonia	Scientific and Water managers	180	Europe
176	Conference	CSIC	WISER conference	Jan 2012	Tallin, Estonia	Scientific and Water managers	180	Europe

177	Conference	CSIC	WISER conference	Jan 2012	Tallin, Estonia	Scientific and Water managers	180	Europe
178	Conference	CSIC	WISER conference	Jan 2012	Tallin, Estonia	Scientific and Water managers	180	Europe
179	Conference	IMAR	The classification of the Biological Quality Element phytoplankton for the Water Framework Directive in the transitional waters of the Rio Mondego, Portugal	25–26 Jan 2012	WISER final conference Tallinn, Estonia	Scientific	180	Worldwide
180	Conference	IMAR	WISER conference	Jan 2012	Tallin, Estonia	Scientific and Water managers	180	Europe
181	Conference	NERC	Guidelines for standardisation of hydroacoustic methods	25 Jan 2012	Tallin, Estonia	Scientific, Stakeholders	100	Worldwide
182	Poster	NERC	Uncertainty in macrophyte metrics used for calculating the ecological status of lakes.	23–25 Jan 2012	Tallinn, Estonia	Scientific, Policy makers	150	Europe
183	Poster	NERC	Extraction of data from WISER databases	21 Jan 2012	Tallinn, Estonia	Scientific, Policy makers	200	Europe
184	Poster	NIVA	The WISER Central Database: content, structure and functions	21 Jan 2012	Tallinn, Estonia	Scientific, Policy makers	200	Europe
185	Poster	NIVA	Climate change, restoration and ecological status in lakes: a Bayesian network modelling approach.	21 Jan 2012	Tallin, Estonia	Scientific, Water managers, NGOs, Stakeholders	200	Europe
186	Conference	SLU	WISER final conference	Jan 2012	Tallinn, Estonia	Scientific, Policy, Management	200	Europe
187	Workshop	SYKE	LLR tool for a river basin manager	22 Jan 2012	Tallin, Estonia	Scientific, Water managers, NGOs, Stakeholders	200	Europe
188	Conference	UCL	Assessing degradation and recovery pathways in lakes impacted by eutrophication using the sediment record	21 Jan 2012	Tallin, Estonia	Scientific	200	Europe
189	Poster	UCL	Using aquatic plant sub-fossils to define reference conditions in shallow eutrophic lakes: a palaeolimnological perspective	23–25 Jan 2012	Tallinn, Estonia	Scientific, Policy makers	150	Europe
190	Presentation	UDE	River management, restoration and the impact of global climate change	26 Jan 2012	Tallinn, Estonia	Scientific and Water managers	150	Europe

191	Conference	UHULL	Precision and behaviour of fish-based ecological quality metrics in relation to natural and anthropogenic pressure gradients in European estuaries	23–24 Jan 2012	Tallinn (Estonia)	Scientific	100	Worldwide
192	Conference	USalento	WISER conference	Jan 2012	Tallin, Estonia	Scientific and Water managers	180	Europe
193	Presentation	CSIC	Meeting with the responsible group for the WFD in the government of Catalonia (Agencia Catalana de l'Aigua)	2 Mar 2012	Barcelona, Spain	Water managers	20	Spain
194	Web	BOKU	Macrophyte Indicator Database	Apr 2010	www.freshwatereco logy.org	Scientific	250	Europe
195	Web	BOKU	Metadatabase search tool	Apr 2011	www.wiser.eu	Scientific	250	Europe
196	Web	BOKU	Taxa Entry Tool and Taxa Validation Tool	Nov 2010	www.wiser.eu	Scientific	250	Europe
197	Web	NERC	Case studies included in the above report have been published on the CEH web site in DPSIR format to help inform water quality managers on the likely successes of specific management practices		http://www.ceh.ac.u k/sci_programmes/ water/Scottish-Loch-Restoration.html.	Scientific, Policy, Management	-	Europe
198	Presentation	NERC	Providing advice on ecological restoration/ conservation measures and recovery expected recovery trajectories		UK	Water managers and policy makers	100	UK
199	Presentation	IO-BAS	Advisory Group –Conservation of Biodiversity Meeting (Black Sea Commission)	4–5 Sep 2011	Istanbul, Turkey	Scientific	17	Black Sea countries

Section B

Part B1: Patents, Trademarks, Registered Designs, etc.

Section B is not applicable to WISER. No patents, trademarks, registered designs resulted from this project.

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights3:	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)

[3] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2

Section B is not applicable to WISER. No patents, trademarks, registered designs resulted from this project.

Type of Exploitable Foreground4	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application5	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
	Ex: New supercond uctive Nb-Ti alloy			*MRI equipment*	*1. Medical* *2. Industrial inspection*	*2008* *2010*	*A materials patent is planned for 2006*	*Beneficiary X (owner)* *Beneficiary Y, Beneficiary Z, Poss. licensing to equipment manuf. ABC*

[19] A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

[5] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

4.3 Report on societal implications

A	General Information *(completed automatically when* Grant Agreement number *is entered.*
Grant Agreement Number:	226273
Title of Project:	Water bodies in Europe: Integrative Systems to assess Ecological status and Recovery
Name and Title of Coordinator:	Prof. Dr. Daniel Hering

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***No***
2. Please indicate whether your project involved any of the following issues (tick box) :	
RESEARCH ON HUMANS	
• Did the project involve children?	no
• Did the project involve patients?	no
• Did the project involve persons not able to give consent?	no
• Did the project involve adult healthy volunteers?	no
• Did the project involve Human genetic material?	no
• Did the project involve Human biological samples?	no
• Did the project involve Human data collection?	no
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	no
• Did the project involve Human Foetal Tissue / Cells?	no
• Did the project involve Human Embryonic Stem Cells (hESCs)?	no
• Did the project on human Embryonic Stem Cells involve cells in culture?	no
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	no
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	no
• Did the project involve tracking the location or observation of people?	no
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	no
• Were those animals transgenic small laboratory animals?	no
• Were those animals transgenic farm animals?	no
• Were those animals cloned farm animals?	no
• Were those animals non-human primates?	no
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	no
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	no
DUAL USE	no
• Research having direct military use	no
• Research having the potential for terrorist abuse	no

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).		
Type of Position	**Number of Women**	**Number of Men**
Scientific Coordinator	0	2
Work package leaders	5	14
Experienced researchers (i.e. PhD holders)	Approx. 40	Approx. 70
PhD Students	Approx. 15	Approx. 15
Other		

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	Approx. 30
Of which, indicate the number of men:	Approx. 15

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?	O X	Yes No

6. Which of the following actions did you carry out and how effective were they?

	Not at all effective				Very effective
❑ Design and implement an equal opportunity policy	O	O	O	O	O
❑ Set targets to achieve a gender balance in the workforce	O	O	O	O	O
❑ Organise conferences and workshops on gender	O	O	O	O	O
❑ Actions to improve work-life balance	O	O	O	O	O
O Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

O Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

O Yes- please specify

X No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

X Yes- please specify website, software tools and manuals

O No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

X Main discipline[6]: 1.1, 1.4, 1.5 X Associated discipline[6]: 1.1 (software)	O	Associated discipline[6]:	

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*	X O	Yes No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

- X No
- O Yes- in determining what research should be performed
- O Yes - in implementing the research
- O Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	O X	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- O No
- O Yes- in framing the research agenda
- X Yes - in implementing the research agenda
- X Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- X Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- O Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- O No

13b If Yes, in which fields?

Agriculture X	Energy	Human rights
Audiovisual and Media	Enlargement	Information Society
Budget	Enterprise	Institutional affairs
Competition	Environment X	Internal Market
Consumers	External Relations	Justice, freedom and security
Culture	External Trade	Public Health
Customs	Fisheries and Maritime Affairs X	Regional Policy
Development Economic and Monetary Affairs	Food Safety	Research and Innovation X
Education, Training, Youth	Foreign and Security Policy	Space
Employment and Social Affairs	Fraud	Taxation
	Humanitarian aid	Transport

13c If Yes, at which level?

- X Local / regional levels
- X National level
- X European level
- X International level

H Use and dissemination

[6] Insert number from list below (Frascati Manual).

14. How many Articles were published/accepted for publication in peer-reviewed journals?	112
To how many of these is open access[7] provided?	16
How many of these are published in open access journals?	0
How many of these are published in open repositories?	0
To how many of these is open access not provided?	96
Please check all applicable reasons for not providing open access:	
X publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ **lack of information on open access** ❑ **other8: ……………**	

15. How many new patent applications ('priority filings') have been made? ***("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).***		0
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	**Trademark**	0
	Registered design	0
	Other	0
17. How many spin-off companies were created / are planned as a direct result of the project?		**0**
Indicate the approximate number of additional jobs in these companies:		**0**

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	X	None of the above / not relevant to the project
❑	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*
Difficult to estimate / not possible to quantify	X❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

[7] Open Access is defined as free of charge access for anyone via Internet.
[8] For instance: classification for security project.

X Yes		O No	

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

X Yes   O No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
❑	Media briefing	X	Coverage in general (non-specialist) press
X	TV coverage / report	X	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
❑	DVD /Film /Multimedia	❑	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

❑	Language of the coordinator	X	English
X	Other language(s)		

Question F-10: Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]