PROJECT FINAL REPORT

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Name of the scientific representative of the project's co-ordinator[1], Title and Organisation:

Dr. Martin Kernan. University College London

Tel: +44 207 6790523

Fax: +44 207 679 0565

E-mail: m.kernan:@ucl.ac.uk

Project website address: http://www.refresh.ucl.ac.uk/

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

4.1 Final publishable summary report

EXECUTIVE SUMMARY

REFRESH had three overarching goals; i) to increase our understanding of how freshwater ecosystems will respond to the environmental changes driven by climate, land use, water use and pollution over the next 50-60 years; ii) to translate this knowledge into a form that can be used by water managers; and iii) To ensure uptake of REFRESH results by target stakeholders.

REFRESH adopted a multi-tiered approach to increasing understanding of how freshwater ecosystems will respond to global change drivers, how this might be managed practically and conceptually and how much management measures will cost. We collated existing knowledge from a wide range of sources and generated new knowledge using experimental and analytical approaches.

To increase our fundamental understanding of the mechanisms through which key global change-related drivers will affect freshwaters we used a series of co-ordinated field experiments to determine the impact of changing temperatures, changes in flow / water level and the interaction between these and nutrient concentration on rivers, lakes and riparian wetlands. The field experiments were supported by laboratory and mesocosm experiments, analysis of major databases and long-term time-series and by evidence from palaeoecological studies. All these approaches were combined to help develop the process-based models needed to run scenarios for adaptive strategies and improve the ecological parts of the models.

The ultimate objective of REFRESH was develop parsimonious integrated models to generate robust simulations of future water quantity, quality and ecology at the catchment scale. In REFRESH we ran a range of scenarios (for climate, land use, water resource use and atmospheric pollution) at a number of case study catchments to simulate hydrological and chemical response to future change and subsequently extrapolate ecological responses associated with temperature increases, altered hydrology and nutrient regimes at sites representative of the climate and land-use types of Europe. A key priority in REFRESH was to improve the ecological parts of the models and to couple the existing integrated models for flow and water chemistry to ecological models of appropriate complexity, so that the ecological response to climate and land-use management change can be predicted at the catchment scale, the feedbacks better understood and the connectivity between rivers, lakes and wetlands better represented. To assess the implications of model output for management we identified the most cost-effective ways of mitigating the adverse impacts of climate change and the impacts of these on achieving good ecological status under the WFD. This was achieved by coupling the ecological and economic outcomes to identify, through in-depth stakeholder dialogue and farm and sub-catchment modelling, the optimum combination of measures that need to be implemented at aggregate catchment scales to achieve WFD and HD compliance in the face of climate change. We also assessed whether the costs of the measures were proportionate and whether there were wider benefits following their implementation.

The stakeholder engagement effort in REFRESH had two main strands. For the first, REFRESH recognised that engaging stakeholders in a dialogue to identify problems, design solutions and address barriers to their uptake is an important element for successful implementation of the WFD and HD and for building adaptive capacity. Second, to maximise uptake of the results of the project, dissemination activities were targeted at specific stakeholder groups and organised to ensure that stakeholders were aware of the project output, that the key messages for managers, practitioners and policy makers were expressed clearly and accessibly and that the stakeholders had the opportunity to feedback into the process. In REFRESH this work was carried from the very beginning to engage users and scientists together in the research process and to elicit stakeholder views that are needed to inform later stages of the Project. Further workshops were held to discuss outcomes of the research and to encourage stakeholders to disseminate the findings.

SUMMARY DESCRIPTION OF PROJECT CONTEXT AND OBJECTIVES

Climate modelling studies indicate that even if greenhouse gases were stabilised at present levels, future climate change is inevitable as the climate system adjusts to emissions that have already taken place. Given the rate and magnitude of change projected it is important to ask what practical adaptation and mitigation steps can be taken to minimise the adverse effects of climate change on freshwater ecosystems over the next 50 years and what measures can be taken to ensure the success of freshwater restoration projects.

REFRESH is concerned with the development of a system that will enable water managers to design cost-effective management strategies for freshwater ecosystems at the local and catchment scales that account for the expected future impacts of climate change and land-use change in the context of the Water Framework and Habitats Directives. At its centre is a process-based evaluation of the specific adaptive measures that might be taken at these different scales to minimise the expected adverse consequences of climate change on freshwater quantity, quality and biodiversity. The Project considers how freshwater ecosystems (rivers, lakes, reservoirs, and riparian wetlands) in Europe will change over the next fifty years and it uses a combination of novel experiments and modelling to generate the understanding and tools needed to implement an adaptive management strategy. There are a number key concepts addressed in the projects which underpin the work programme.

Scenarios and storylines

Predicting how freshwaters will change in future is challenging, especially as they will respond in complex ways not only to climate change but also to change in other drivers acting separately and in combination with climate change. Hence, clearly defined scenarios for the future are required to enable experiments to be designed realistically and models to be run under expected combinations of future pressures. In REFRESH we developed realistic scenarios for future climate change, land-use/land management change, nitrogen deposition and water abstraction/water resource change and combined the scenarios to generate a range of storylines in the modelling and cost-effectiveness work at a number of case study catchments. In addition we engaged national and local stakeholders in the generation of storylines to develop a consensus view on the relevance and applicability of the various storylines when applied to the case study catchments.

Adaptation, mitigation and restoration strategies

Given the rate and magnitude of climate change projected over the next 50 years, it is necessary to minimise the adverse effects of climate change on freshwaters and to modify management and restoration targets to allow for shifts in the climate system. In REFRESH we focused on problems of increasing water temperature, changing hydrology (and salinity) and interactions between climate change and the behaviour of nutrients and organic matter as the principal climate-related threats to freshwater ecosystems. The overall principle is to improve the resistance and resilience of freshwater ecosystems to the adverse impacts of climate change by restoring ecosystem quality as required by the WFD. Specific adaptation strategies considered included: (i) the management of riparian areas to control water temperature by the establishment of woody riparian vegetation; (ii) the management of catchment hydrology to maintain flow in streams, water-level in lakes and regular flooding in wetlands; (iii) the re-creation of riparian floodplains to buffer against extreme precipitation events and to reduce nutrient flows and humic substances to water bodies; (iv) the management of catchment land-use to reduce diffuse nutrient loading and soil erosion; and (v) the management of water abstraction from, and effluent discharge to, surface waters.

Understanding processes

Adaptive management strategies need to be based on an understanding of the single and combined effects of the key climate-related drivers (temperature, hydrology and nutrients) on ecosystem

structure, functioning and biodiversity. We focused primarily on the most vulnerable systems which are mainly those with small water mass (where warming will be highest and hydrological impacts most pronounced) in lowland regions (where the risks of eutrophication associated with nutrient loading and oxygen stress are greatest). Such systems are found throughout Europe in all climate zones. To increase our fundamental understanding of the mechanisms through which the key climate-related drivers will affect freshwaters we used a series of carefully designed, co-ordinated field experiments in which river, lake and wetland sites were selected to represent a gradient of climate conditions across Europe. For rivers the emphasis was on the impact of changing temperatures and low and variable flows under different nutrient conditions. For riparian wetlands the experiments were designed to study the processes involved in changing temperatures, drought regimes and reducing nutrient loading on wetlands. For lakes the experimental focus was on lake-level fluctuations and on ecosystem functioning especially with respect to carbon, nitrogen, phosphorus, oxygen and salinity dynamics. The field experiments were supported by laboratory and mesocosm experiments, analysis of major databases and long-term time-series and by evidence from palaeoecological studies All these approaches were combined to help develop the process-based models needed to run scenarios for adaptive strategies and which are required for up-scaling from local to river basin.

Identifying thresholds and reference conditions

A critical concern in the management of freshwater ecosystems is the attempt to prevent water bodies from crossing key thresholds, where systems may change abruptly and involve a switch to regimes that are difficult to restore. There is considerable uncertainty about how climate change may cause thresholds to be crossed, or may cause thresholds to move. In REFRESH we considered this problem for rivers, lakes and wetlands using analyses of existing long-term and palaeo-data time-series from sites distributed along the primary European climate gradients, from the results of the experiments and from extensive literature reviews. We evaluated how the threshold concept and knowledge of specific thresholds can be incorporated into adaptation, mitigation and restoration strategies needed to achieve the objectives of the WFD and HD. Climate change not only drives freshwater ecosystems across new thresholds but also changes the currently static concept of the reference state as defined by the WFD. Under climate change, reference conditions become dynamic and the definition of good ecological status becomes insecure. In REFRESH we examined how the use of reference conditions for lakes, rivers and riparian wetlands might be affected following climate change and how the concept of a dynamic reference state can be built into WFD and HD methodologies.

Indicators and vulnerability

Research funded by previous EU projects developed indicator systems for freshwater ecosystems under pressure from hydromorphological and pollution pressures, and subsequently from climate change. In REFRESH we focused on developing an effective system of indicators for freshwaters focussing essentially on ecological indicators sensitive to the functional response of rivers, lakes and wetlands to climate-induced changes in temperature, flow/water-level and nutrient/organic matter loading. Special attention was given to the use of species and assemblage traits as measures of functional response.

Developing and improving integrated catchment models

The ultimate objective of REFRESH was develop parsimonious integrated models that can generate robust simulations of future water quantity, quality and ecology at the catchment scale, the scale prescribed by the WFD for management decision-making and the scale at which adaptive measures will be most effective. In REFRESH we undertook integrated model development using the results from the reviews, analyses, experiments and local models of WP2-4 to extrapolate ecological responses associated with temperature increases, altered hydrology and nutrient regimes to the

catchment scale at sites representative of the climate and land-use types of Europe. A key priority in REFRESH was to improve the ecological parts of the models and to link models between ecosystem types and couple the existing integrated models for flow and water chemistry to ecological models of appropriate complexity, so that the ecological response of freshwater ecosystems to climate and land-use management change can be predicted at the catchment scale, the feedbacks better understood and the connectivity between rivers, lakes and wetlands better represented.

Assessing the cost-effectiveness of adaptive management strategies
Successful implementation of the adaptive management strategies at the catchment scale requires the willingness of relevant stakeholders to adopt the measures proposed. A principal barrier to implementation is cost. There are two main aspects, first, the proportionality or disproportionality of compliance costs in relation to statutory European policy obligations under the HD and the WFD and second the specific costs of the alternative measures that might be introduced to achieve compliance. Cost-effectiveness Analysis (CEA) has emerged as the preferred method for assessing the best means for water users or those whose behaviour impacts on water quality in order to achieve compliance with policy. Most established methods for assessing cost-effectiveness of water quality enhancement strategies fail to acknowledge fully the implications of the highly varied nature of land management systems and land manager behaviours, even at subcatchment scale. Cost-effectiveness studies of nutrient mitigation measures based on stylised or typical farm types do not take into account the inherent variability among farms caused by differences in farm size, land quality, spatial location, production techniques employed or managerial abilities. In REFRESH the intention was to identify the most cost-effective ways of mitigating the adverse impacts of climate change and the impacts of these on achieving good ecological status under the WFD or the favourable status of HD sites. This was achieved by coupling the ecological and economic outcomes to identify, through in-depth stakeholder dialogue and farm and sub-catchment modelling, the optimum combination of measures that need to be implemented at aggregate catchment scales to achieve WFD and HD compliance in the face of climate change.

Engaging with stakeholders and exchanging knowledge
Effective implementation of policy depends on the willingness and capacity of the various stakeholders to accept the policy and carry out the identified measures. Whatever the measures, there is likely to be some form of change required, ranging from awareness-raising to changing behaviour and practices. Given that climate variability may require rapid and far-reaching adaptation of practices, understanding the circumstances in which these changes might occur, and how to enable them, will be essential. Engaging stakeholders in a dialogue to identify problems, design solutions and address barriers to their uptake will assist with the implementation of the WFD and HD and build adaptive capacity. However, this requires a negotiated relationship between governments, relevant agencies, land managers and other water users and requires an understanding of the multiple perspectives, and potential conflicts of interest between the stakeholders to develop a constructive dialogue. In REFRESH this work was carried out throughout the duration of the project. Workshops with stakeholders were held to engage users and scientists together in the research process and to elicit stakeholder views that are needed to inform later stages of the Project. Further workshops were held to discuss outcomes of the research and to encourage stakeholders to disseminate the findings.

In these contexts, the Project has the following specific objectives:

- to generate scenarios and storylines for future climate, land-use, water resource demand and air pollution relevant to the future management of freshwater ecosystems;
- to review and assess measures that can be taken to mitigate the effects of temperature, changing hydrology (and salinity) and increased nutrient and organic matter loading expected under different future scenarios;

- to understand the processes that govern the relationship between temperature, hydrology (and salinity) and nutrient/organic matter loading and the structure, function and biodiversity of freshwater ecosystems;
- to develop methods for identifying thresholds and reference conditions for systems facing climate change;
- to develop new indicator systems and vulnerability assessment methods for systems facing climate change;
- to assess how climate change will alter species distribution patterns, especially those prioritised in the HD, at the European scale;
- to develop and demonstrate effective methodologies to assess the cost-effectiveness of alternative adaptation/mitigation strategies in freshwaters;
- to develop and improve the performance of integrated catchment models for simulating the ecological response of freshwater ecosystems to climate, land-use and pollution change;
- to use the models to explore the ecological and cost-effectiveness of alternative adaptation, mitigation and restoration strategies to ensure long-term sustainable management; and
- to engage with stakeholders to develop scenarios and storylines and explore barriers to the implementation of adaptation and mitigation strategies at national and catchment scales.
- to disseminate the output of the project widely among the scientific and dtakeholder communities and translated this in a way that renders it accessible to policy makers and implementers.

There are thus three overarching goals

i) to increase our understanding of how freshwater ecosystems will respond to the environmental changes driven by climate, land use, water use and pollution over the next 50-60 years.

ii) to translate this knowledge into a form that can be used by water managers. This can then feed into the design of cost-effective restoration and management programmes that will account for the projected future impacts of climate, land use etc

iii) To ensure uptake of REFRESH results by target stakeholders – water managers, conservation bodies, policy makers, policy implementers etc

DESCRIPTION OF THE MAIN S&T RESULTS/FOREGROUNDS

The main S&T results are broken down by work package for clarity.

Work package 1

Five reviews have been produced focusing on adaptation strategies in freshwater management;
Deliverable 1.1 a 'Report on climate change adaptation and mitigation strategies already in practice based on the 1st River Basin Management Plans of the Member States'
Deliverable 1.2, a 'Review of published literature for adaptation and mitigation measures including both scientific and policy papers.'
Deliverable 1.3 a' Review of the practical adaptation strategies adopted here in REFRESH for rivers (WP2.6), lakes (WP3.6) and wetlands (WP4.6)'
D**eliverable 1.4** a report 'Integrating strategies at sub-catchment and local scale and strategies at catchment and European scales'
Deliverable 1.5 an 'Overview of practical climate adaptation strategies in European freshwaters at sub-catchment and local scales'

Climate change scenarios: At the outset REFRESH generated climate change scenarios (**Deliverable 1.6**) for each of the demonstration catchments together with an evaluation of the uncertainty in these scenarios. These have been generated using output from the FP6 ENSEMBLES project which generated an ensemble prediction system for climate change based on the principal state-of-the-art, high resolution, global and regional Earth System Models. The scenarios fed into subsequent modelling and storyline generation for modelling and cost effectiveness analysis.

Land use change scenarios: A review of scenario frameworks and previous large-scale land use scenario exercises for Europe was produced (**Deliverable 1.7**). Based upon this review, a generic socio-economic storyline framework for the REFRESH scenarios was developed with reference to the IPCC SRES framework. A specific case study implementation of quantitative land use change scenarios was then generated for the Dee catchment that linked the socio-economic drivers with climate change scenarios using the concept of 'land capability' to identify viable options for land use change (**Deliverable 1.8)**. From this, a generic toolkit was then developed from the LandSFACTS software, complete with user-interface and guidelines, to allow it to be used for those other demonstration catchments that aim to investigate quantitative land use change (**Deliverable 1.9**).

Additionally, long-term nitrogen deposition scenarios (**Deliverable 1.10**) and, following a review of existing scenarios for water resources in Europe (**Deliverable 1.11)** water use scenarios, were developed for the REFRESH demonstration catchments were for the demonstration catchments.

Stakeholder engagement: A number of workshops involving stakeholders at different levels (from policy makers to farmers) were planned in REFRESH. A workshop was organised in London bringing together policy-makers and implementers from across Europe with scientists from REFRESH (**Deliverable 1.13)** focused on the future changes and challenges to WFD and HD implementation, as compared to those experienced at present. Two workshops were organised involving local stakeholders acting locally in the River Dee catchment in Scotland (**Deliverable 1.14**) and the River Louros catchment in Greece (**Deliverable 1.15**). The focus of these catchment scale meetings was to identify what constrains and influences actions to help the water environment and the workshops identified a series of potential barriers to implementation of water management legislation in two very different environments (**Deliverable 1.16**).

WORK PACKAGE 2

TASK 1 Temperature constraints on management success in rivers

We addressed the effects of climate-driven changes in temperature regimes on the success of management measures in rivers, on structure and functioning of river ecosystems, and on changes in river biodiversity. Shading, either by re-vegetation of wooded banks or by restoration of buffer strips or wooded riparian floodplain wetlands, can help to lower temperature, especially in smaller streams. Field experiments were used to investigate temperature change effects on river ecosystem structure and functioning along a gradient from un-shaded to fully shaded lowland streams.

Wooded riparian zones can mitigate stream water temperature rises induced by climate changes in north western Europe. Reducing stream water temperature can help maintain or restore the habitat for cold stenothermic stream organisms, among other benefits. Despite the large body of work on the effect of wooded riparian zones on water temperature, quantitative information on the magnitude of water temperature changes along open or shaded stretches of different lengths is scarce.

We measured stream water temperature year round along 1000- to 2000-m-long stretches of six streams in six countries with a shaded-to-open transition and with an open-to-shaded transition. We used the best-fitting regression models to describe the spatiotemporal changes in water temperature along these transitions. The derived data was compared among streams, and we evaluated the relationship between the magnitude of temperature changes and the stream physical properties.

The effect of the presence or lack of a canopy on water temperature was especially pronounced at relatively high stream water temperatures. During the spring and summer months, the water temperature increased by up to 1.9 °C after leaving a forested stretch, and cooled down by up to 2.3 °C on entering a shaded stretch. The magnitude of change in stream water temperature increased with the length of the stream stretch studied. The magnitude of temperature decrease along shaded stretches depended on the stream size and the LAI, with wooded riparian zones being especially effective as a temperature mitigation measure for small streams (width <3.5 m). The magnitude of the temperature increase along open stream stretches was mostly LAI dependent.

Synthesis and applications. These results provide a quantitative basis for ecologically successful stream temperature mitigation. The possible effects of stream temperature restoration through planting of wooded riparian zones, as well as stream temperature degradation along open stream stretches, are discussed. The observed temperature changes are reflective of the stream physical properties, amount of shade, length of stream stretch, and the time of the year.

TASK 2 Low flows and drought constraints on management success in rivers

We addressed the effects of climate-driven low flows and droughts on management success in rivers, on structure and functioning of river ecosystems, and on changes in river biodiversity. The focus was on low flows and droughts in relation to completeness and naturalness of in-stream habitats and the construction of riparian buffer strips/floodplain wetlands to establish water retention along Atlantic, small-sized lowland streams. In such streams, periods of low flow and droughts will increase and extreme summer floods can wash away communities. Indicators (both structural and functional) reflecting key hydrological conditions were studied using controlled field experiments differing in intensity and periodicity of low flow. Algae, macroinvertebrates (in particular, oxygen sensitive groups) and macrophytes were used as biological effect parameters, and a number of ecosystem and physico-chemical parameters were monitored continuously.

As a result of hydromorphological degradation and climate change the number of low-order lowland streams transforming from perennial to intermittent flow increases in northwestern Europe. To understand the effects of such a regime shift on macroinvertebrate communities, field experiments

were carried out in lowland streams in The Netherlands, Galicia and Denmark. Following a BACI design, flow was manipulated, resulting in two outcomes:
1.) a period of stagnation, with only minimal water loss;
2.) a period of drought, resulting in a dry streambed with water present only in scattered small pools.
We studied the degree to which the stagnant reach, isolated remnant pools, or the dry stream bed acted as refugia for macroinvertebrates and, where possible, to relate the observed changes to ecological preferences.
In the Danish and Dutch streams stagnation resulted in only minor changes in taxon composition. Most taxa remained present in the stagnant reach throughout the study period and overall richness even increased due to colonization by lentic taxa. However, the rheophilic taxa; they disappeared within one week after the flow ceased.
The stream fauna recovered in the pools and the dry bed overlapped almost completely with that of the stagnant reach, but contained only a subset of that found in the stagnant reach. Directly after the water disappeared a peak in taxon richness and abundance was recorded in the pools and in the wet surficial sediment, indicating a concentration effect of the receding water. This was followed by a steep decline in richness in the following weeks, coinciding with a deteriorating water quality in the pools and further drying of the surficial sediment. Nonetheless, several taxa were able to survive up to 25 days in the surficial sediment. The pool assemblage shifted towards one of lentic polysaprobic waters.
Our results indicate that although many macroinvertebrates are able to survive when only flow ceases, the characteristic rheofiles, disappear quickly after the onset of stagnation. Temporal loss of flow, even spanning only a short period of time, could have severe consequences for the composition macroinvertebrate assemblages of lowland streams.
In the Galician streams there was a significant overall effect of flow reduction on both abiotic and biotic stream components, although with different responses regarding streams and stretches. In the nutrient-poor stream, there was a marked decline of invertebrate densities in the stagnant stretch relative to the control, whereas in the nutrient-rich stream the strongest declines were found with invertebrate richness. For the drought stretch, there were changes only in the nutrient-rich stream, where EPT richness was significantly reduced. Moreover, the experimental flow reduction produced changes on the invertebrate structure, mainly determined by the loss of sensitive, rheophilic and oxophilic taxa. Our findings indicate that even short-term water reductions have a significant impact on the structure of the stream invertebrate community, with potential ecological consequences for aquatic biodiversity and stream functioning.
In general, lowland streams are extremely vulnerable to climate change and anthropogenic impacts because of their position in the hydrological network and proximity to human populations. Our results highlight the need for better awareness of impairment to lowland streams, to be included in current management practices and development of adaptive strategies.

<u>TASK 3 Nutrient and organic material constraints on management success in rivers</u>
We addressed the effects of climate-driven changes in nutrient levels on the success of management strategies in rivers, on the structure and functioning of river ecosystems, and on changes in river biodiversity. The focus was on nutrients and organic matter in relation to the construction of riparian buffer strips/floodplain wetlands to establish water retention along small lowland streams. In the controlled field multiple stress experiments the combined effects on algae, macroinvertebrates and macrophytes were studied and the effects on a number of ecosystem and physico-chemical parameters were measured.

Temperature and shading
Streams without riparian forest are particularly vulnerable to increasing stream water temperature. Planting of riparian forest is considered a mitigation measure to reduce water temperatures for the

benefit of stream organisms. However, no studies have investigated how long a forested reach is needed to obtain a significant temperature decrease. In 2010 and 2011 we therefore measured temperatures along a number of small lowland streams, all with a sharp transition between an upstream open reach and a downstream forested reach. In all stream reaches we also measured canopy cover and a range of physical variables characterizing the streams reaches. This allowed the analysis of differences in mean daily temperature and amplitude per month among forested and open sections, analysis of annual temperature regimes and analysis of the influence of the physical condition on temperature changes. Stream water temperature in the open reaches was affected by heating and in mid-summer we observed an increase in temperature over the entire length of these reaches. This resulted in temperatures even in Denmark above the incipient lethal limit for brown trout. Along the forest reaches we observed a significant decrease in mid-summer temperature immediately (100 to 500 m) after entering the forest. Sometimes stream temperature continued to decrease when moving further into the forested reach and the temperature decline did not reach a plateau indicating that the full cooling potential of the riparian forest was not reached. In other cases temperature was stabilised or appeared influenced by groundwater seepage.
Even relatively short stretches (100-500 m) of forest alongside streams can thus act as mitigation measure to combat heating of stream water. However, the best (and cheapest) way may simply be reestablishment of the natural hydrology in the catchments. Flooding of riparian areas and natural succession leading to growth of smaller trees and bushes adapted to this environment would have the combined effects of reducing stream temperature and increasing biodiversity of both the stream and the riparian area.

Oxygen and flow reduction
Specific dissolved oxygen requirements of benthic invertebrates are rarely considered when evaluating impacts to streams, in spite of being the reason for the disappearance of many taxa with oxygen availability as a direct effect of general flow reduction and other organic disturbances.
In an experimental study we tested the response of invertebrate species and communities to a complete reduction in flow created by longitudinally damming two streams with contrasting low and high nutrient levels. We sampled benthic invertebrates in control, and impact stretches (stagnant and drought) before and after the establishment of the dam over 10 weeks in summer. Oxygen daily values decreased and exhibited a strong daily fluctuation at the impacted stretches. The relationship between invertebrates and minimum daily DO values indicated the existence of differential sensitivity and tolerance of taxa to experimentally reduced oxygen concentrations, causing the decline of a high number of sensitive taxa in a synchronous way. We explored taxa resistance to minimum daily DO and different sensitivities and taxa reduction in resistance were evident as the minimum DO threshold diminished. The response of invertebrates was more evident in the impact stretches of the nutrient-rich stream, attributed to the greater and more sustained induced oxygen depletion.

Stagnation and drought
Small, permanent streams are at risk of becoming stagnant or intermittent due to climate change-induced hydrological changes, which can be further intensified by anthropogenic disruptions such as water abstraction. Macroinvertebrate communities are vulnerable to such changes due to their dependence on the stream hydromorphological regime. We conducted fully controlled field experiments in impacted and unimpacted lowland streams with contrasting nutrient availability; using dams and diversions to create short-term (2-10 weeks) stagnant and drought conditions. Furthermore, we installed pools in the drought area to test their value as refugia for benthic macroinvertebrates.
After 2 weeks, benthic macroinvertebrate community composition changed significantly in all treatments of all streams. In the pool treatments, diversity was significantly lowered (unimpacted

stream) or not affected (impacted stream) compared to the drought treatment, indicating that pools did not act as a substantial refugium for benthic macroinvertebrates under extreme low flow conditions. Current velocity and amount of deposited organic material explained most of the change in the macroinvertebrate community. Nutrient availability did not influence the response of the benthic macroinvertebrate community to the treatments in Danish streams but it did in Dutch and Galician ones, probably in each case because the physicochemical changes were exacerbated in the impacted stream, thereby outweighing the expected higher resilience of this community in Denmark or not in the Netherlands and Spain.
Our results clearly demonstrate that short-term stagnation and drought events in lowland streams can result in a strong alteration of the species composition.

TASK 4 Thresholds and reference conditions: moving targets in river management
We identified temperature, flow and nutrient/organic matter load thresholds for rivers for application in adaptation, mitigation and restoration strategies. Long-term biological, hydrological and physico-chemical data series were analysed to determine if changes in ecosystem structure and functioning are occurring, whether these are linked to climate drivers and whether ecologically relevant thresholds can be identified (e.g. the transition from a permanent to a temporary system. This transition is already occurring in many European streams, not only Mediterranean systems). We focussed on functional indicators for this transition. We evaluated whether reference conditions in selected river types were changing and whether this was linked to climate drivers. Reference conditions were tested for climate vulnerability. We developed a concept of dynamic reference conditions (moving targets) as part of WFD methodologies (phytobenthos and macroinvertebrates).

Changes in ecological status at RIvPACS reference condition sites were studied to exemplify the objective of this work part. The WFD requires Member States to determine the ecological status of rivers and streams with respect to deviation from a type-specific reference condition. It is essential that Member States can demonstrate that the biological datasets used to define reference conditions meet the criteria of the WFD. The approach requires that reference sites be at their ecological optima, and are assumed to not change because by definition they are not impacted. We used RIvPACS reference site data and UK Environment Agency monitoring data to identify 81 RIvPACS reference sites that had subsequent monitoring data, and analysed seasonal patterns in ASPT and Ntaxa. Autumn ASPT increased over time in both data sets, but not Ntaxa, indicative of a shift in reference conditions and species replacement. The trend was site dependent, indicating that long term climatic cycles, or shifts in climate, are an unlikely cause. Deviation from the perceived reference condition was common for ASPT and Ntaxa at most sites, as a majority of subsequent samples did not fall within +/- 5% of the RIvPACS reference values. The ASPT and Ntaxa values of the RIvPACS reference samples for a site did not lie within the standard error range of the overall mean ASPT and Ntaxa for 70 and 80% of the sites respectively. ASPT was generally higher in upland areas of the UK and lowest in lowland agricultural areas. Rates of change in ASPT were highest at sites with intermediate ASPT scores. Low and high values of Ntaxa were more dispersed across the UK, though Ntaxa correlated to mean air temperature indicating a north/south gradient. Rates of change in Ntaxa were also highest at sites with intermediate Ntaxa scores, and rates of change were higher for spring samples. These results demonstrate that the fixed reference condition concept may not be realistic and that selection of reference sites should consider long term variability.

TASK 5 Indicators and vulnerability assessment in rivers
We derived innovative biological indicators (traits, functional response of benthic macroinvertebrates, algae, macrophytes and fish) for monitoring, assessment and evaluation of climate change impacts of temperature, flow (low flows, droughts and floods) and nutrients/organic material on adaptive management strategies in rivers. Existing large-scale data sets and species-

specific ecological information were analysed by using different types of response models and bioclimatic envelope modelling, and also by using time-series data and space-for-time substitution with known environmental changes related to climate change. We developed response models for river habitats and new tools for vulnerability assessment incorporating connectivity and dispersal capacity. A database was produced.

The combined **Deliverable 2.18/4.12** summarises the recent revisions of the freshwaterecology.info database including newly added ecological parameters and organism groups. It gives a short overview of the current state of the database and is supplemented by two case studies. The online database currently holds about 21,000 taxa from five different freshwater organism groups in Europe and provides approximately 72,000 ecological preferences and biological traits of fish, macro-invertebrates, macrophytes, diatoms and phytoplankton.
Within REFRESH we extended the database to encompass indicators, traits and functional response parameters relevant for river, lake and riparian wetland assessment. Additionally, the development of the database were summarised in a scientific paper "Life in European freshwaters – putting 20,000 species into boxes"

Task 6: Mitigation, adaptation and restoration in rivers under changing conditions
We evaluated the merits of various adaptation, mitigation and restoration methods to counteract effects of climate and land-use change on the structure and function of rivers. We reviewed existing strategies at the local scale in different European climate zones and assessed the success rate and cost-effectiveness of projects according to water type and measure. Differences in success rates for similar restoration methods across climatic zones, taking current land-use into consideration, were highlighted. The main drivers of recovery of biodiversity and ecosystem structure and functioning in rivers were identified.

Projected future climate change will undoubtedly result in even more dramatic shifts in the states of many aquatic ecosystems. Managing water resources and aquatic ecosystems in the face of uncertain climate requires new approaches. The focus of management and restoration will need to shift from (historic) references to potential future ecosystem services, and from reactive measures towards pro-active ones. Strategic adaptive management based on potential future climate impact scenarios will need to become a part of any action.
The objective of this task was to produce a practical guide to the most effective management strategies, applicable at sub-catchment and local scales, for use throughout Europe. Firstly, a list of sub-catchment and local scales adaptation measures was compiled for stream and rivers, and for lakes. It comprises measures that are normally being taken by local authorities/managers in different ecoregions and water types (for all kinds of purposes). To design a practical guide for water managers the scores were translated into a climate adaptation label per adaptation measure. Secondly, strategic adaptation measures aim to either improve resistance and resilience to stabilise aquatic ecosystems or to accept change and accommodate this. Therefore, three building blocks of a best practice framework for managing resilience in aquatic ecosystems were identified:
1. the principles from resilience concepts (nine basic principles)
2. the ecosystem approach (including the 5-S-Model and the DPSIRR chain),
3. strategic adaptive management.

The three together compose a practical guide for strategic adaptive management for aquatic ecosystems. A list of sub-catchment and local scales adaptation measures was compiled for streams and rivers and also for small shallow and large deep lakes. The list was specified for climate regions (Atlantic, boreal, alpine, continental and Mediterranean)

The list comprises common measures used by local authorities/managers in different ecoregions and water types (for all kinds of purposes). It includes only measures that mitigate direct and indirect effects of climate change. The measures are scored with the number(s) that corresponds to the one or more major climate change effects (Table 1).

Table 1. Score that relates each measure to a specific climate pressure.

score	climate change induced pressure	Example
0	no climate change related pressure	
1	temperature rise	direct, like warming, stratification
2	increase winter precipitation	direct effects, like run off, water level fluctuation, spates, inundation
3	summer extremes	direct effects, like droughts, spates
4	water quality	indirect effects, like nutrient cycling, eutrophication, oxygen regime changes, salt seepage
5	others	indirect effects, like exotic species, terrestrialisation

To design a practical guide for water managers the scores were translated into a climate adaptation label. For this label the scores 1 to 5 were taken into account. If an adaptation measures scores against all 5 climate change induced pressures then this measures contributes highly to climate adaptation. The fewer scores a measures has the lower its contribution. This approach resulted in the definition of climate adaptation labels (Table 2).

Table 2. Climate change adaptation labels.

colour code	Colour	number of climate induced pressures	explanation
	dark green	4-5 (+++)	win-win measure
	light green	2-3 (++)	win-win measure
	pale green	1 (+)	no regret measure
	yellow	0	
	red	-	regret measure

The list with adaptation measures (Verdonschot & Besse 2012) comprises measures that are commonly used by local authorities/managers in different ecoregions and water types (for all purposes). The scores in this list were used to design a practical guide for water managers and thus were translated into a climate adaptation label.

WORK PACKAGE 3

We have finished all 19 deliverables including several targeted at stakeholders. We have also published 91 scientific papers, including several comprehensive reviews and many more papers and reviews are in various stages of preparation. Some key outcomes are presented here:

Analysis of climate change effects using long-term data. Analyses of long-term data have been conducted for four lakes:

i) Lake Müggelsee, Germany: The effects of two recent Central European summer heat waves (2003 and 2006) on cyanobacterial blooms in eutrophic shallow Lake Müggelsee were evaluated. Critical thresholds of abiotic drivers were extracted from the available long-term (1993-2007) dataset on the lake using classification tree analysis to explain observations of cyanobacteria biomass. It was found that cyanobacterial blooms were especially pronounced when thermal stratification was critically intense and long-lasting. The study showed that extracting critical thresholds of environmental drivers from long-term records is a promising approach for predicting ecosystem responses to future climate warming. Changes in short-term meteorological variability will determine whether cyanobacteria will bloom rather than average temperature increases.

ii) Lake Võrtsjärv, Estonia: Long-term changes in phytoplankton composition in relation to hydrological, meteorological and nutrient loading data in large shallow Lake Võrtsjärv were analysed. All four calculated taxonomic indices showed a unidirectional deterioration of the lake's ecological status despite reduced concentrations of nutrients. The results suggest a non-linear response of phytoplankton to changing nutrient loadings and that the change observed between 1977 and 1979 was a regime shift triggered by water level change. High shade tolerance of the new dominants and their ability to create shade obviously stabilised the new status, making the lake resistant to restoration efforts.

iii) Lake Vansjø, Norway: A Bayesian Network model was developed for the shallow basin of Lake Vansjø in order to link biological response variables with the REFRESH scenarios and catchment and lake modelling. For variables with WFD status class boundaries (e.g. total phosphorus depth, chlorophyll a), the intervals of the discrete probability distribution are set by the WFD class boundaries "Good/Moderate" and "Moderate/Poor", which should ideally represent thresholds in dose-response relationships. For other variables, the intervals are based on the main breakpoints identified by the regression tree analysis.

iv) Lake Mjøsa, Norway: Analyses in Lake Mjøsa focused on two types of thresholds: (1) nonlinearities in the relationship between pressure (total phosphorus) and phytoplankton and effects of climatic variables on such relationships (e.g. cold vs. warm years; high vs. low stability) and (2) phenology: change in the timing of peak biomass of phytoplankton and zooplankton. For diatoms, the peaks in biomass are clearly lower in the 1990s-2000s compared to the 1970s-1980s. This reduction corresponds to the overall reduction of phytoplankton biomass, which is due to eutrophication abatement measures. The timing of the peaks also appears to have shifted, from June-July in the 1970s-1980s to smaller peaks in August-September in the 1990s-2000s. For peak biomass of chrysophytes, in contrast, the magnitude appears stable or slightly increasing across the decades. Moreover, the timing appears slightly earlier in the 2000s (mid-June) than in the preceding decades (June-July). The timing of the peaks also appears to have shifted, from June-July in the 1970s-1980s to smaller peaks in August-September in the 1990s-2000s.

Review of the effects of changes in temperature and net precipitation

The review provides strong evidence that climate change will enhance eutrophication in mesotrophic and eutrophic lakes as a result of physico-chemically and biologically induced higher internal loading and, in North temperate lakes, enhanced external nutrient loading as well. The effects on phytoplankton of such changes are ambiguous; most approaches indicate an increase in biomass, but the results generally point to a major increase in the risk of dominance and blooming of potentially toxic cyanobacteria species. If the biomass of phytoplankton and/or the amount of suspended matter increases, we can expect a shift in production within the ecosystem, from benthic and littoral processes to pelagic processes, as has also been found as a result of eutrophication. The role of macrophytes for maintaining clear water conditions will likely diminish, although water level reduction as in semi-arid lakes may counteract this effect. Enhanced salinity is to be expected in the Mediterranean lakes, which may reduce species diversity and adversely affect the provision of key ecosystem services.

Changes in species distribution due to climate warming are difficult to counteract. There may, however, be opportunities to compensate for some of the cascading effects of the changes in lake ecosystems as many of the symptoms of warming are similar to those following from enhanced nutrient loading. Measures should be aimed at increasing the natural resilience of ecosystems against external perturbations. For instance, measures taken to reduce the nutrient input to fresh waters, beyond those already implemented or planned, are straightforward and may include: i) application of

fertilisers as determined by soil retention capacity and crop needs, leading to less intensive land use in catchments with sensitive fresh waters in order to reduce diffuse nutrient inputs; ii) (re)-establishment of riparian vegetation to buffer nutrient transfers to water bodies; iii) re-meandering of channelised streams to increase retention, decomposition and loss of organic matter and nutrients; iv) improvement in land management and agricultural practices to reduce sediment and particulate and dissolved nutrient export from catchments; v) improvement of the design of sewage works to cope with the consequences of flood events and low flows in receiving waters; vi) more effective reduction of nutrient loading from point sources by proper sewage water treatments and from the atmosphere, the latter by reducing emissions from industry and agriculture; vii) in warmer regions, restrictions on alterations of natural hydrological cycles and water use, in particular for irrigated crop farming so as to reduce the risk of severe salinisation and eutrophication; viii) increased control of dispersal, arrival and establishment of exotic species. Some of these adaptation measures have been integrated in the River Basin Management Plans required under the European Water Framework Directive, but since they are largely qualitative (Nõges et al., 2010a,b) they will certainly promote discussion among different stake holders.

Cross-European mesocosm experiment

We conducted a simultaneous, standardised pan-European (six countries from Sweden to Turkey) mesocosm experiment to elucidate the effects of climate change on shallow lake community structure, functioning and metabolism at low and high nutrient levels crossed with contrasting depths. We used cylindrical fibreglass mesocosms. Nitrogen and phosphorus were dosed in monthly intervals and water was circulated continuously in the mesocosms from spring to autumn (Landkildehus et al., submitted). The mesocosms were inoculated with a mixed sample of sediment and plankton from lakes in each country with contrasting nutrient concentrations and stocked with macrophytes and planktivorous fish. Sediment was pre-equilibrated to the experimental nutrient concentration. During the experiment, the water level decreased with increasing temperature, and in the Mediterranean mesocosms the water level was reduced by 90 cm; in contrast, conductivity was more than doubled. The average chlorophyll a concentration in the deep mesocosms with high nutrients increased along the temperature gradient but peaked at intermediate temperatures in the shallow mesocosms. Average macrophyte PVI (% plant volume inhabited) increased with rising temperature in the shallow mesocosms, while oxygen saturation data suggest that net primary production peaked at intermediate temperature and was lowest in warm lakes, and overall lower in deep than in shallow mesocosms.

Scientific papers on nutrient balances, zooplankton, ecosystem resilience based on zooplankton, periphyton, microbial communities are about to be submitted, followed later this year by papers on macrophyte, phytoplankton and metabolism.

Study of 31 Turkish lakes

A comprehensive study was conducted in Turkish lakes representing contrasting climate conditions. Numerous papers have been published or submitted. Highlights include:

- We found dominance of small-sized zooplankton in the warm and saline lakes. Physiological tests further showed that salinity controls *Daphnia* populations through increased mortality, decreased reproduction and slower growth. Loss of the keystone taxa *Daphnia* may have cascading effects in the lake ecosystem and lead to a higher risk of a shift to a turbid water state under warmer and drier conditions.
- Contrary to observations from temperate lakes, the submerged macrophytes in warm lakes did not act as a refuge for large-bodied grazers, such as *Daphnia*. Instead, when fish inhabited the plant beds, they avoided the plants and preferred to hide near the sediment when exposed to predation. Furthermore, also smaller-sized taxa among rotifers, cladocerans and copepods

utilised the sediment as a hiding place depending on the intensity of the predation threat. However, only partial avoidance of predation was possible as zooplankton grazing was low (low zooplankton:phytoplankton biomass ratio) compared to the situation in similar temperate lakes.

- Lakes located in southern lowlands (warmest) are the most eutrophic and saline with high nutrients and phytoplankton biomass, dominance of small planktivorous fish and low biodiversity. Northern upland lakes were characterised by low nutrients and chlorophyll a concentrations, dominance of large cladocerans and large proportions of piscivores. These results indicate that climate change may result in higher salinization and eutrophication with more frequent cyanobacteria blooms and loss of biodiversity in Mediterranean lakes if they do not completely desiccate.

A review of water level and salinity

We produced a comprehensive review of the ecological impacts of global warming and water abstraction on lakes and reservoirs due to changes in water level and salinity (**Deliverable 3.11**). The review is based on long-term data from seven lakes covering a geographical gradient of fifty two degrees of latitude and a literature review discussing how changes in water level and salinity related to climate warming and water abstraction impact the lakes' ecosystem structure, function, biodiversity and ecological state. Furthermore, we provided some guidelines for mitigation of the negative effects on the ecological state of lakes resulting from changes in climate and water abstraction and highlighted research gaps.

Both the case studies and the literature often showed profound negative (but not always) ecological effects of water level reduction – either due to climate warming or abstraction for irrigation, with potential synergistic effects, often followed by increasing salinity leading to reduced biodiversity in the Mediterranean region. Some of the negative cascading effects on lake ecosystems resulting from water level reductions and salinity increases may be counteracted. We emphasise the need for integrated water resources management, which includes reshaping of planning processes, coordinating land and water use, recognising water quantity and quality linkages, conjunctive use of surface water and groundwater, protecting and restoring natural systems, also to enhance inland water retention time. Win-win measures include those promoting sustainable water use such as water pricing and water use prioritisation; control over abstraction of surface and ground water; implementation of safety water technologies; efficient usage and conservation technologies; reduction of water loss and water friendly farming. Further win-win measures are those that improve the storage capacity of water in the drainage basin such as forest reforestation and controlled drainage, and in some areas use of desalinised sea water.

To compensate for enhanced eutrophication due to global warming, focus should also be on reducing external loading of nutrients and sediment to the lakes via changes in land management and agricultural practices, as discussed above. In-lake measures may include sediment removal, sediment capping (chemical treatment of the sediment) and/or biomanipulation.

Effect of increased dissolved organic matter input to lakes

An increase in dissolved organic carbon (DOC) in streams and lakes has been reported across the northern temperate region, but the effects of elevated DOC on whole lake ecosystems when combined with nutrient inputs are as yet unclear. In order to address this uncertainty, we performed a mesocosm study using twenty-four large outdoor mesocosms, each containing lake water and sediment together with one of three different levels of organic matter (added as filtered peaty water) (Deliverable 3.9). Identical amounts of nitrogen and phosphorus were added at intervals to all the mesocosms to simulate eutrophic conditions, but addition of the humic matter resulted in the highest

total phoshorus and total nitrogen concentrations in the DOC-treated mesocosms. Light was particularly low in the high DOC mesocosms.

We found no significant difference between the organic matter treatments in terms of net ecosystem production, respiration or gross primary production. However, dissolved oxygen was lowest in the mesocosms receiving the highest level of added organic matter. In spring, mesocosms receiving high levels of organic matter exhibited the greatest increases in chlorophyll a among the treatment groups, whereas later in the year the high organic matter treatments showed the lowest phytoplankton biomass among the treatments. The highest phytoplankton biomass in summer, autumn and winter was observed in mesocosms receiving low organic matter level concentrations. A number of the mesocosms became turbid in summer as a result of cyanobacteria blooms. The concentration of cyanobacteria was highest and the duration of the bloom longest in the mesocosms receiving low levels of organic matter and lowest in those receiving high levels of organic matter. The concentration of organic matter concentration also affected higher trophic levels: total macroinvertebrate abundance increased with allochthonous carbon in spring and summer. However, fish abundance did not show consistent trends. The results of the study suggest that as cyanobacteria seemed to benefit from a low increase in humic substances in the mesocosms, eutrophic shallow lakes might be faced with increased pressures towards a turbid state with an increase of DOC in the near future.

A review of the effects of dissolved organic matter

The dissolved organic matter experiments were accompanied by a comprehensive review (**Deliverable 3.14** concerning the current understanding of the effects of DOC and particulate organic carbon (POC) upon different elements of the lake food web and ecosystem-scale processes. We also considered the likely combined effects of increasing DOC loading, eutrophication and climate change upon lake ecosystems. The findings suggest that increases in DOM concentrations and in phytoplankton biomass, as a result of increases in nutrient concentrations, are likely to have additive effects on light attenuation and thus on the thermal structure of a lake. In addition, the influence of changes in algal biomass is likely to interact with climate change as well as DOC loading. Reduced mixed depths and warmer surface temperatures are anticipated through both climate change and loss of transparency by increases in DOC or algal biomass. These synergistic consequences may then result in further changes in algal communities, favouring the growth of buoyant cyanobacterial species, which may in turn further enhance light absorption near the surface.

Despite a growing body of literature on the effects of organic matter upon the structure and functioning of lake ecosystems, there is currently little knowledge of the implications of organic matter loading for the way lakes are managed. However, the need for this knowledge is becoming increasingly urgent due to observed increases in organic matter. In Europe, the Water Framework Directive (EC 2000) has been the major driver of lake management over the last ten years. Therein measures to reduce inputs of key limiting nutrients, specifically phosphorus, have been the focus of European lake management policy. The literature review suggests that measures to reduce phosphorus loading to lakes, in order to restore good ecological status, may also interact with changing organic matter loading in a way that affects the structure and functioning of lake ecosystems. Specifically, we may expect that measures to reduce phosphorus loading would reduce phytoplankton production in favour of bacterial production based upon external carbon sources. This change may be particularly pronounced for lakes experiencing elevated levels of DOC loading. Such a change would likely result in the re-structuring of phytoplankton communities (favouring mixotrophs) and would increase the relative importance of the microbial food chain as a conduit for energy flow to higher trophic levels. Ultimately, due to the energetic inefficiency of this pathway, we may expect that the productivity of higher trophic levels (zooplankton, fish) could be affected as an

unintended consequence of lake management. In addition, high levels of DOC loading are known to impose light limitation upon phytoplankton and benthic algal communities. If, in humic systems, light is the primary limiting factor for phytoplankton growth then seeking to reduce primary producer biomass by cutting nutrient loads may not be as effective as anticipated.

In addressing the implications of organic matter loading for lake restoration and management, there is a clear need to think beyond the physical boundaries of lake ecosystems and consider landscape-scale processes and the management decisions that impact upon them. Land use can have significant effects on the loading of organic matter to lakes. In order to understand these impacts, it is therefore important to broaden the scope of scientific investigation to the catchment scale, including the stream network draining the catchment. Deforestation, agriculture and urbanisation can alter the quantity and quality of organic matter inputs to running waters and receiving water bodies.

Ensemble modelling

A global trend of increasing health hazards associated with proliferation of toxin-producing cyanobacteria makes the ability to project phytoplankton dynamics of paramount importance. Whilst ensemble (multi-)modelling approaches have been used for a number of years to improve the robustness of weather forecasts, this approach has until now never been adopted in ecosystem modelling. A REFRESH modelling study has shown that the average simulated phytoplankton biomass derived from three different aquatic ecosystem models is generally superior to any of the three individual models in describing observed phytoplankton biomass in a typical temperate lake ecosystem, and we simulate a series of climate change projections. Since this is the first multi-model ensemble approach applied to some of the most complex aquatic ecosystem models available, we believe that it sets a precedent for what will become a commonplace methodology in the future by enabling increased robustness of model projections and scenario uncertainty estimation arising from differences in model structures.

WORK PACKAGE 4

We designed a complementary framework of experimental studies and meta-data-analyses which, through experiments and reviews of existing data, assessed the potential impacts of future climate change on the hydrology, biogeochemistry, functioning and biodiversity of European riparian wetlands. The experimental manipulations of riparian hydrology (drought and flooding treatments) were carried out along a climatic gradient across Atlantic Europe. The objective was to simulate increased summer droughts and increased winter flooding periods by diverting stream water to dry out, or flood, stream riparian wetlands. The climatic gradient investigated runs North-South across Atlantic Europe, from Denmark, North Germany, the Netherlands, Atlantic Spain to Mediterranean Spain. Results on wetland biogeochemistry (N and P), biodiversity (plants and riparian beetles) and functioning (nutrient cycling, decomposition) are summarized.

Regarding plant species composition, a correspondence analysis suggests both climate components (temperature and precipitation/hydrology) could be major explanatory variables. Firstly, a clear gradient was found in the presence of species from North to South Europe (Figure: the first axis separates sites across a North-South gradient, with Danish sites to the left, Dutch/German sites in the centre and Spanish sites to the right). The main variable corresponding to the differences in species composition across all sites is air temperature. Secondly, for all sites, the most prevalent plant species found in the riparian zones all show adaptations to flood events. Thirdly, on the second axis, groundwater chemistry strongly differentiates sites. Most notably, the Groote Molenbeek site differs from all other stream riparian zones. The latter is probably due to the situation of the Groote Molenbeek in a highly intensively agricultural area. Overall, both climatic variables (temperature,

precipitation-driven hydrology) and regional groundwater chemistry variables (NO3, SO4) correspond very clearly to the composition of the standing vegetation in the riparian wetland sites, suggesting that especially increasing temperatures and (loss of) flooding may have a dramatic effect on riparian zone species compositions, but that regional nutrient status is almost as important (certainly where nutrient loads are high).

In response to increased flooding, vegetation species composition, richness and biomass responded rapidly, even within the first year of applied flooding treatments. In the majority of the sites, flooding had a pronounced negative effect on species richness of the vegetation, while positively affecting standing biomass. Flooding also had a positive effect on springtime nutrient availability and species richness of the seeds deposited in the riparian zone. Nutrient release (measured as available phosphorus and nitrogen in the soil) following flooding and deposition of nutrient-rich sediments seems to mediate the major effect on the composition of the standing vegetation. The increased species richness of deposited seeds in the riparian zone indicates that flooding contributes to seed arrival, and may thus modulate species composition. In conclusion, winter flooding can have a negative effect on riparian species richness especially in already nutrient-enriched sites, by positively influencing the nutrient availability of the soil and plant biomass, while also potentially changing species composition due to the increased input of seeds.

In the first year, the flooding treatment acted as a heavy disturbance, with extensive die-back of the existing vegetation probably due to submergence and oxygen depletion in the root zone. Despite this die-back, there appeared very little effect on the functional trait characteristics of the community in the second and third year when comparing the functional characteristics of the treated plots with the control plots. However, linear regression coefficients indicated that changes took place, and that communities in both the dry and wet end of the hydrological gradient responded much faster than those under stable conditions. This result reveals the importance of following the functional response of the vegetation over a prolonged time period following a change in abiotic conditions.

The effects of increased drought on vegetation biomass and composition are less pronounced than for increased flooding, at least partly due to the fact that at some sites and in some years the drought treatment was not very effective due to high precipitation. As a consequence, for plant species the response is less clear than for flooding, although there are species shifts in some of the sites towards more terrestrial communities, indicating that increased drought leads to loss of riparian wetland habitat and species, and a narrowing of the riparian zone.

From a more detailed study carried out in the Danish, German and Dutch sites it appeared that only few species (range 1-22 species) were found in the sediment seed pool and mean richness was only slightly higher in the sediment seed pool deposited along the stream situated in the largest catchment compared to those of smaller catchments, indicating that the effect of catchment size on the richness of the sediment seed pool was minor. We also found very similar trait characteristics of the sediment seed pool when comparing seed (e.g. longevity, mass, physical dimensions) and canopy (e.g. SLA, height, leaf mass) trait characteristics from the four catchments. However traits associated with the height of the species and the average number of seeds produced by the species seemed to be influenced by land use characteristics e.g. the fraction of seeds from species being tall was higher in catchments with high percentages of forest and low percentages of agriculture. We conclude that the sediment species pool generally consists of few species sharing very similar functional trait characteristics and that differences in catchment size and land use characteristics seems to play a minor role in shaping sediment seed pool characteristics. Consequently flooding and sediment deposition, being processes that are expected to be intensified in a future climate, may not suffice to

regain diversity in currently species poor riparian areas along lowland streams situated in agricultural landscapes.

Further, the seed pool tended to be more species rich compared to later successional stages in the vegetation (first and second years establishment and standing vegetation), in particular under dry conditions. Further, the seed pool and later successional stages of the vegetation differed in both species and trait composition. For all regions we found that the seed pool was characterized by a higher fraction and/or abundance of species forming tall canopies producing large amounts of seeds compared to later successional stages. The existing vegetation on the other hand was characterized by a higher fraction and/or abundance of species producing large seeds with a high floating capacity indicating that these traits can be associated with improved species fitness in riparian areas. In addition to differences found between the sediment seed pool and later successional stages, we observed differences in the response of community trait characteristics to the hydrological condition. The floating capacity of the seeds was higher in flooded sites and the canopies were taller compared to that found in control and dry sites, whereas the total mass of seeds produced was higher in the dry sites indicating that these sites were characterized by a higher fraction and/or abundance of ruderal species. Consequently, the functional characteristics of the riparian communities is likely to change with intensified flooding regimes towards a higher fraction and/or dominance of tall species producing seeds with a high floating capacity. We foresee that these traits may improve the fitness of the community under more frequent and/or prolonged flooding events and also that a higher floating capacity of the seeds of dominant and/or abundant species in the community we may also expect that species dispersal along rivers will be a more significant pathway for species dispersal under a future climate

In conclusion, a changing climate may very rapidly be followed by a change in riparian wetland species composition. Existing species not adapted to the new conditions may not survive, and are quickly replaced by better adapted species which arrive by simply migrating (clonally) downslope or upslope within the riparian zone or via seed dispersal. In the latter case, increased seed deposition, particularly of seeds from riparian species adapted to dispersal by water, following increased winter flooding may be expected to contribute to species turnover (with especially very common species arriving in great numbers). In situations of increased winter flooding, higher flood-related springtime nutrient availability is likely to mediate loss of species and species richness in the riparian zone, especially in areas with high nutrient loading. In situations of increased summer drought, the true riparian zone is effectively narrowed, with more terrestrial species coming in and loss of wetland habitat and species.

Riparian beetle assemblages were investigated in summer in six of the study sites, in each case comparing the diverted (summer drought) section to the non-diverted (control) section of the stream riparian zone. The sites were located in Denmark (Sandemans baek and Voel baek), Germany (Boye), the Netherlands (Groote Moolenbeek) and Spain (Caselas and Pego). Beetles were sampled by pitfall traps, which were installed for one week in the drought experimental phase once per study site.

Drought has positive effects on the community composition and diversity of beetles in the riparian zone. The retreating water left unvegetated and muddy riparian areas open for colonization. Species who are bound to these environmental conditions immigrated and thus increased the richness in beetle families and genera. This applies also to carabid beetles. However, the drier wetland conditions and lack of aquatic areas typically benefited non-riparian beetle genera, and even reduced waterbound beetle genera (Fig. x). Although several studies emphasize that new habitats are directly colonized by macropterous carabid beetles, we could not find increased numbers in all drought

sections. In contrast we found higher abundances and higher species richness of brachypterous specimen in the drought sections (Fig. 6). Those species prefer organic mud and wet detritus, which was released from the retreating water. They are eurytopic species relying on this wet substrate and migrated into the drought sections on search for food. No latitudinal gradient was detectable in the response to drought by beetles in general or carabid beetles. However, our results suggest general differences in beetle richness and compositions. The number of beetle families decreased with increasing latitude, which might be an artifact of the general climate association of the beetles. Southern control sections were characterized by a higher number of carabid species and higher diversity as particularly the Iberian Peninsula was a retreat for many species in the last glaciation and is currently a hot spot of beetle species diversity.

In contrast to other aquatic organism groups, for which negative effects of drought and climate change are expected in terms of decreased species richness and diversity (Boulton, 2003), beetle richness and diversity seem to (partly) benefit. This positive response has different reasons: First, the retreating water level opens new terrestrial patches for colonization and the order of the beetles is one of the species richest orders. Many species are adapted to riverine habitats and their strong flight ability supports a fast immigration in open spots. Second, many beetle species inhabit riparian areas and particularly the water edge utilizing food sources left behind from retreating water (e.g. carcasses, organic matter). Third, beetles are often habitat specialists and an increase in habitat diversity has direct effects for species to colonize those habitats while in terms of the very small size of many beetles their necessary patch size is extremely slight. Similar responses of arthropod communities to drought were found by Corti & Datry (2014). However, the greatest contribution to the increasing beetle richness and diversity was due to arrival of non-riparian beetles, and the lack of aquatic areas even reduced the number of waterbound beetles.

These results suggest that riparian beetles profit from summer drought and retreating summer stream water levels, but that maintenance of wet areas in the riparian zone, even during summer drought phases, is important for waterbound beetles.

We have generated important information regarding the effects of hydrological and temperature changes on wetland biodiversity and functioning, highlighting the important contribution of lateral aquatic habitats for species diversity and the sensitivity of riparian plants to the hydrologic regime. Our reviews emphasise the strong biological linkages between aquatic and riparian ecosystems, further suggesting that successful restoration and conservation of riparian zones require an integrative approach that operates across ecosystem boundaries. Additionally, we proposed practical indicators for assessing the state of wetland biogeochemical functioning relevant for managers, and generated publicly accessible information on the traits of important riparian species including Odonata and Carabidae. These are presented in a paper on riparian invertebrates and in the update of the www.freshwatercology.info website (**Deliverable 4.12**). A list of additional ecological parameters related to invertebrate traits relevant in wetland ecosystems was established and relevant references were identified to extract ecological information from these sources with special focus on Trichoptera (caddisflies), Plecoptera (stoneflies) and Ephemeroptera (mayflies). Data were codified and integrated in the testing environment of www.freshwaterecology.info and will go online with the next updated version of the database. Additional indicator groups for wetlands riparian beetles as well as Odonata, were chosen and a literature review on the autecology and European distributions was conducted. The data on riparian beetles will be available at www.freshwaterecology.info as downloadable file with the next online update of the database; the Odonata data will be integrated into the online database as soon as the expert check is finished.

The implications of threshold responses for the management and conservation of riparian zones were reviewed in a non-technical report aimed at policy maker and managers. We provided an overview of the concept of ecological thresholds and summarised recent case studies where riparian wetlands exhibited non-linear responses to abiotic drivers. Finally, we discussed the implication of threshold responses for the management of riparian zones and suggested future research directions. We developed a practical summary report on the experiments carried out, and on the species and habitats most vulnerable to climate change. These included red-listed species and habitats included in the Habitat Directive.

WORK PACKAGE 5

Beyond the State of the Art

The main results of workpackage 5 are the development of a method, applied at nine sites, based on new model chains to represent coupled river-lake-wetland ecosystems that includes key ecological indicators and uses integrated scenarios, a common modelling framework, and the testing of the latest sensitivity and uncertainty analysis techniques to determine the impacts of environmental change on flow and streamwater nitrogen and phosphorus concentrations and key ecological indicators. New models, based on Bayesian Belief Networks, were developed to describe the impacts of multiple stresses on streamwater macro-invertebrate biodiversity, riparian plant diversity, macrophyte status and algal-cyanobacterial interactions in lakes.

Overall evaluation of the impacts of environmental change on the WFD status of the demonstration sites

The general picture derived from the catchment-scale modelling is that the predicted effects of environmental change over the next 50 years on waters differ between the northern and southern sites. In the north and mid-latitudes, the projected increased temperatures are balanced to some extent by increased precipitation, leading to relatively small effects on water flows, though seasonal effects due to changes in winter precipitation and/or snowpack accumulation and melt may still be important. In the south, increased temperatures and lower precipitation act in the same direction to reduce water flows considerably. In the case of Lake Beysehir, this may even lead to the lake drying up in the foreseeable future, and this effect would far outweigh any nutrient-related problems. In general, the effects of climate change alone on nutrient concentrations are rather small. The effects of credible land use changes are rather larger, and generally, the land use changes representing the "environmental" storylines (B1 and B2) reduce nutrient concentrations, and those from the "economic" storylines (A1 and A2) increase them. However, there are exceptions and considerable differences in response between sites. The responses seem more dependent on the mixture of nutrient sources (e.g. agriculture versus wastewater) than the degree of climate change. Modelled ecological changes are not generally proportional to the changes in nutrients. Ecological change can be less than the nutrient change (e.g. chlorophyll at Lake Beysehir and the Orlik Reservoir in the Czech Republic) or greater due to a complex set of reactions in the food web (e.g. at the IJsselmeer). Modelled mitigation options can reduce nutrients, and there is no evidence here that they are less effective under a future climate. With less certainty, mitigation options can affect the ecological status of waters at these sites in a positive manner leading to an improvement in Water Framework Directive status at some sites, such as Pyhäjärvi and Vltava. Uncertainty in the climate models, as represented by the differences between the three GCM-RCM combinations used in this study, does not affect this overall picture much, though there are differences at individual sites.

Climate drivers

Model predictions tend to show that Europe will become warmer, and also wetter in the north, but much drier in Mediterranean regions, and the modelling results used in REFRESH conform to this pattern. All three GCM-RCM models predict a rise in temperature over Europe, with the Had Model consistently and significantly higher than the others, with a mean rise of 2.2 °C, followed by KNMI (1.4 °C) and SMH (1.0 °C). This is the order generally observed for these models in Europe. The highest temperature rises are in Finland: apart from this site there is a north-south gradient with the greatest temperature rises in the south, though the differences between the models are generally greater than the differences between the sites. Predictably, there is also a north-south gradient in the actual temperature, though this is modified by the relatively high altitude of the southern sites. For precipitation, there is a distinct north-south divide, with small increases in the north and mid-latitude sites, and large decreases in the south. At Arbúcies in the Pyrenees, there is considerable variability between models, with the Had Model predicting a 17% decline in precipitation, and the SMH Model a 15% increase. Once again, the Had Model tends to give more extreme predictions. All models concur, however, in predicting substantial decreases in precipitation at the Greek and Turkish sites.

The increase in temperature increases evapotranspiration, thus reducing the water available for river flow. This has contrasting effects in the north and the south. The northern sites generally have a small increase in precipitation and the increase in temperature, and thus evapotranspiration almost cancels it out, leading to a smaller percentage increase in discharge, or even a slight reduction in some model - site combinations, reducing the magnitude of change in river flow. The southern sites have a large percentage decrease in precipitation, and here higher temperatures exaggerate the change, leading to an even larger percentage reduction in discharge, since the increased evapotranspiration is a larger percentage of the available water. The Hadley Model gives the largest decreases in discharge in the south, and the KNMI Model the smallest.

To understand the change in discharge pattern more completely, however, seasonal effects need to be taken into account. At Arbúcies, for instance, the KNMI Model predicts a 2% increase in precipitation, but a 14% increase in discharge. This is because under the KNMI model at Arbúcies the pattern of precipitation shifts to give less precipitation in summer and more in winter. The smaller evapotranspiration in winter means that winter precipitation is more effective in generating HER, hence the increase in discharge. Similar, though less spectacular effects are probably occurring at all the sites. At the Tarland Burn on the Dee, for instance, the KNMI Model predicts a decreased summer flow and increased winter flow too, resulting in a slightly increased flow overall, but the SMH Model gives a year-round flow reduction. The difference between these behaviours may be of considerable ecological significance.

Nutrient Concentrations

Changes in total P due to climate change alone are mostly small, whereas changes in SRP are larger and more variable both between sites and between climate models. The differences seem due mostly to differences in the types of source present at each site. Where there is a substantial wastewater input, as at the Vltava site, reducing water volumes imply increases in nutrient concentrations as wastewater inputs are a reasonably constant volume. Where agriculture is the major source of nutrients, loads can decline in proportion to the declining water flux, and hence concentrations do not change or even decline, as at Beysehir, where the reduction in SRP is substantial. Nitrate shows little change due to climate change alone, the modelled changes mostly being small declines.

For total P, the modelled changes in nutrient concentrations due to land use change are greater than with climate change alone. Clearly the effects of the land use changes will depend on the magnitude of the change modelled, but both climate and land use changes are best estimates of the likely

scenarios, so it seems valid to compare them. For SRP, this is also mostly the case, but at certain sites the changes due to climate alone are greater. At Beysehir, this is because the change in climate is substantial (less precipitation and higher temperatures), so the agricultural changes have relatively little effect. At the Vltava, the importance of wastewater inputs means that concentrations increase due to low flows, increasing the importance of climate change. Percentage changes in nitrate-N concentrations are generally somewhat smaller than those of SRP or total P concentrations, except at Yläneenjoki, which may be because the land use scenarios there involve quite large changes in agricultural practice. As with total P, the modelled changes are greater than when there is land use change as well as climate change, except at Beysehir and the Louros (where all changes are small). At these sites, nitrate concentrations decline in virtually all scenarios, whereas further north there is a mixture of responses depending on the scenario, with in general, the "Environmental" scenarios generating reductions. At the Vltava the B2 (LU4) scenario however generated an increase in N, as this scenario has a higher proportion of arable land.

The overall pattern of nutrient changes in rivers is that climate change alone does not cause a large proportional change in concentration, except for SRP at the Vltava (increase) and Beysehir (decrease). Generally, SRP and nitrate decrease due to climate change, while total P increases. Predicted changes in land use generally make a larger difference to concentrations, though SRP is more equivocal. The "Economic" land use scenarios generally increase concentrations while the "Environmental" scenarios decrease them, but the precise pattern depends on the predicted land use change in each case. In most cases the nutrient concentrations react in the same way independently of the climate model used, but in some instances (notably at the Louros) the differences between the predictions using different climate models are greater than those between the scenarios.

The changes in nutrient concentrations in lakes due to climate change are quite small, and are smaller than the relative concentration changes in the rivers that feed the lakes. Differences between the predictions of the GCMs are small too. This may be because lakes have mechanisms that buffer concentrations, such as transit times of water, P release from sediments or denitrification, and these reduce the differences between scenarios. Changes in discharge also tend to reduce the differences between scenarios, making lake loadings less variable than concentrations. The exception is Beysehir, where reductions in both discharge and concentration cause a large change in load.

Changes in chlorophyll concentration due to land use are generally considerably greater than those due to climate change alone. At Pyhäjärvi and Vansjø-Høbol, climate change leads to a small increase in chlorophyll concentrations, economic land use scenarios produce a further large increase, and environmental land use scenarios lead to a reduction. In both cases the changes closely mirror those of total P. Temperature-induced increases in algal growth and internal P loading cause an increase in chlorophyll at the IJsselmeer due to climate change, whereas land use change leads to a reduction due to decreased external nutrient loading. At the Orlik Reservoir (Vltava) a small decrease in chlorophyll due to climate change is attributed to increased P retention by the reservoir due to hydrological changes. Land use changes generally caused a decrease in chlorophyll, even when total P increased. This illustrates that changes such as in seasonal hydrological patterns can over-ride the responses expected from simple linear relationships. At Beysehir, changes in chlorophyll are largely negative due to reduced nutrient loading and water flux. The chlorophyll changes are however substantially smaller than the changes in water and nutrient inputs. At both Vltava and Beysehir, there are substantial differences in response to the GCM models – the KNMI Model had the smallest effect, the Hadley Model was intermediate, and the SMH Model led to the largest decreases in chlorophyll. This is a different response pattern to those in the driving variables.

Mitigation Strategies and Water Framework Directive Outcomes
Mitigation measures were generally effective in reducing nutrient concentrations in current climates. Mitigation strategies were generally aimed at improving ecological outcomes and hence tended to target P. Reductions in nitrate concentrations were therefore much lower than those of total P and SRP. Mitigation strategies continued to work with future climates, though in some cases the effects were small.

The initial status of the sites covered a wide range of WFD categories. Mitigation gives a general reduction in risk, and can cause sites to cross boundaries between WFD classes in a favourable direction. Of the 37 changes assessed, seven led to increases in WFD status, and three to crossing the moderate/good boundary, thus fulfilling the requirements of the Directive. Otherwise the WFD status stayed the same.

Publications and other dissemination activities
The number of outputs from workpackage 5 is substantial with 16 (of 16) deliverables produced, 22 journal articles already published in peer-reviewed, leading international journals, a further three submitted, with more to be produced as the new model development and applications of the models are written-up. Key papers will be those based on Deliverables 5.13 and 5.14 that will report on the REFRESH models and the synthesis of the modelling effort for the demonstration sites. Many of the papers are also collaborative with other workpackages. To date, the work done in WP5 has been presented at 27 national and international conferences.

WORK PACKAGE 6
Task 1 (Profiling the selected catchments)
The main anthropogenic activity identified in all demonstration catchments is primary production and more particularly agriculture. In some cases, livestock production and fisheries (Dee, Louros, Orlík) or forestry and timber harvesting (Dee, Pyhäjärvi, Vansjø-Hobøl) are also significant activities. Water demand for municipal use, mainly for drinking water and/or recreational activities constitutes a considerable issue in six cases and hydropower is important in two cases.

Diffuse pollution due to mainly farming practices is considered as a critical pressure, influencing landscape patterns, water abstraction and chemical/nutrient emissions. Moreover, high population density, industries and transport networks are associated with increased water demand and increased municipal wastewater discharges (Thames, Louros, Orlík). Hydrological and climate changes are reported as significant pressures as well, in Thames and Vansjø-Hobøl. Forestry is noted as a potential pressure in Pyhäjärvi, while fisheries and fish farming/breeding create pressure in Dee, Louros and Orlík.

The ecological water state of Thames is particularly compromised, since 77% of surface waters do not meet good ecological status. In Dee, WFD assessments have shown that the condition of 30 out of its 53 water bodies requires improvement. Intensive farming activities along with municipal wastes have also seriously degraded water quality in Louros. Excess amounts of nutrients resulting mainly from agricultural runoff and waste-water treatment plants are identified as the main threat in the water bodies of Pyhäjärvi and Vansjø-Hobøl catchments. In Orlík, intensive agricultural production along with the expansion of transportation networks and industrial zones has created significant pressure.

Overall, the impacts of the aforementioned pressures on water quality and quantity involve disturbances in biodiversity and aquatic ecosystem functioning, significant changes in natural

landscape patterns, eutrophication and temporary water shortages. Impacts such as drought, flooding and disturbances in ecosystem functions are relevant to the Thames catchment due to various anthropogenic pressures, while eutrophication including harmful algae blooms is recorded in the cases of the Pyhäjärvi and Vansjø-Hobøl catchments and in one of the Dee sub-catchments. In Louros, agricultural practices, extensive land reclamation projects, hydrological regulation of the river and high water abstraction, impact on the landscape and the operation of lagoons that are supplied by Louros' waters. Similarly, pressures related to agricultural mass production, fish breeding, industry and households, along with drainage and technical adjustments of streams have caused significant changes to landscape and water functions in the Orlík.

Policy responses have been significnat in the Dee, where a variety of regulatory, voluntary and economic instruments/ measures and some general binding rules have been identified and some are already under implementation in the context of a management plan. In the Thames, a combination of incentive, advisory and regulatory mechanisms have been in place for a number of years to help farmers and other land managers protect the environment and significant water quality improvements have occurred in the last decade. With the exception of the CAP farm investment scheme and investments by municipalities on waste-water and solid waste treatment plans, response to date has been very poor in terms of the application of the WFD in Louros. On the contrary, response to the HD has been sensitive to environmental conservation needs. WFD action plans are under implementation in the Finnish catchment, while the Morsa project has introduced mitigation measures in Vansjø-Hobøl. Weak cooperation among municipalities and state authorities has resulted in the very low uptake of mitigation actions in Orlík.

The impact matrices constructed for the six sub-catchments show that the most severe impacts are relalted to hydromorphological characteristics and physical-chemical impacts on water quality. Also it is observed that the catchments of Morsa and Orlik have the highest number of "severe" impacts followed by Louros and Thames, while the catchments of Dee and Pyhäjärvi/Yläneenjoki have the highest number of "minor" impacts.

Task 2 (Selecting sub-catchments to represent variety of within-catchment compliance challenges):
Data available to inform choices of the sub-catchments varied considerably. In some cases there were only official data to draw on giving insufficient information with regard to some of the economically significant functions and ecosystem services provided by water. In other cases (e.g. Norway and Finland), there has been a great deal of scientific investigation already, which has provided a wealth of data.

Whereas the widespread nature of agricultural activity means that agricultural impacts on water quality through emissions of fertilizers, manures and pesticides over much of Europe are almost universal, impacts are nonetheless strongly shaped by intensity of agricultural practice, cropping regime and soil type. However other uses, such as commercial fishponds can also create very significant compromising conditions for water bodies in some sub-catchments.

Task 3 (Scoping the solutions)
Collaborative Scoping of Solutions Workshops were organized in order to engage stakeholders in the the scoping of solutions process. These workshops were designed to build on knowledge of the nature and sources of pressures at the sub-catchment level informing the stakeholder discussions and used to contrast local views with scientific findings.

The objectives of the workshops were addressed through three sets of activities: (1) discussion of water quality problems in the sub-catchment and the sources of these pressures, (2) discussion of

measures to alleviate these problems and perceptions of their cost and effectiveness, and (3) discussion of climate change and its effect on water quality and adaptation measures.

Workshop discussions showed that nutrient pollution was the most widely cited problem, while agricultural activity and sewage treatment were identified as the major sources of pollution. Identified problems had often a contextual perspective, while other sources of pollution diverging from common trends include fishery management of ponds (CZ), housing developments and private septic tanks (Thames), forestry, quarries, septic tanks and the increase in the number of migratory geese (Dee). Divergences in contextual factors and in the feasibility, scope and perceived effectiveness of mitigation action, led to the specification of a significant variety of solutions, proving that there is not a common path to compliance. Workshop participants were able to develop a consensus on the potential effects of climate change. On the other hand (with very few exceptions), stakeholders seemed to have a rather contemporary perception of conditions and cannot project solutions in the form of "climate change proofing" of mitigation measures. Also, in some cases, other issues (such as future developments in agricultural policy) were perceived as being more immediately important compared to climate change. This finding indicates the need for more coherent and rigorous efforts by policy makers (as all levels, i.e. international, national, regional, local) to raise awareness and initiate the detailed investigation of climate change response options.

Task 4 (Cost-effectiveness Analysis of Solutions):
In the case of the **Dee**, adaptation and mitigation measures considered focus mainly on agricultural land use and wastewater treatment works (WWTWs). Findings from the cost-effectiveness analysis indicate that: (1) the identification of key pressure sources and targeted measures are the best way to achieve cost-effective pollution mitigation, (2) livestock measures are more costly to implement than arable sector measures (in Tarland), (3) fertilizer reduction in the arable sector is the most cost-effective measure (in Tarland),(4) conversion of arable land to grassland is a costly option, (5) WFD targets in Tarland can be achieved at a relatively low total cost (compared to many other water bodies in Scotland), (6) investment in WWTWs appears to be the most effective and economically feasible strategy to deal with phosphorus loading problems, and (7) water quality standards for P can be achieved with modest total costs by implementing the combined measures of fertilizer input reduction and investment in WWTWs in the Loch of Skene catchment. Disproportionality analysis identified various non-market benefits of the improvement of water quality and the major beneficiaries. With the help of an extended CBA tool (using the NPV decision criterion), the key finding is that implementation of WFD measures in the study area is not disproportionately expensive in terms of comparison of the economic costs and societal benefits. However, economic efficiency analysis of mitigation/adaptation measures may not be the only environmental decision parameter; other non-economic factors and wider benefits may be taken into consideration in the decision making process.

Analysis in the **Thame** is focuses on phosphorous reduction from agriculture (arable and livestock) and sewage treatment works, which have been identified as the main pressures for the achievement of WFD and HD targets in the sub-catchment. Results indicate that the most cost-effective combination of measures to tackle phosphorous pollution includes establishing ten meter with riparian buffer strips, 20% P fertilizer reduction across all crop land, adoption of minimum tillage systems (over 50% of combinable crops), and establishment and maintenance of constructed wetlands and winter cover crops. Costs of implementation of these measures (including foregone benefits from agriculture) are outweighed by significant non-market benefits identified through existing stated preferences data, suggesting that the improvement of water quality can be achieved in a proportionate way from an economic viewpoint. Local stakeholders consulted throughout the project share this vision of proportionality, but acknowledge that a significant burden is placed upon

farmers, while it is the public more generally who benefits from improved water quality. To address these distributional effects, it would be necessary to widen the decision criterion beyond purely cost-effectiveness, stimulating compensation mechanisms, increasing environmental regulation flexibility and awareness raising.

In the **Louros**, the mitigation measures proposed imitate the measures originally offered by the agri-environmental programme for Louros with two differences. First, we included, besides the cultivations of cotton and maize, the cultivations of medic and citrus fruit that could formulate potentially serious polluting activities. Second, we assumed different levels of abatement under two different production processes (“technologies”). The first production process allows for reductions in fertilizer application by means of set-aside land, reduction in fertilization to the cultivated land and reduction in irrigation. The second production process allows for equal levels of reductions in fertilizers but demands 5% set aside margins, allows the set aside land to be rain fed cultivated by nitrogen fixing legumes, and reduces irrigation. Climate change for the Louros catchment and its likely impacts on plant productivity and land use was drawn from a complete and coherent assessment study of climate change effects carried out by the Central bank of Greece under the supervision of the Academy of Athens. Following the IPCC story lines, four climate change scenarios were devised. For each climate change scenario the future costs for applying the mitigation measures were re-estimated. Costs of reducing N and P under climate change were again aggregated to the whole Louros catchment taking into account the distribution of cultivations in the catchment under climate change induced land use changes. Modelling of nutrients and sediment transport was based on INCA-N and INCA-P and was carried out by WP5. Modelling provided a baseline (calibrated) estimate of nutrient concentrations without any mitigation measures or land use and climate change. This showed very clearly, and in accordance to monitoring data, that the water quality of the Louros catchment was in good environmental status and under any definition of environmental standards. Thus, there was not a need to apply a catchment wide agri-environmental programme, or at least, this was not justified on the basis of non-point source pollution from agricultural activity. Modelling also produced simulated concentrations for nutrients under the mitigation measures and without any land use and climate change. These simulations showed that the application of mitigation measures marginally improve the water quality. The baseline scenario (i.e., no mitigation measures) also was simulated for climate change induced land use changes. Climate change, increases nutrient concentrations but not as much as it would have been expected from foreseen land use changes. This is due to the fact that climate change, and especially expected higher temperatures, lower precipitation and decrease runoff, reduce sediment and nutrient transport and increase the use of nutrients by plants. Thus, the quality of water at Louros remains, under any environmental threshold levels, at good status. When mitigation measures are applied to the climate change baseline scenario, the reduction in nutrient concentration is marginal for nitrogen and more significant (but still low) for phosphorous. Despite the fact that water quality in Louros is at good status under all environmental thresholds and all alternative simulations, it was decided to run the cost effectiveness analysis (CEA) and disproportionality analysis (DA) exercises assuming that the agri-environmental policy would have been applied, if recession had not occurred. So, instead of searching for the most cost effective solution we could search for the least ineffective solution. Disproportionality Analysis requires the estimation of aggregate benefits discounted over a time period. Budget constraints did not allow the estimation of benefits from a primary valuation study and the benefit transfer methodology was applied. Taking into account the high cost of even the most cost-effective mitigation measure, it is not surprising that we calculated a highly negative net present value at around -16 million euros. However, our estimations are based on the assumption that benefits accrue to locals due to the use of Louros water and thus refer mainly to use values. This argument misses the point that Louros water feeds the estuaries at Amvrakikos Gulf and that more and cleaner water has a direct impact on habitats and biodiversity to the adjacent Natura 2000 site.

This implies that we may not restrict the benefits to Louros inhabitants only but allow other households (in Greece or Europe) to express non-use values for the Louros estuaries. To reach a breakeven position of zero net present values (i.e., with discounted costs equalling discounted benefits) the number of households should be tripled. Under any climate and land use change, benefit estimate or discount rate the net present value is negative, indicating that if such a project is undertaken, it would be highly disproportionate. For the benefits side, disproportionality is raised along two dimensions. First, the spatial dimension of benefits; second is the disproportionality to incomes. The distributional pattern of WTP estimates depends upon income elasticity. If income elasticity is less than one (as is the case with environmental services incorporating non-use values and certainly the case for biodiversity) WTP are distributed regressively among the beneficiaries. If the income elasticity is more than one, as it is sometimes the case for environmental goods such as water quality, WTPs are distributed progressively. If we assume that income elasticities are less than one and WTP is distributed regressively, this means that an agri-environmental project like the one that is proposed for Louros, has the possibility of benefiting poorer households more than rich households. This is due to the fact that the proportion of WTP to income is decreasing as income rises and thus the environmental improvement has proportionately higher benefits to poor groups than to rich groups among the general population. Costs are disproportional because are accrued only to the agricultural activity. Even within agriculture, costs are disproportionately distributed with the highest cost undertaken by cotton and maize producers. Cost, in the current economic situation, is not affordable by farmers and the imposition of such a policy without subsidisation for forgone income would force a part of the farming population out of business

Lake Pyhäjärvi is presently in Good water status, but very close to the threshold between Good and Moderate. This means that the status is only Moderate during half of the years, and problems occur related to eutrophication. The protection objective in this study is to ensure the likelihood for the lake to remain in the good status. Measures are applied by farmers in the catchment area where, in a sense, the costs of protection are thus borne. The farmers are compensated for conducting mitigation measures, which makes the state and the tax-payers the actual cost-bearer. the analysis was based on a transdisciplinary approach, in which economic analysis for costs and benefits and catchment modelling to study effectiveness of protection measures are supplemented by input received from local stakeholders. Two stakeholder workshops discussed possible mitigation measures and potential benefits of water protection, respectively. To estimate cost-effectivenes, three different types of farming practices to increase winter-time vegetation coverage were considered in the case study. The actual CEA studied costs and effects of different combinations of these, namely, 1) Increasing the amount of winter cereals; 2) Changing from cultivator tillage to direct sowing; 3) Increasing the amount of nature management fields. The analysis of costs and effects of mitigation measures showed that there are cost-effective combinations of measures to reduce nutrient load. Some of the combinations could even reduce the costs of farming. In comparison to economic results of the farms, the combinations would lead to modest decrease or modest increase of economic result on a farm level. Only the most costly combinations of measures would mean a significant increase of costs of farming. It can be concluded that on the other hand affordability should not form an obstacle for applying the methods, but on the other hand the possible, modest reduction of costs of farming is not a strong incentive for adopting them. Choices that farmers make are strongly influenced by agri-environmental scheme of the EU CAP. Future agri-environmental schemes should be targeted for creating incentives for farmers to adopt more effective measures, but especially such that do not lead to unnecessary increase of costs, since there are cost-effective alternatives. A stakeholder workshop was organised to identify the types of benefits that can be gained by use of water and water areas of the Lake Pyhäjärvi. Five groups of main uses were identified: i) water as a resource, ii) recreational use by the local people, iii) professional fishing, iv) tourism and v) significance of good water quality for the reputation and living conditions in the area. A benefit transfer method was used to quantify

the potential benefits that can be gained from reaching the set protection target. The analysis of potential benefits suggests that considerable benefits can be gained from meeting the protection goal. There is thus a social need to continue protection of the lake and high benefits to be gained. Comparison of costs of protection and potential benefits to be gained indicates that benefits are clearly higher than the costs.

Morsa (Vansjø-Hobøl) The analysis has focused on the reduction of total phosphorus, which is associated with eutrophication problems and the most cost-effective combination of measures included (ranked in order, with the most cost-effective measure first and the least last): i) Buffer zones with vegetation along creeks and rivers; ii) Sedimentation ponds; iii) Reduced tillage practices (leaving the fields in stubble during winter); iv) Reduction of sewage from scattered dwellings (stand-alone systems); v) Transfer of sewage to MSTPs outside the catchment. Caution needs to be taken when using these results in practice. Managers should for example not only consider the cost-effectiveness of the removal of total phosphorus, but also other concerns, such as the bioavailability of phosphorus from different sources, and risks of bacteria from sewage pollution. It must also be stressed that the cost-effectiveness figures for measures aiming to tackle diffuse runoff from agriculture are uncertain, and it may take several years before the effects of such measures are detectable in the river waters. Through stakeholder interactions, this analysis also identified a large range of wider benefits from these measures, ranging from improved cooperation across administrative borders to increased well-being of the local population. It is believed that such benefits may contribute to the continued motivation for implementing mitigation measures. The disproportionality analysis showed that the reduction of phosphorus in the case study catchment was proportionate and economically justified, but distributional effects and affordability considerations should be taken into account. Payment for ecosystem services, where beneficiaries contribute as well as polluters, may therefore be considered.

In the **Vltava** catchment, the analysis focused on phosphorus (P) reduction from its major sources in the catchment of the Orlík Reservoir, i.e., municipal wastewater discharges, fishpond fisheries, and agriculture (arable and livestock).The starting point of the CEA was an analysis of existing measures implemented in 2007-2015. Findings indicate that these measures would reduce the P inflow by approx. 22 tonnes (corresponding to 20% of the total necessary P reduction) at total costs of CZK 465 mil. (EUR 18 mil.) a year. CEA The then focused on creating a cost-effective scenario, the implementation of which would result in the total necessary phosphorus reduction, i.e. reduction of the P inflow to one half to prevent the massive algal bloom in summer months. Numerous measures for P reduction were identified in discussions with stakeholders and expert specifications. In total, 3,097 measure applications were analysed within the CEA (of which 1,654 qualified for the effective scenario). The total annual costs were CZK 369 mil (which equals to EUR 15 mil./year). CEA was followed by a benefit transfer analysis in order to calculate the benefits incurred by the water quality improvement. The focus was on recreational benefits for residents and tourists. Furthermore, due to a lack of available data, we assumed other benefits and the future tourism development through expert judgments. Benefits were calculated on different time scales corresponding to the cost analysis. The first scenario calculated benefits between 2007 and 2015 (amounting to CZK 256 million, i.e., EUR 10.23 million). The benefits in the case of the CEA scenario realisation were calculated in the second scenario (expected lifespan of the measures being 20 years); we calculated benefits between 2016 and 2035 (amounting to CZK 3,016 million, i.e., EUR 120.5 mil.). The cost-benefit calculations were then amended by stakeholder consultations sought for the acceptability of the proposed scenario, distributional effects and wider effects caused by its realisation. Qualitative methods (focused groups, questionnaires) were used to capture those features. It showed a problem of financing the implementation of proposed applications of measures (small municipalities do not have the money to build the infrastructure, fish producers and farmers require subsidies to change their practices above

legal requirements). Furthermore, fish producers denied their contribution to P releases to a large extent.

Task 5 (Flagging the wider benefits to ecosystem services)
A combination of expert consultation and stakeholder participation was used to identify the wider benefits of measures to improve the water status in the six demonstration catchments.

Results indicate that identified costs and cost-bearers were mostly specific to the chosen mitigation measures and activities associated with them, while benefits and beneficiaries largely seem context-specific. Also, as probably expected, costs of protection measures are borne upstream and benefits are enjoyed downstream. Rather few anthropogenic sources of pressures exist, affecting the welfare of a rather large number of people.

Costs and cost-bearers identified and classified as important by local stakeholders include increased farm production costs and reduced yields, but also other sectors such as quarrying, fisheries and forestry. Water and drainage/sewage treatment authorities were also noted as significant cost-bearers in some catchments, while private households were expected to bear costs associated with septic tank management. Benefits and beneficiaries identified correspond to rather wider range than that associated with costs and cost-bearers. Recreational benefits were identified in all case studies and linked to economic welfare. Biodiversity benefits were also identified including those associated with species populations and wildlife health. Finally, an improvement of the quality of life was identified.

Regarding proportionality, it was argued that costs are more concrete and short term, while benefits were more abstract, subjective and longer term. In some cases this led to difficulties in the comparison of costs and benefits. However, there was a general opinion that benefits outweigh costs, despite their long term and "uncertain" nature.

Identified wider benefits were mostly non-water and non-strictly water ones. Main non-strictly water benefits identified for REFRESH demonstration catchments include biodiversity conservation, soil conservation, and increase of amenity and aesthetic values. Non-water benefits quoted include improvements in human health and wellbeing, gains in economic activity (including employment), educational resources and changes in attitudes towards environmental sustainability, and food security, but also pest control, climate change, retention of nutrients and organic material, air filtering, improvement of pollination, and generally, reduced environmental impacts.

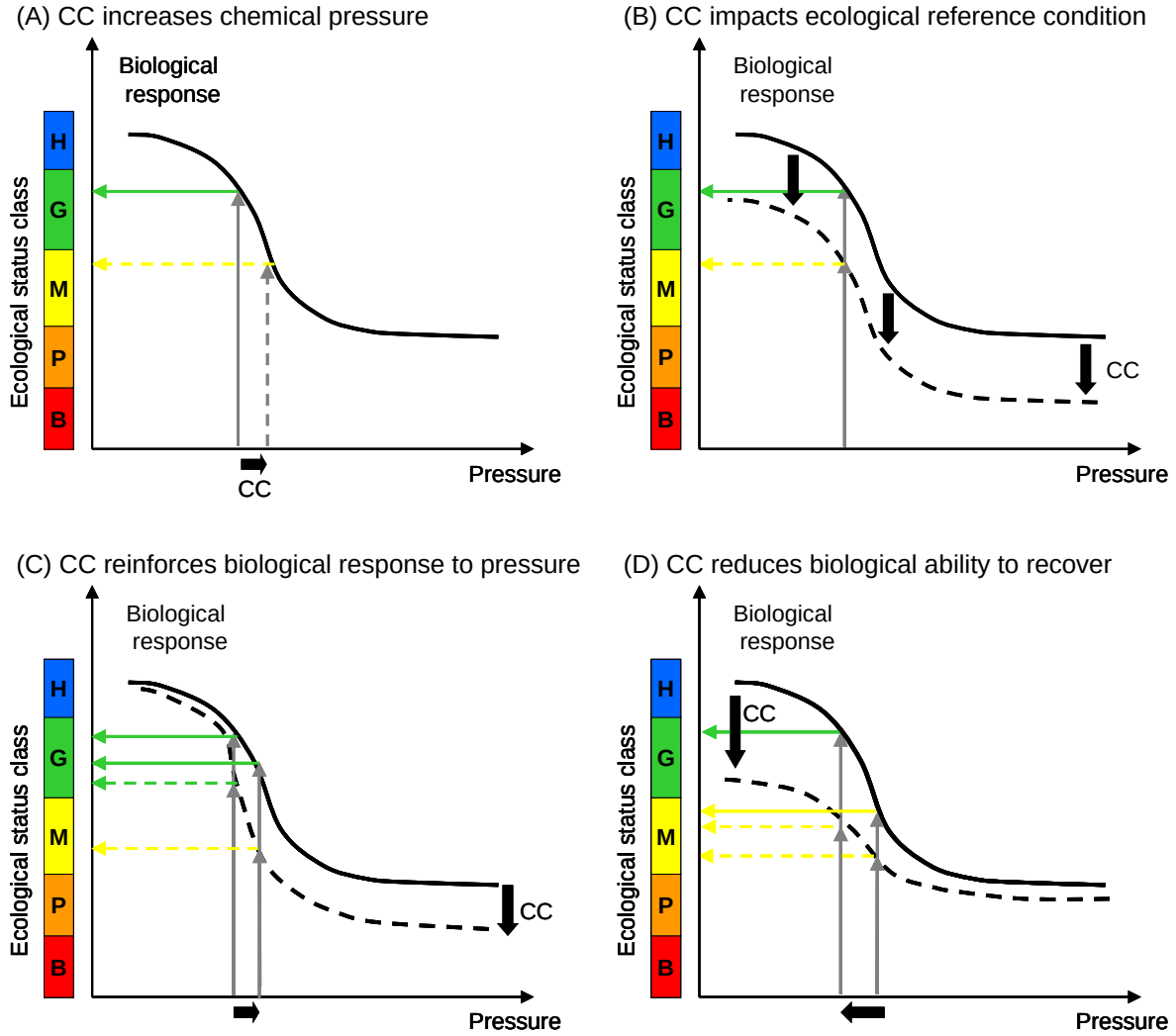
We conclude that this exercise led to inference on the existence of a significant range of wider benefits associated with mitigation measures, which target the improvement of water quality. The existence of such benefits should play a fair role and be acknowledged in any holistic analysis of interventions to maintain water qualities to support sustainable and multifunctional management of European water catchments. Further, the link between these benefits and, rather complex factors such as perceptions on the state of the environment, development strategy capacity at the local level and economic factors influencing productive behavior should be taken into account when mitigation and adaptation actions are designed and implemented, in order to enhance policy efficacy. Finally, with the exception of the Louros case study, wider benefits identified in the context of Task 6.5 further support findings of Task 6.4 on the existence of proportionality and confirm that the chosen mitigation/adaptation measures would generate social benefits.

THE POTENTIAL IMPACT (INCLUDING THE SOCIO-ECONOMIC IMPACT AND THE WIDER SOCIETAL IMPLICATIONS OF THE PROJECT SO FAR) AND THE MAIN DISSEMINATION ACTIVITIES AND EXPLOITATION OF RESULTS

REFRESH work on streams created a basis to apply knowledge on the effects of climate change and land use change on the structure, functioning and biodiversity in rivers and the effectiveness of adaptation and mitigation measures to restore rivers.
The shading experiments provided quantified insights in the role of temperature in rivers and the potential ecological gain to use shade to compensate temperature rise. The related shading and temperature reviews made a wider application and generalisation of the experimental results possible. Furthermore, shading also supplies organic material to rivers which improves the ecological functioning and thus adds to the objectives of the Water Framework Directive and the Habitat Directives. Shading as a measure is also of low cost. The indicators for temperature and wooded river banks were renewed and can improve the assessment techniques that accompany the WFD implementation.
The shading experiments were prepared and performed in about 48 streams spread over the Atlantic region of Europe, each in direct cooperation with local stakeholders (mostly regional water authorities). The results were communicated directly to the respective stakeholder and will help them in applying this type of measures.
The stagnation and drought experiments provided quantified insights in the role of low flow and drought in rivers and the potential ecological losses. The experiment provided thresholds for low flow and drought in Atlantic lowland rivers. The related low flow and drought reviews made a wider application and generalisation of the experimental results possible. Furthermore, flow and oxygen appeared crucial for rivers and decide the ecological functioning. Thus good oxygen regimes and healthy flow conditions are primary targets in any part of measures to reach the objectives of the Water Framework Directive and the Habitat Directives. The indicators for flow and oxygen were selected and can improve the assessment techniques that accompany the WFD implementation.

We have produced a comprehensive report on the implications of climate change for ecological reference conditions, thresholds and classification systems for European lakes (Del. 3-15-16). The aim of the report was to assess impacts of climate change on reference conditions and ecological thresholds in European lakes, to consider the implications for ecological classification systems (reference values, class boundaries and water body types), and to provide recommendations to river basin managers concerning monitoring programmes and programmes of measures. The EC guidance on river basin management in a changing climate (2009) states that "In general, reference conditions and default objectives should not be changed due to climate change projections over the timescales of initial WFD implementation (up to 2027) unless there is overwhelming evidence to do so" (section 5.4.4. Reference sites). Moreover, one should "avoid using climate change as a general justification for relaxing objectives" (EC 2009, section 5.5 Objectives setting), such as relaxing the Good/Moderate boundary.Nevertheless, although national classification systems are already established and intercalibrated by most EU member states, the six-year River Basin Management planning cycle of the WFD offers an opportunity to review the methods for the adequate assessment of the ecological status of EU water bodies. Moreover, the programme of measures within the River Basin Management Plans should take account of climate change effects in order to achieve the WFD Good status target. In addition, impacts of climate change may affect lake ecosystem services and threaten the implementation of the EU Biodiversity Strategy 2020, especially target 2: Maintain and restore ecosystems and their services. Therefore, although not explicitly mentioned in the WFD, synergies between the WFD and the Biodiversity Strategy may contribute to both maintaining and restoring lake ecosystems and the services they provide.

The following key messages can be extracted from the literature review, new data analyses and case studies presented in this report as a basis for recommendations. In general, our results and recommendations support and expand on those given in the EC guidance (2009), by Moe et al. (2010a - see Fig. 7) and by Nõges & Nõges (2014). With respect to impacts of climate change on reference conditions: i) shifts in in lake type may occur, ii) changes in reference conditions for phytoplankton are expected for species composition, abundance and the onset and frequency of algal blooms, iii) an increase in reference concentrations of nutrients and cyanobacteria are likely to be required, iv) changes in reference conditions for fish, macroinvertebrate and macrophyte taxonomy based metrics are expected. With respect to impacts of climate change on thresholds and classification systems: i) the probability of exceeding the good/moderate boundaries for one or more biological quality elements will increase, ii) the current good/moderate class boundary for macrophyte metrics and the concentration of cyanobacteria will probably be reached at lower nutrient levels in the future, iii) fish metrics that include salmonids may need adjustment of class boundaries, iv) the current good/moderate boundaries for the BQEs could be retained but nutrient standards will need to be more stringent OR the good/moderate boundaries for the BQEs will need to be relaxed and the current nutrient standards retained.



Potential impacts of climate change on components of ecological status classification, for a biological metric (e.g., EQR based on amount of cyanobacteria) which responds to a nutrient pressure. Ecological status classes: H = high, G = good, M = moderate, P = poor, B = bad. Solid curves: present situation; stippled curves: impact of climate change (CC). (A) CC affects the level of local pressures. (B) CC affects the reference condition of the biological element (i.e. the baseline or condition found in sites with minimal impact of other anthropogenic pressures). (C) CC affects the biological element's response to increased local pressures, including thresholds used for defining boundaries between ecological status classes. (D) CC affects the biological element's ability to recover when local pressures are decreased due to measures. (From Moe et al. 2010a).

With respect to ecosystem services: i) the costs of treating drinking water supply are likely to increase, ii) water supply for drinking and irrigation will be threatened in Southern Europe, iii) the quality of bathing water will deteriorate, iv) the value of lakes for sportsfishing may be reduced, v) the overall value of lakes for recreation may be reduced. And finally with respect to recommendations for river basin managers: i) monitoring of biological quality assessment metrics in a set of reference lakes to assess the nature and degree of any change will be required, ii) improved monitoring of lakes impacted by eutrophication is crucial to assess whether the nutrient reduction measures and other restoration efforts are sufficient to achieve good status, iii) if only one BQE can be prioritised then phytoplankton should be selected as the BQE responding most strongly to eutrophication, iv) any change in lake type should be considered before the programme of measures is revised, v) climate change impacts on lakes are probably still small enough to be compensated with small to moderate additional restoration efforts in the 2nd RBMPs, vi) climate change impacts are expected to increase in the coming years and may thus require major improvements in nutrient reduction measures for the 3rd RBMP if good status and sufficient provision of ecosystem services are to be achieved in 2027.

We have furthermore **established a number of guiding principles concerning various aspects of the WFD such as the risk assessment, status assessment of lakes, objective setting, and the programme of measures (Del. 3.21).** These include:

Principle 1 assures that reducing external nutrient loading to lakes remains the key for successful lake restoration and meeting water quality targets also in CC conditions. Based on studies made in REFRESH it is shown that critical nutrient loading to achieve and maintain good ecological status in lakes has to be lowered in a future warmer climate as natural mechanisms that support zooplankton grazing weaken. Although in most studies, P is considered the most important limiting nutrient in lakes, several authors advocate consideration of both N and P.

Principle 2 suggests that water managers consider the dominant cascading effects in lake food chains and advocates for using zooplankton in lake monitoring schemes. A number of studies within REFRESH have demonstrated that increasing pressure exerted by planktivorous fish on zooplankton in warmer climates may cause rapid and dramatic increase in phytoplankton including cyanobacteria. Understanding the trophic cascade of a lake is the key for interpreting changes in variables characterizing the WFD ecological status, making future predictions and selecting effective restoration measures.

Principle 3 emphasizes the importance of geographic, and type-specific differences of lakes for selecting appropriate conservation, adaptation and restoration measures and distinguishes between three types of lake sensitivity: fast reaction, "memorizing" of past conditions, and proneness to system shifts exemplified by a number case studies.

Principle 4 stresses the importance of developing clear prioritization principles in order to diminish potential conflicts and trade-offs between management measures. Uncoordinated sectoral responses can be ineffective or even counterproductive, because a response in one sector can increase the vulnerability of another sector and/or reduce the effectiveness of its adaptation responses.

Results of the experimental work on riparian wetlands have been (and are being) disseminated to the broader scientific community via peer-reviewed publications and presentations at conferences and other (scientific) meetings. In addition, a summary report on the experimental results for a more general audience has been produced (Del 4.4), with a special focus on putting the results in a perspective relevant to riparian wetland management, conservation and restoration. This Del is available on the REFRESH website and its contents can be translated and used by all partners in

national communications. All partners have been in intensive contact with local stakeholders such as water boards and landowners through their experimental sites, and have disseminated knowledge also through tv presentations and talks addressing a more general public. In addition, its contents form the basis of brief communications on REFRESH results targeting specific, relevant audiences. Finally, during the past four years of research on riparian wetlands a great number of junior researchers and PhD students (>8), MSc students (>10) and BSc students (>10) have been trained in scientific research, riparian wetland ecology, freshwater management, conservation, and restoration, and their education and skills will hopefully contribute to better European wetland management. This not only contributes to the growing population of skilled workforce able to deal with climate change effects on freshwaters, but also to awareness raising.

A modelling framework has been developed that takes integrated scenarios of climate, land management, water use and atmospheric deposition change as input to biophysical catchment models that represent connected river-lake-wetland systems, and determines the long-term, and is some cases, seasonal changes in flow and water quality and key ecological indicators. This framework is applicable on a catchment-by-catchment basis and thereby considers the nuances of each and is compatible with the basic management unit on which the Water Framework Directive is based: the river catchment. The parameter sets from the model applications will be made available allowing others to use the models with some idea of parameters that can be left 'as factory settings' and suggested parameter ranges for certain catchment types. The biophysical modelling framework has been used in conjunction with cost-effectiveness analysis to identify which measures will best help reduce nutrient pollution today and fifty years hence when set against the background of projected environmental change. A new generation of models, based on Bayesian Networks, have been trialled to incorporate multiple stresses on key ecological indicators.

The catchment biophysical monitoring highlighted a paucity of baseline flow, water quality and biological data in southern Europe. It is recommended that the EU provide the resources to support environmental monitoring in this region which is most at risk from the direct impacts of climate change. In REFRESH case studies for these regions, nutrient water quality appears of secondary importance to flow and other water quality elements, such as salinity and water temperature.

The general picture presented from the catchment modelling is that the predicted effects on waters differ between the northern and southern sites. In the north and mid-latitudes, the increased temperatures are balanced to some extent by increased precipitation, leading to relatively small effects on water flows, though seasonal effects may still be important. In the south, increased temperatures and lower precipitation act in the same direction to reduce water flows considerably. In the case of Lake Beysehir, this may even lead to the lake drying up in the foreseeable future, and this effect would far outweigh any nutrient-related problems. In general, the effects of climate change alone on nutrient concentrations are rather small. The effects of credible land use changes are rather larger, and generally, the land use changes representing future "environment-focussed" storylines (B1 and B2) reduce nutrient concentrations, and those from the "economic, market driven" storylines (A1 and A2) increase them. However, there are exceptions and considerable differences in response between sites. The responses seem more dependent on the mixture of nutrient sources (e.g. agriculture versus wastewater) than the degree of climate change. Modelled ecological changes are not generally proportional to the changes in nutrients. Ecological change can be less than the nutrient change (e.g. chlorophyll at Lake Beysehir and the Orlik Reservoir in the Czech Republic) or greater due to a complex set of reactions in the food web (e.g. at the IJsselmeer). Modelled mitigation options can reduce nutrients, and there is no evidence here that they are less effective under a future climate. With less certainty, mitigation options can affect the ecological status of waters at these sites in a positive manner leading to an improvement in Water Framework Directive status at some sites.

Uncertainty in the climate models, as represented by the differences between the three GCM-RCM combinations used in this study, does not affect this overall picture much, though there are differences at individual sites.

Mitigation measures were generally effective in reducing nutrient concentrations in current climates. Mitigation strategies were generally aimed at improving ecological outcomes and hence tended to target P. Reductions in nitrate concentrations were therefore much lower than those of total P and SRP. Mitigation strategies continued to work with future climates, though in some cases the effects were small. The initial status of the sites covered a wide range of WFD categories. Mitigation gives a general reduction in risk, and can cause sites to cross boundaries between WFD classes in a favourable direction.

The socio-economic work has involved collating large amounts of material from disparate sources in selecting sub-catchments. Significant networks have been built with local stakeholders and national experts and it is clear that there is strong interest in the thematic challenges that WP6 in particular and REFRESH in general, set out to address. More important, the intensive consultation of stakeholders promotes an important aim of the project, namely to co-construct water management solutions which are not only effective (in terms of compliance and costs), but are also feasible both economically and socially, and thus have a strong chance to be actually adopted in the demonstration catchments. This particular analysis of WP6 is expected to promote a new approach on the selection of mitigation and adaptation interventions at local scale across Europe.

Furthermore, the policy implications of WP6 findings are considered important for agricultural policy and especially for Pillar 2 agri-environmental measures, which represent a very significant proportion of EAFRD funds dedicated to rural development. WP6 findings point out to four important policy rules, which if applied, are expected to enhance policy efficacy.

The first policy rule is to "express policy targets in the units used by the targeted environmental standard". This will force policy makers to an ex-ante assessment of their proposed policy with science based nutrient transport models.

The second policy rule is to "climate change proof" the policy. Policy designers should ensure that, due to the long term commitments of agri-environment programmes, the proposed measures will continue to achieve compliance under expected changes such as climate and land use changes, and will continue to be cost effective, i.e., they will continue to achieve compliance with the lowest possible cost. This will force policy designers to proposed mitigation measures that are "climate change proofed", i.e., will achieve cost efficient compliance under changing future conditions. Thus, measures would be designed in a way to allow transition to a stricter abatement level if changes are unfavourable or to looser abatement if changes are favourable with the lowest cost. This can be achieved by using science based nutrient transport models that simulate nutrient concentrations under changed environmental conditions. Thus, farmers would be a priori informed that, if conditions change, they will have to adopt transitional measures.

The third policy rule is to "unravel and flag all wider and associated benefits". If a proper benefit assessment is carried out, especially for WFD related agri-environment programmes, the habitats and biodiversity non-use values should be measured and the target population should be expanded outside the limits of the local population and the benefits due to use values.

The fourth policy rule is to "take account of disproportionality and affordability effects" and establish firm grounds for possible departures from the Polluter-Pays-Principle.

The main socio-economic and wider societal impacts of work done under WP7 to date is that stemming from the dissemination of Project results to the stakeholders concerned with management of freshwaters. In the final year of the project a major effort was undertaken to ensure that the research output reached target stakeholders in an accessible way (during stakeholder meetings, science-policy interface events, through policy briefs, newsletters and summary leaflets) to maximise potential uptake and therefore impact. With the key messages for management and policy delivered directly to those responsible for making and implementing policy we believe we the work done in REFRESH has the potential to provide managers with ways to improve implementation of the Water Framework Directive and policy makers with suggestions as to how the design of the Directive might be improved during the next stage of its revision. More detailed dissemination are described below.

Dissemination activities

The Project web was developed and updated throughout the course of the Project. It provides an introduction to the Project aims, objectives and work programme, access to the REFRESH publication bibliography, links to related projects and organisations and includes a section giving access to publications and deliverables from the Euro-limpacs Project. A list of deliverables is provided in the public part of the Web site and clicking a deliverable that has been submitted links to an abstract describing the deliverable. All publically available deliverables can be downloaded from this part of the web site without the need for a restricted login. It also served as a management tool providing news, information, access to documents, work package resources and a means of communicating with different groups within the consortium. REFRESH news items were continually updated. The Web site was continually updated with news from REFRESH. Stakeholder meetings in key case study catchment were summarised with links to reports and publicity fliers. Details about project meetings and the activities of other freshwater projects (e.g. WISER and BioFresh) were provided. Reports from the REFRESH regional stakeholder meetings in the UL, Norway, Estonia and Turkey were added along with an account of the joint REFRESH / BioFresh Science Policy Symposium in Brussels. Links to presentations and video footage from the meetings were included. The results section of the Web was expanded to highlight the key messages from the project with links to more detailed output. A separate section on Policy Briefs from REFRESH was added to the main menu as part of the REFRESH commitment to disseminate output to stakeholders as well as the scientific community. This has been achieved both at the local level (in REFRESH case study catchments) and at the pan-European level (e.g. Joint Science / Policy symposium).

A series of dissemination materials has been produced for use by the consortium. These include a generic poster and Powerpoint presentation and a REFRESH flier. Three REFRESH newsletters were produced in the final reporting period and circulated widely via the REFRESH Stakeholder Database and the networks of contacts of REREFRESH scientists all over Europe. The Newsletter is also publicly accessible on the REFRESH web site. The first of these provided a general introduction to the REFRESH work programme highlighting the experimental work and the modelling case studies. The second focused on the outputs of the four regional stakeholder meetings in Norway, Estonia, UK and Turkey. The final newsletter showcased work undertaken at each of the modelling / cost-effectiveness case studies. In the case of the Thame study, this was supplemented by a leaflet providing more detail of the stakeholder activities undertaken in this sub-catchment of the Thames. This was circulated locally but also held up as an example of the successful stakeholder engagement underpinning REFRESH work in the case study catchments

REFRESH has been represented at numerous national and international workshops and meetings. These have included policy oriented meetings, national and local stakeholders meetings and international conferences. REFRESH established links with the CIS:SPI community and the SPI Water Cluster Projects (STREAM, Water DISS 2.0 and WISE-RTD) with the intention of strengthening the effectiveness of the REFRESH dissemination activities. This led to a review of the REFRESH dissemination strategy and much of this was guided by the recently published 'Roadmap for uptake of EU water research in policy and industry'

Five regional stakeholder meetings were held in Estonia (two meetings), UK, Turkey and Norway. A report from each of these (Deliverables 7.7-7.10) in additional to one in Australia organised by Griffith University. A summary of each of the European meetings was included on the REFRESH web site with links to the presentations and to video footage (for the UK and Turkish meetings) of these.

The final reporting period saw continuing development of the Climate-and-freshwater.info web site. This now includes case studies from REFRESH as well as a section on restoration practices and guidelines, particularly in the context of global change.

The modelling and cost-effectiveness/disproportionality analyses undertaken at each of six REFRESH case study sites were synthesised and presented as a Deliverable for each catchment. These syntheses have been added to the Project Web site.

In partnership with the EU FP7 project BioFresh, REFRESH organised a Science Policy Symposium for Freshwater Life with the aim of bringing together policy makers and stakeholders from the water, energy and conservation sector, NGOs, the scientific community and selected experts to discuss challenges in implementation of the 2020 Biodiversity strategy and the EU Water Framework Directive and to agree on recommendations for policy making and future research. The scientific advances of BIOFRESH and REFRESH were presented (along with those of a number of other FP7 projects), and the implications of these for the freshwater management in the EU were discussed with the aim of highlighting clear recommendations for policy making. The Symposium sought to support the implementation of the Biodiversity Strategy 2020 and the EU Water Framework Directive (and its potential revision) and to create synergies across them building on the best recent knowledge on the current and future status of freshwater ecosystems and their inherent biodiversity. REFRESH has increased understanding of freshwater ecosystem response to climate and land use change and develops tools to support adaptive management.

BIOFRESH delivered policy relevant data and results on the current status, trends, pressures and conservation priorities of freshwater biodiversity.

The symposium aligned key research findings with the needs of policy making and generate policy-relevant messages relating to:

- Conservation planning and management of freshwater biodiversity in the context of Green Infrastructure and Natura 2000.
- Future protected area networks considering environmental scenarios and policy targets
- Freshwater biodiversity data and information to contribute to recent activities in ecosystem assessments by JRC, EEA and the European Commission
- Achievements of WFD good ecological status under climate and land use change scenarios
- Interlinkages between biodiversity, water related policies and other policy sectors (e.g. energy, agriculture and cohesion) to infer recommendations on synergies for their implementation.

A series of policy briefs were produced toeards the end of the project highlighting some of the policy and management implications of REFRESH output. These focused on;
i) Zooplankton-an integrative Biological Quality Element for assessing the Ecological Status of lakes
ii) Riparian Forest can help mitigate climate warming effects in lowland temperate streams
iii) Stricter nutrient loading limits help lake ecosystems to withstand climate change pressures
iv) Stronger need for maintaining environmental flow in streams in a changing climate

4.2 Use and dissemination of foreground

A plan for the use and dissemination of the foreground was set out in Annex 1, description of work. The REFRESH dissemination strategy as described in the plan follows;

Dissemination of results

Dissemination of the Project results is a key component of REFRESH and considerable resources have been set aside so that output from the Project reaches the widest (and most appropriate) audience and is communicated in a way that ensures these results have a practical applicability. Work package 7 is given over entirely to dissemination. Communication of the results will be conducted through:

- a comprehensive and regularly updated publicly accessible web site;
- summary documents clarifying the science underpinning adaptation, mitigation and restoration strategies written in a way that is accessible to managers and other stakeholders;
- targeted news letters;
- popular science articles;
- the organisation of stakeholder workshops at local, regional, national and international levels;
- best-practice strategy advice for managers;
- demonstration case studies illustrating predicted and actual outcomes of adaptive responses under different climate change and land-use change scenarios; and
- policy oriented reports highlighting setting out the implications of REFRESH results for relevant national legislation and EU directives.

Given the level of expertise and the breadth of research and stakeholder networks represented by the partners involved, the dissemination of results from REFRESH will incorporate the accumulated knowledge and experience of many years of research funded from national and EU projects. Stakeholder engagement and dissemination of results will be based not only on increased understanding from REFRESH but on the accumulated wisdom of many years of national and internationally funded research. The resources given over to dissemination have been allocated with this in mind.

Stakeholder engagement in REFRESH will be a two-way process. WP1 Task 3 will provide a forum for discussion and agreement of appropriate scenarios and storylines to be used in REFRESH and identification of potential barriers to the implementation of adaptation and mitigation strategies. This dialogue will continue throughout the work programme, particularly in WP6 and WP7. A major focus of the dissemination effort will be the public part of the Project web site which will provide access to all Project results and the products of all dissemination activities outlined above. The external component of the Project web site will be designed to:

- inform the European Commission, the water industry, environmental managers and the scientific community of the existence and aims of the Project;
- disseminate the preliminary and principal results of the Project. In particular all publicly available deliverables will be accessible;
- synthesize all Project output (with links to more detailed material) in an accessible style and provide an easily navigated reference site for management of freshwater aquatic ecosystems which brings together results from European and national projects which have undertaken research in this area;
- present the databases generated in the Project to the scientific community;

- provide active links to a wide range of other relevant web sites, including the Council of Europe, consortium member organisations, other relevant research groups and Projects, national and international water industry organisations; and
- provide an archive for all summary documents, newsletters, stakeholder workshop proceedings, best practice strategy documents, popular science articles, case study reports and policy position papers highlighted in WP7.

The results section will summarise output from the Project using non-specialist language and a list of all deliverables will be provided with summary descriptions and links to those that are publicly available. This will be updated throughout the life of the Project. There will also be a section on climate change effects on freshwater ecosystems which will comprise a state-of- the-art summary of research in this area. It will include sections on adaptation, mitigation and restoration strategies and how these interact with, and are affected by, changing climate. Links will be provided to other EU and national projects working in this area. The objective is to provide a 'one-stop shop' for stakeholders at all levels (including potential users from the scientific community, policy makers, managers and those responsible for implementing legislation, conservation organisations, education institutes and the general public). Additionally, this section will include an inventory of all EU and, (where possible) nationally funded projects focusing on surface freshwater ecosystems and their management and a summary of collated research output from these projects bringing this together for the first time into a single, readily accessible web-based information system. The web site will be designed and developed during the first 12 months of the Project and throughout.

Dissemination during the first reporting period

During the first reporting period (1st February 2010 – 31st July 2011) the planned dissemination strategy was adhered to for the most part. 1. The Project web site was developed and provided an introduction to the Project aims, objectives and work programme. It gave access to REFRESH publications, links to related projects and organisations and includes a section giving access to publications and deliverables from the Euro-limpacs Project. It also served as a management tool providing news, information, access to documents, work package resources and a means of communicating with different groups within the consortium.

A series of dissemination materials has been produced for use by the consortium. These were primarily introductory at that stage, highlighting the REFRESH aims, objectives and the approaches being used in the Project. A generic presentation in PowerPoint (**Deliverable 7.4.2**), a poster (**Deliverable 7.4.1**) and a flier (**Deliverable 7.4.3**) were made available to partners to down load from the Web site and use or adapt as required. A six monthly newsletter (primarily for internal consumption) was circulated with updates and information from the Project (**Deliverables 7.6.1, 7.62 and 7.6.3**). It was intended that subsequent newsletters would be circulated beyond Project participants to a wide range of stakeholders from year 2. The first popular article for stakeholder consumption (**Deliverable 7.5.1**) due in Month 12 was based on the stakeholder engagement activities undertaken in WP1 Task 3 and comprise an article for International Water Association Watershed & River Basin Management Specialist Group Newsletter June 2011 and a Knowledge Scotland Policy brief (http://www.knowledgescotland.org/briefings.php?id=253).

REFRESH was represented at numerous national and international workshops and meetings. These included policy oriented meetings, national and local stakeholders meetings and

international conferences. Links were established with many projects, networks and institutes with aims that are complementary to those of REFRESH.

Other supporting materials planned for the first 18 months were the subject of discussion within WP7 and at steering group level. It was originally planned to include a series of guides to freshwater science for non-specialists use, popular articles for audiences beyond the scientific community and contributions to existing *e*-newsletters. While it was still planned to disseminate to these audiences it was felt that, at the earlier stages of the project it would be more useful to focus WP7 resources on developing the Web site and raising the profile of the Project with local, national and international stakeholders to ensure we were in a position to receive meaningful feedback as to the stakeholder needs. Therefore the guides to freshwater science (**Deliverable 7.3**) due in Months 6, 12 and 18 were postponed until the second half of the Project. Further, during discussions at the first Project meeting in Aberdeen it was felt that the scope of the Guides to Freshwater Science should change to encompass research specifically being undertaken in REFRESH. Given the material already existing and readily available to stakeholders it was felt that such general guides would be superfluous. Instead it was agreed to repackage this deliverable so that it delivers results from REFRESH in an accessible, user-friendly format for stakeholder consumption. A series of key questions being addressed by REFRESH will be defined and these will form the basis for dissemination via the Web site, via policy briefings and through a series of policy/stakeholder briefings circulated to targeted end users. These would provide syntheses of different aspects of the work programme to be updated as new results become available.

Dissemination during the second reporting period

The key foci in the second reporting period were i) an expansion the project web site (increased news flow, syntheses of results and access to Project deliverables on the public side and expanded functionality on the intranet with updated deliverables and milestones tables) and ii) revision of the REFRESH dissemination strategy in the light of discussions within the Science Policy Interface community including those involved in the Common Implementation Strategy (CIS) of the Water Framework Directive (WFD) Science Policy Interface (CIS:SPI) activities and the SPI Water Cluster group of Projects. Some of the WP7 deliverables are now redefined and shifted towards the final year of the project to maximise the potential uptake of these.

It was clear from discussions at numerous SPI events that there continue to be problems with attempts to establish practical exchanges among the scientific and policy-making communities, in particular regarding dissemination of research outputs from European Union funded projects and transfer of usable information to policy implementers. This is an area which is often given insufficient attention in research projects and in the final year of REFRESH it was decided to promote improved communication and connectivity between sectors at the EU level, nationally through statutory bodies and conservation agencies and among the scientific community. REFRESH recognised that for the dissemination of research output to be successful, the target audience needed to encompass those beyond the scientific community and include policy makers, those tasked with implementing environmental and other legislation, conservation bodies and other NGOs, water managers, local stakeholders and the general public. This was be reflected in the dissemination strategy in the final year of the project which incorporated some of the key recommendations for research projects set out in the 'Roadmap for uptake of EU Water Research in Policy and Industry' produced by the SPI-Water Cluster (http://www.stream-project.eu/sites/default/files/SPI%20Cluster%20Roadmap%20FINAL_0.pdf).

Remaining resources were planned to be used so that output from the Project reaches the widest (and most appropriate) audience and is communicated in a way that ensures these results are taken up and have a practical applicability.

In consultation with the WaterDiss 2.0 project (one of the SPI water cluster projects) a draft Dissemination strategy (available on the REFRESH Web site at http://www.refresh.ucl.ac.uk/webfm_send/1965) for one of the key outputs from REFRESH, the REFRESH model (see WP5) was drawn up. This will be further developed with the WATERDISS project at a meeting planned for April 2013.

As a result of this there were a number of changes to WP7 following revision of dissemination strategy

A number of WP7 deliverables were rescheduled or modified following ad hoc discussions at a number of Science Policy Interface meetings and with participants in the SPI water cluster projects (Science-Policy Interfacing in Water Management : WaterDISS 2.0. STREAM and STEP-WISE). The 'Roadmap for uptake of EU water research in policy and industry' focused on increasing and making more efficient the communication efforts of EU water research projects so that they could reach distinct targeted audiences, improving accessibility to water research results, speed up their uptake and strengthen the Water Science - Policy Industry interface to become results oriented. The roadmap follows the efforts over two years by the three EU funded projects of the SPI - Water cluster to support the communication and dissemination of EU water research project results. The roadmap is based on the assessments and recommendations made by the SPI - Water cluster and the conclusions of the final conference of STEP-WISE and STREAM projects.

The Roadmap has a number of key recommendations which REFRESH used as a framework for dissemination in the final year of the Project.

1. Increase communication efforts of EU water research projects to reach distinct targeted audiences
Research funding organisations, as e.g. EC, should insist that their projects create a professional communication strategy targeting the necessary stakeholders for uptake of their results through:

- layman factsheets, which are entered into the WISE-RTD Water Knowledge Portal;
- tailored seminars to reach diverse stakeholders;
- stakeholder representation in the consortiums;
- the creation of thematic conferences where projects present their results; these conferences are organised by professional organisers and are advertised on a central website;
- promoting e-Learning courses and summer schools allowing the audience to better engage in the topic.

2. Improve accessibility to water research results and speed up their transfer
Relevant flexibility in resources planning with respect to dissemination activities should be allowed for dissemination also shortly after the project ends. The production of layman reports focusing on the results of the projects should be made obligatory. The use of online tools, which can present information on various projects at the same time and disseminate the research results as widely as possible, web platforms, e-learning, webinars and social media should be encouraged.

3.Strengthen the Water Science-Policy-Industry Interface to become results-oriented

Research projects should write, in a standardised - format, a policy statement for each reporting period to demonstrate how results are relevant for EU and national politicians. These policy briefs should be shared on a central website; WISE- RTD is ideal for this purpose. Thematic conferences of projects from the different EU funding schemes should involve the EC and EP units or committees and also local and regional policy makers and implementers. Thematic conferences with input from a number of projects are believed to be more attractive to participants from SMEs and industry than smaller conferences based around a single research project. Specific Water Science meets Policy and Industry events should be organised by the EC on a regular basis with specific focus on themes that will be of relevance for the policy implementation in the following years.

As a result of the discussions it was felt that a number of the WP7 dissemination deliverables should be delayed or reformulated to ensure maximum potential uptake of results. A better appreciation of the nature of the target stakeholders has emerged during this time. In particular more effort will be needed to reach those responsible for implementing River Basin Management Plans and Environmental Agencies in the member states as these are the key people who can ensure that management strategies for freshwater ecosystems account for the potential impacts of future global change. During the reporting period, in addition to attending these SPI events and discussing dissemination strategies UCL established a number of contacts with key individuals to act as nodal contacts to reach the target audience (many of whom may not speak English). During the final year of the project UCL will liaise closely with these individuals to deliver efficiently targeted and accessible dissemination of REFRESH and used.

Thus a priority will be to disseminate the outputs of REFRESH to RBMP managers. Resources will be focused on ensuring that REFRESH results reach the people responsible in the most effective way. Steps have already been taken in this direction. In France a colleague from ONEMA is translating WISER deliverables into French for French RBMPs and has indicated he would be willing to discuss a similar undertaking in REFRESH. Other key contacts have been made in Germany and the Netherlands to provide the foundations for national dissemination of REFRESH output and other contacts are being sought in other member states. This will be ongoing throughout the final year of the project. It is also planned to tap into the River basin Network run by the JRC and the strategic co-ordination group through contact with representatives from DGEnv.

Dissemination during the final reporting period

Dissemination activities in the final reporting period continued to be dynamic and responsive to stakeholder needs and recommendations. This necessitated reallocation of resources and greater focus in some areas. As a result several WP7 deliverables were cancelled to allow greater resources, effort and focus on what were viewed by the project and stakeholders consulted to be more useful dissemination activities.

The main focus of the final reporting period was to ensure REFRESH research output was disseminated in a targeted way to the appropriate stakeholders. A key element of this was that the dissemination effort would be addressed directly to these stakeholders (stakeholder workshops, face to face meetings and targeted policy briefs) and designed in such a way that the key messages were presented in a succinct, accessible way to maximise potential uptake. This was achieved across a number of dissemination tasks.

Task 1

The Web site was continually updated with news from REFRESH. Stakeholder meetings in key case study catchment were summarised with links to reports and publicity fliers. Details about project meetings and the activities of other freshwater projects (e.g. WISER and BioFresh) were provided. Reports from the REFRESH regional stakeholder meetings in the UL, Norway, Estonia and Turkey were added along with an account of the joint REFRESH / BioFresh Science Policy Symposium in Brussels. Links to presentations and video footage from the meetings were included. The results section of the Web was expanded to highlight the key messages from the project with links to more detailed output. A separate section on Policy Briefs from REFRESH was added to the main menu as part of the REFRESH commitment to disseminate output to stakeholders as well as the scientific community. This has been achieved both at the local level (in REFRESH case study catchments) and at the pan-European level (e.g. Joint Science / Policy symposium).

Three REFRESH newsletters were produced in the final reporting period and circulated widely via the REFRESH Stakeholder Database and the networks of contacts of REREFRESH scientists all over Europe. The Newsletter is also publicly accessible on the REFRESH web site. The first of these provided a general introduction to the REFRESH work programme highlighting the experimental work and the modelling case studies. The second focused on the outputs of the four regional stakeholder meetings in Norway, Estonia, UK and Turkey. The final newsletter showcased work undertaken at each of the modelling / cost-effectiveness case studies. In the case of the Thame study, this was supplemented by a leaflet providing more detail of the stakeholder activities undertaken in this sub-catchment of the Thames. This was circulated locally but also held up as an example of the successful stakeholder engagement underpinning REFRESH work in the case study catchments

Task 2
In the final reporting period five regional stakeholder meetings were held in Estonia (two meetings), UK, Turkey and Norway. A report from each of these (Deliverables 7.7-7.10) in additional to one in Australia organised by Griffith University. A summary of each of the European meetings was included on the REFRESH web site with links to the presentations and to video footage (for the UK and Turkish meetings) of these.

The final reporting period saw continuing development of the Climate-and-freshwater.info web site. This now includes case studies from REFRESH as well as a section on restoration practices and guidelines, particularly in the context of global change.

Task 3
The modelling and cost-effectiveness/disproportionality analyses undertaken at each of six REFRESH case study sites were synthesised and presented as a Deliverable for each catchment. These syntheses have been added to the Project Web site.

Task 4
In partnership with the EU FP7 project BioFresh, REFRESH organised a Science Policy Symposium for Freshwater Life with the aim of bringing together policy makers and stakeholders from the water, energy and conservation sector, NGOs, the scientific community and selected experts to discuss challenges in implementation of the 2020 Biodiversity strategy and the EU Water Framework Directive and to agree on recommendations for policy making and future research. The scientific advances of BIOFRESH and REFRESH were presented (along with those of a number of other FP7 projects), and the implications of these for the freshwater management in the EU were discussed with the aim of highlighting clear recommendations for

policy making. The Symposium sought to support the implementation of the Biodiversity Strategy 2020 and the EU Water Framework Directive (and its potential revision) and to create synergies across them building on the best recent knowledge on the current and future status of freshwater ecosystems and their inherent biodiversity. REFRESH has increased understanding of freshwater ecosystem response to climate and land use change and develops tools to support adaptive management.

BIOFRESH delivered policy relevant data and results on the current status, trends, pressures and conservation priorities of freshwater biodiversity.

The symposium aligned key research findings with the needs of policy making and generate policy-relevant messages relating to:

- Conservation planning and management of freshwater biodiversity in the context of Green Infrastructure and Natura 2000.
- Future protected area networks considering environmental scenarios and policy targets
- Freshwater biodiversity data and information to contribute to recent activities in ecosystem assessments by JRC, EEA and the European Commission
- Achievements of WFD good ecological status under climate and land use change scenarios
- Interlinkages between biodiversity, water related policies and other policy sectors (e.g. energy, agriculture and cohesion) to infer recommendations on synergies for their implementation.

A series of policy briefs were produced toeards the end of the project highlighting some of the policy and management implications of REFRESH output. These focused on;
i) Zooplankton-an integrative Biological Quality Element for assessing the Ecological Status of lakes
ii) Riparian Forest can help mitigate climate warming effects in lowland temperate streams
iii) Stricter nutrient loading limits help lake ecosystems to withstand climate change pressures
iv) Stronger need for maintaining environmental flow in streams in a changing climate

Although the project is finished, many scientific papers are in various stages of completion and results will continue to be published in future years. In addition, the project will continue to be represented at scientific conferences and stakeholder events.

Section A (public)

	TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Beneficiary	Main author	Title of the periodical or the series	Journal issue	Publisher	Place of publication	Year of publication	Pages	Permanent identifiers[1] (if available)	Is/Will open access[2] provided to this publication ?
1	Windows of change: temporal scale of analysis is decisive to detect ecosystem responses to climate change	FVB	Adrian, R.	Marine Biology	159	Springer-Verlag		2012	2533-2542	http://dx.doi.org/10.1007/s00227-012-1938-1	
2	Biogenic methane contributes to the food web of a large, shallow lake	EMU	Agasild, H.	Freshwater Biology	59	John Wiley & Sons Ltd		2014	272–285	http://dx.doi.org/10.1111/fwb.12263	
3	Revealing a conservation challenge through partitioned long-term beta diversity: increasing turnover and decreasing nestedness of boreal lake metacommunities	SLU	Angeler, D.G.	Diversity and Distributions	19	Wiley		2013	772–781	http://dx.doi.org/10.1111/ddi.12029	no
4	Temporal scales and patterns of invertebrate biodiversity dynamics in boreal lakes recovering from acidification	SLU	Angeler, D.G.	Ecological Applications	22	Ecological Society of America		2012	1172 - 1186	http://dx.doi.org/10.1890/11-1474.1	no
5	Insight on Invasions and Resilience Derived from Spatiotemporal Discontinuities of Biomass at Local and Regional Scales	SLU	Angeler, D.G.	Ecology & Society	17	Resilience Alliance		2012	32	http://dx.doi.org/10.5751/ES-04928-170232	yes

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6	Revealing the organization of complex adaptive systems through multivariate time series modeling	SLU	Angeler, D.G.	Ecology & Society	16	Resilience Alliance	USA	2011	5	http://dx.doi.org/10.5751/ES-04175-160305	yes
7	Patterns of temporal community turnover are spatially synchronous across boreal lakes	SLU	Angeler, D.G.	Freshwater Biology	57	John Wiley & Sons Ltd		2012	1782–1793	http://dx.doi.org/10.1111/j.1365-2427.2012.02838.x	no
8	Algal invasions, blooms and biodiversity in lakes: Accounting for habitat-specific responses	SLU	Angeler, D.G.	Harmful Algae	23	Elsevier		2013	60 - 69	http://www.sciencedirect.com/science/article/pii/S1568988313000140	no
9	Measuring the relative resilience of subarctic lakes to global change: redundancies of functions within and across temporal scales	SLU	Angeler, D.G.	Journal of Applied Ecology	50	John Wiley & Sons Ltd		2013	572–584	http://dx.doi.org/10.1111/1365-2664.12092	no
10	Tracing alpha, beta, and gamma diversity responses to environmental change in boreal lakes	SLU	Angeler, D.G.	Oecologia	172	Springer	Berlin-Heidelberg	2013	1191-1202	http://dx.doi.org/10.1007/s00442-012-2554-y	no
11	Stream characteristics and their implications for the protection of riparian fens and meadows	AU	Baattrup-Pedersen,A.	Freshwater Biology	56	John Wiley & Sons Ltd		2011	1893 - 1903	http://dx.doi.org/10.1111/j.1365-2427.2011.02606.x	

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38	Groundwater nitrogen and the distribution of groundwater-dependent vegetation in riparian areas in agricultural catchments	AU	Battrup-Pedersen A	Ecological Engineering		Elsevier	Netherlands	2013		http://dx.doi.org/10.1016/j.ecoleng.2013.07.047	
39	Effects of stream flooding on the distribution and biodiversity of groundwater-dependent vegetation in riparian areas	AU	Battrup-Pedersen A	Freshwater Biology	58	John Wiley & Sons	USA	2013	pp. 817-827	http://dx.doi.org/10.1111/fwb.12088	
40	Catchment characteristics and plant recruitment from sediment in stream and meadow habitats	AU	Battrup-Pedersen A	River Research and applications	29	John Wiley & Sons	USA	2013	pp. 855-863	http://dx.doi.org/10.1002/rra.2573	
41	Species recruitment following flooding, sediment deposition and seed addition in restored riparian areas	AU	Battrup-Pedersen A	Restoration Ecology	21	John Wiley & Sons	UK	2013	pp. 399-408	http://dx.doi.org/10.1111/j.1526-100X.2012.00893.x	
42	Predictive modelling of protected habitats in riparian areas from catchment characteristics	AU	Battrup-Pedersen A	Ecological Indicators	18	Elsevier	Netherlands	2012	pp. 227-235	http://www.sciencedirect.com/science/article/pii/S1470160X11003773	
	Shallow lakes and resilience: Conservative patterns revealed through a multinational, synchronized mesocosm experiment	SLU	Baho, D.L.							Submitted	

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12	Combining limnological and palaeolimnological data to disentangle the effects of nutrient pollution and climate change on lake ecosystems: problems and potential	UCL	Battarbee, R.W.	Freshwater Biology	57	John Wiley & Sons Ltd		2012	2091–2106	http://dx.doi.org/10.1111/j.1365-2427.2012.02860.x	
13	Eutrophication and Restoration of Shallow Lakes from a Cold Temperate to a Warm Mediterranean and a (Sub)Tropical Climate	METU/AU	Beklioğlu, M.	Eutrophication: causes, consequences and control	n/a	Springer Netherlands		2011	91-108	http://dx.doi.org/10.1007/978-90-481-9625-8_4	Yes
	Influences of climate and nutrient enrichment on the ecology of Mediterranean shallow lakes: a space-for-time-substitute approach using both latitudinal and altitudinal gradients.	METU	Beklioğlu, M.						Submitted		
14	Hydrological extremes modulate nutrient dynamics in Mediterranean climate streams across different spatial scales	CSIC	Bernal, S.	Hydrobiologia	719	Springer Netherlands		2012	31-42	http://hdl.handle.net/10261/56461	
15	In-stream net uptake regulates inorganic nitrogen export from catchments under base flow conditions	CSIC	Bernal, S.	Journal of Geophysical Research	117	John Wiley & Sons Ltd		2012	G00N05, pp10	http://dx.doi.org/10.1029/2012JG001985	

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16	Impacts of salinity and fish-exuded kairomone on the survival and macromolecular profile of Daphnia pulex	METU	Bezirci,G.	Ecotoxicology	21	Springer		2012	601-614	http://dx.doi.org/10.1007/s10646-011-0820-0	
17	'Diatoms and pH reconstruction' (1990) revisited	UCL	Birks, H.J.B	Journal of Paleolimnology	49	Springer Netherlands		2013	363-371	http://dx.doi.org/10.1007/s10933-013-9697-7	
18	Climate-driven changes in water level: a decadal scale multi-proxy study recording the 8.2-ka event and ecosystem responses in Lake Sarup (Denmark)	AU	Bjerring, R.	Journal of Paleolimnology	49	Springer Netherlands		2013	267-285	http://dx.doi.org/10.1007/s10933-012-9673-7	Yes
19	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?	AU	Boll, T.	Hydrobiologia	679	Springer Netherlands		2012	175-186	http://dx.doi.org/10.1007/s10750-011-0867-1	Yes
	Fish community assemblages and diversity in Turkish lakes – role of temperature, altitude, and salinity.	METU	Boll, T.							Submitted	

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20	Short-and long term niche segregation and individual specialization of brown trout (Salmo trutta) in species poor Faroese lakes	AU	Brodersen, J.	Environmental Biology of Fishes	93	Springer Netherlands		2012	305-318	http://dx.doi.org/10.1007/s10641-011-9914-z	
21	Fish diversity in European lakes: geographical factors dominate over anthropogenic pressures	AU	Brucet, S.	Freshwater Biology	58	John Wiley & Sons Ltd		2013	1779–1793	http://dx.doi.org/10.1111/fwb.12167	Yes
22	Effects of Temperature, Salinity and Fish in Structuring the Macroinvertebrate Community in Shallow Lakes: Implications for Effects of Climate Change	AU	Brucet, S.	Plos One	7	Plos One		2012	e30877EP	http://dx.doi.org/10.1371%2Fjournal.pone.0030877	Yes
	Climate, productivity and trophic cascade effects on the size diversity of aquatic assemblages in shallow Mediterranean lakes	AU	Brucet, S.							Submitted	
23	The influence of water level on macrophyte growth and trophic interactions in eutrophic Mediterranean shallow lakes: a mesocosm experiment with and without fish	METU	Bucak, T.	Freshwater Biology	57	John Wiley & Sons Ltd		2012	1631–1642	http://dx.doi.org/10.1111/j.1365-2427.2012.02825.x	

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24	Rapid Ecological Shift Following Piscivorous Fish Introduction to Increasingly Eutrophic and Warmer Lake Furnas (Azores Archipelago, Portugal): A Paleoecological Approach	CSIC	Buchaca, T.	Ecosystems	14	Springer		2011	458-477	http://dx.doi.org/10.1007/s10021-011-9423-0	Yes
25	Modelling nitrogen and phosphorus loads in a Mediterranean river catchment (La Tordera, NE Spain)	CSIC	Caille, F.	Hydrology and Earth System Sciences Discussions	8	EGU Journals		2011	7555–7594	http://www.hydrol-earth-syst-sci-discuss.net/8/7555/2011/	
26	Salinity inference in inland Turkish shallow lakes based on paleoecology using sub-fossil cladocerans	METU	Çakiroğlu, A.I.	Department of Biology	PhD Thesis	Middle East Technical University	Ankara, Turkey	2013	p.160		
	Relatedness between contemporary and surface sediment sub-fossil cladocera assemblages in Turkish shallow lakes	METU	Çakiroğlu, A.I.							Submitted	
27	Restoration of a subtropical eutrophic shallow lake in China: effects on nutrient concentrations and biological communities	AU	Chen, F.	Hydrobiologia	718	Springer Netherlands		2013	59-71	http://dx.doi.org/10.1007/s10750-013-1603-9	Yes

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	The response of two submerged macrophyte and periphyton to elevated temperature at high nutrient level: a microcosm approach	AU	Cao, Y.							Submitted	
	Temperature effects on periphyton and epipelon in low-nutrient shallow freshwater lakes: a mesocosm study	AU	Cao, Y.							Submitted	
28	A trait-based approach to assess the vulnerability of European aquatic insects to climate change	CNRS-EDB	Conti, L.	Hydrobiologia	721	Springer Netherlands		2013	297-315	http://dx.doi.org/10.1007/s10750-013-1690-7	
29	Modelling phosphorus loading and algal blooms in a Nordic agricultural catchment-lake system under changing land-use and climate	NIVA	Couture, R-M.	Environ. Sci.: Processes Impacts		Royal Society of Chemistry		2014	p.12C3EM00630A	http://dx.doi.org/10.1039/	Yes
30	Dynamic carbon budget of a large shallow lake assessed by a mass balance approach	EMU	Cremona, F.	Hydrobiologia	n/a	Springer Netherlands		2013	1-15	http://dx.doi.org/10.1007/s10750-013-1686-3	
	From bacteria to fish: a dynamic ecosystem approach for assessing whole-lake and component-specific metabolism	EMU	Cremona, F.	Aquatic Sciences						Submitted	

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31	The interactive responses of water quality and hydrology to changes in multiple stressors, and implications for the long-term effective management of phosphorus	UREAD	Crossman, J.	Science of the Total Environment	454–455	Elsevier	The Netherlands	2013	230 - 244	http://www.sciencedirect.com/science/article/pii/S0048969713002155	Yes
32	The role of cladocerans in tracking long-term change in shallow lake trophic status	AU	Davidson,T.	Hydrobiologia	676	Springer Netherlands	The Netherlands	2011	299-315	http://dx.doi.org/10.1007/s10750-011-0851-9	Yes
33	Inferring a single variable from an assemblage with multiple controls: getting into deep water with cladoceran lake-depth transfer functions	AU	Davidson,T.	Hydrobiologia	676	Springer Netherlands	The Netherlands	2011	129-142	http://dx.doi.org/10.1007/s10750-011-0901-3	Yes
34	The role of palaeolimnology in assessing eutrophication and its impact on lakes	AU	Davidson,T.	Journal of Paleolimnology	49	Springer Netherlands	The Netherlands	2013	391-410	http://dx.doi.org/10.1007/s10933-012-9651-0	
35	Plankton dynamics under different climatic conditions in space and time	AU	De Senerpont, L.	Freshwater Biology	58	John Wiley & Sons Ltd		2013	463–482	http://dx.doi.org/10.1111/fwb.12053	Yes

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	Macrophyte and periphyton carbon subsidies to bacterioplankton and zooplankton in a shallow, eutrophic lake in tropical China	AU	De Kluiver, A.							Submitted	
36	Nutrients exert a stronger control than climate on recent diatom communities in Esthwaite Water: evidence from monitoring and palaeolimnological records	UCL	Dong, X.	Freshwater Biology	57	John Wiley & Sons Ltd		2012	2044–2056	http://dx.doi.org/10.1111/j.1365-2427.2011.02670.x	
2	Environmental temperature is the dominant predictor of the size structure of European lake fish assemblages	AU	Emmrich, M.	Journal of Biogeography	In press	John Wiley & Sons	UK	2014	In press		Yes
37	Calibration of the INCA-N Model in the Pyhäjoki and Yläneenjoki Catchments in Finland. Paper Number:1008920	SYKE	Etheridge, J.R.	2010 ASABE Annual International Meeting	n/a	IWA Publishing	Pittsburgh, Pennsylvania	2010		http://dx.doi.org/10.13031/2013.29757	
38	Technical Note: Alternative in-stream denitrification equation for the INCA-N model	SYKE	Etheridge, J.R.	Hydrology and Earth System Sciences Discussions	10	EGU Journals		2013	14557–14569	http://www.hydrol-earth-syst-sci-discuss.net/10/14557/2013	Yes

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39	Reducing uncertainty in the calibration and validation of the INCA-N model by using soft data	SYKE	Etheridge, J.R.	Hydrology Research	45.1	IWA Publishing		2014	73-88	http://dx.doi.org/10.2166/nh.2013.039	No
40	Soil erosion and phosphorus losses under variable land use as simulated by the INCA-P model	NIVA	Farkas, C.	Soil Use and Management	29	John Wiley & Sons Ltd	UK	2013	124–137	http://dx.doi.org/10.1111/j.1475-2743.2012.00430.x	
41	PERSiST: a flexible rainfall-runoff modelling toolkit for use with the INCA family of models	SLU	Futter, M.N.	Hydrology and Earth System Sciences	18	Copernicus Publishing	Germany	2014	855–873	http://www.hydrol-earth-syst-sci.net/18/855/2014/	Yes
42	Fish community assemblages changed but biomass remained similar after lake restoration by biomanipulation in a Chinese tropical eutrophic lake	AU	Gao, J.	Hydrobiologia	724	Springer Netherlands	The Netherlands	2014	127-140	http://dx.doi.org/10.1007/s10750-013-1729-9	Yes
	A comparative study of food webs in macrophyte- and phytoplankton - dominated basins of a shallow eutrophic tropical lake in China.	AU	Gao, J.							Submitted	
43	Effects of climate-induced increases in summer drought on riparian plant species: a meta-analysis	UU-BIO	Garssen, A.	Freshwater Biology	In press	John Wiley & Sons Ltd		2014	In press	http://dx.doi.org/10.1111/fwb.12328	Yes

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43	Meta-analysis Shows a Consistent and Strong Latitudinal Pattern in Fish Omnivory Across Ecosystems	AU	González-Bergonzoni, I.	Ecosystems	15	Springer	The Netherlands	2012	492-503	http://dx.doi.org/10.1007/s10021-012-9524-4	
	Fish determine trophic web architecture and macroinvertebrate assemblage structure in arctic streams of Greenland.	AU	González-Bergonzoni, I.							Submitted	
	Higher ambient temperature drives greater herbivory by omnivorous fish in a subtropical stream.	AU	González-Bergonzoni, I.							Submitted	
44	Analysis of the reproductive strategy of Jenynsia multidentata (*Cyprinodontiformes, Anablepidae*) with focus on sexual differences in growth, size, and abundance	AU	Goyenola, G.	Hydrobiologia	673	Springer	The Netherlands	2011	245-257	http://dx.doi.org/10.1007/s10750-011-0784-3	Yes
	Temperature effects on body size of freshwater crustacean zooplankton from Greenland to the tropics	AU	Havens, K.E.							Submitted	

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45	High predation is of key importance for dominance of small-bodied zooplankton in warm shallow lakes: evidence from lakes, fish exclosures and surface sediments	AU	Iglesias, C.	Hydrobiologia	667	Springer	The Netherlands	2011	133-147	http://dx.doi.org/10.1007/s10750-011-0645-0	Yes
	Food webs are more truncated in subtropical than temperate shallow lakes: Implications of fish omnivory in warm lakes.	AU	Iglesias, C.							Submitted	
46	Chapter 6 - Biomanipulation as a Restoration Tool to Combat Eutrophication: Recent Advances and Future Challenges	AU	Jeppesen, E.	Advances in Ecological Research	47	Academic Press		2012	411 - 488	http://www.sciencedirect.com/science/article/pii/B9780123983152000065	
47	Recent climate induced changes in freshwaters in Denmark	AU	Jeppesen, E.	Global impacts of climate change on inland waters		John Wiley & Sons Ltd	UK	2012	155-172	ISBN: 978-1-119-96866-5	Yes
48	Climate change effects on nitrogen loading from cultivated catchments in Europe: implications for nitrogen retention, ecological state of lakes and adaptation	AU	Jeppesen, E.	Hydrobiologia	663	Springer Netherlands		2011	1-21	http://dx.doi.org/10.1007/s10750-010-0547-6	Yes

	TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Beneficiary	Main author	Title of the periodical or the series	Journal issue	Publisher	Place of publication	Year of publication	Pages	Permanent identifiers[1] (if available)	Is/Will open access[2] provided to this publication ?
49	Impacts of climate warming on the long-term dynamics of key fish species in 24 European lakes	AU	Jeppesen, E.	Hydrobiologia	694	Springer Netherlands		2012	1-39	http://dx.doi.org/10.1007/s10750-012-1182-1	Yes
50	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)	AU	Jeppesen, E.	Hydrobiologia	676	Springer Netherlands		2011	1-19	http://dx.doi.org/10.1007/s10750-011-0831-0	Yes
51	Climate change impacts on lakes: an integrated ecological perspective based on a multi-faceted approach, with special focus on shallow lakes	AU	Jeppesen, E.	Journal of Limnology	In press	PAGEPress	Pavia	2014	In press		Yes
	Substantial changes in annual and seasonal efflux of CO2 from shallow lakes when shifting from turbid to clear: the role of fish, zebra mussels and macrophytes.	AU	Jeppesen, E.							Submitted	

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	Ecological impacts of global warming and water abstraction on lakes and reservoirs due to changes in water level and salinity	AU	Jeppesen, E.							Submitted	
52	Modelling the impacts of climate change on flow and nitrate in the River Thames: assessing potential adaptation strategies	UREAD	Jin, L.	Hydrology Research	43	IWA Publishing		2012	902-916	http://dx.doi.org/10.2166/nh.2011.080	
53	Tracing recovery under changing climate: response of phytoplankton and invertebrate assemblages to decreased acidification	SLU	Johnson, R.	Journal of the North American Benthological Society	29	BioOne		2010	1472 - 1490	http://dx.doi.org/10.1899/09-171.1	no
54	The contribution of lateral aquatic habitats to insect diversity along river corridors in the Alps	FVB	Karaus, U.	Landscape Ecology		Springer Netherlands		2013	1-13	http://dx.doi.org/10.1007/s10980-013-9918-5	
55	An elevation-based regional model for interpolating sulphur and nitrogen deposition	BCAS	Kopáček, J.	Atmospheric Environment	50	Elsevier		2012	287 - 296	http://www.sciencedirect.com/science/article/pii/S1352231011012696	
56	Quantifying nitrogen leaching from diffuse agricultural and forest sources in a large heterogeneous catchment	BCAS	Kopáček, J.	Biogeochemistry	115	Springer		2013	149-165	http://dx.doi.org/10.1007/s10533-013-9825-5	Yes

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57	Factors Controlling the Export of Nitrogen from Agricultural Land in a Large Central European Catchment during 1900–2010	BCAS	Kopáček, J.	Environmental Science & Technology	47	ACS Publications	Washington	2013	6400 - 6407	http://dx.doi.org/10.1021/es400181m	Yes
58	Warmer climates boost cyanobacterial dominance in shallow lakes	AU	Kosten, S.	Global Change Biology	18	John Wiley & Sons Ltd		2012	118–126	http://dx.doi.org/10.1111/j.1365-2486.2011.02488.x	Yes
59	Response of littoral macrophytes to water level fluctuations in a storage reservoir	BCAS	Krolová, M.	Knowledge and Management of Aquatic Ecosystems		EDP Sciences		2013	pp21	http://dx.doi.org/10.1051/kmae/2013042	Yes
60	Depth limit of littoral vegetation in a storage reservoir: A case study of Lipno Reservoir (Czech Republic)	BCAS	Krolová, M.	Limnologica - Ecology and Management of Inland Waters	42	Elsevier		2012	165 - 174	http://www.sciencedirect.com/science/article/pii/S0075951111000582	
61	Productivity and nutrient retention of lakes on seasonal, interannual and morphometric scales	EMU	Laas, A.	Eesti Maaülikool (EMU)	PhD Thesis	Estonian University of Life Sciences	Tartu	2012	148	ISBN: 978-9949-484-46-1	
62	High-frequency metabolism study in a large and shallow temperate lake reveals seasonal switching between net autotrophy and net heterotrophy	EMU	Laas, A.	Hydrobiologia	694	Springer Netherlands		2012	57-74	http://dx.doi.org/10.1007/s10750-012-1131-z	

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	Climate change effects on shallow lakes: Design and preliminary results of a cross-European climate gradient mesocosm experiment.	FVB	Landkildehus, F.							Submitted	
63	Anthropogenic modification disrupts species co-occurrence in stream invertebrates	FVB	Larsen, S.	Global Change Biology	20	John Wiley & Sons Ltd		2013	51-60	http://dx.doi.org/10.1111/gcb.12355	
	The importance of environmental variables to submerged macrophyte community assemblage and coverage in shallow lakes: differences between northern and southern Europe.	AU	Lauridsen, T.L.							Submitted	
64	Monitoring of spatial water quality in lakes by remote sensing and transect measurements	SYKE	Lepistö, A.	Aquatic Ecosystem Health & Management	13	Taylor & Francis Online		2010	176-184	http://tandfprod.literatumonline.com/doi/abs/10.1080/14634981003796295	no
65	Almost 50 years of monitoring shows that climate, not forestry, controls long-term organic carbon fluxes in a large boreal watershed	SYKE	Lepistö, A.	Global Change Biology	20	John Wiley & Sons Ltd		2013	1225-1237	http://dx.doi.org/10.1111/gcb.12491	no

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66	Increasing organic C and N fluxes from a northern boreal river basin to the sea	SYKE	Lepistö, A.	Water Quality: Current Trends and Expected Climate Change Impacts	348	IAHS Publ.	Melbourne	2011	83-88	http://www3.villanova.edu/conferences/biogeomon/Talk%20pdfs/Session%201/1_Lepisto_Ahti.pdf	
67	Similarity between contemporary vegetation and plant remains in the surface sediment in Mediterranean lakes	METU	Levi, E.	Freshwater Biology	59	John Wiley & Sons Ltd		2014	724–736	http://dx.doi.org/10.1111/fwb.12299	Yes
68	Effects of warming and nutrients on sediment community respiration in shallow lakes: an outdoor mesocosm experiment	AU	Liboriussen, L.	Freshwater Biology	56	John Wiley & Sons Ltd		2011	437–447	http://dx.doi.org/10.1111/j.1365-2427.2010.02510.x	Yes
	Does stocking of filter-feeding fish for production have cascading effects on zooplankton and the ecological state? A study of fourteen (sub) tropical Chinese reservoirs with contrasting nutrient levels.	AU	Lin, Q.							Submitted	
	uccesSful restoration of a tropical shallow eutrophic lake by biomanipulation: strong bottom-up but weak top-down effects recorded.	AU	Liu, Z.							Submitted	

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	Effects of water temperature on summer periphyton biomass in shallow lakes: a pan-European mesocosm experiment.	FVB	Mahdy, A.							Submitted	
69	Longitudinal variation of macroinvertebrate communities in a Mediterranean river subjected to multiple anthropogenic stressors	FVB	Manfrin, A.	International Review of Hydrobiology	98	John Wiley & Sons Ltd		2013	155–164	http://dx.doi.org/10.1002/iroh.201201605	
70	Economic prescriptions and policy applications in the implementation of the European Water Framework Directive	FVB	Martin-Ortega, J.	Environmental Science & Policy	24	Elsevier	The Netherlands	2012	83 - 91	http://www.sciencedirect.com/science/article/pii/S1462901112000767	
71	Cost-effectiveness analysis in the implementation of the Water Framework Directive: A comparative analysis of the United Kingdom and Spain	FVB	Martin-Ortega, J.	European Water	37	EWRA		2012	15-25	http://www.ewra.net/ew/pdf/EW_2012_37_02.pdf	
72	Environmental and Resource Costs Under Water Scarcity Conditions: An Estimation in the Context of the European Water Framework Directive	FVB	Martin-Ortega, J.	Water Resources Management	25	Springer Netherlands		2011	1615-1633	http://dx.doi.org/10.1007/s11269-010-9764-z	

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73	Does increased hydrochemical model complexity decrease robustness?	UREAD	Medici, C.	Journal of Hydrology	440–441	Elsevier	The Netherlands	2012	1-13	http://www.sciencedirect.com/science/article/pii/S0022169412002156	Yes
74	Environmental Warming in Shallow Lakes: A Review of Potential Changes in Community Structure as Evidenced from Space-for-Time Substitution Approaches	METU	Meerhoff, M.	Global Change in Multispecies Systems Part 1	46	Academic Press		2012	259 - 349	http://www.sciencedirect.com/science/article/pii/B9780123969927000046	Yes
75	Lower biodiversity of native fish but only marginally altered plankton biomass in tropical lakes hosting introduced piscivorous Cichla cf. ocellaris	AU	Menezes, R.F.	Biological Invasions	14	Springer Netherlands		2012	1353-1363	http://dx.doi.org/10.1007/s10530-011-0159-8	Yes
76	Variation in fish community structure, richness, and diversity in 56 Danish lakes with contrasting depth, size, and trophic state: does the method matter?	AU	Menezes, R.F.	Hydrobiologia	710	Springer Netherlands		2013	47-59	http://dx.doi.org/10.1007/s10750-012-1025-0	Yes
	Does eutrophication homogenize fish assemblages in Danish lakes?	AU	Menezes, R.F.							Submitted	

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77	Hydrological and water quality impact assessment of a Mediterranean limno-reservoir under climate change and land use management scenarios	AU	Molina-Navarro, E.	Journal of Hydrology	509	Elsevier		2014	354 - 366	http://www.sciencedirect.com/science/article/pii/S0022169413008779	Yes
78	Nitrogen, macrophytes, shallow lakes and nutrient limitation: resolution of a current controversy?	AU	Moss, B.	Hydrobiologia	710	Springer Netherlands		2013	3-21	http://dx.doi.org/10.1007/s10750-012-1033-0	Yes
79	Predicting the future state of freshwater lake ecosystems influenced by climate and land use changes	AU	Nielsen, A.	Department of Bioscience & Department of Agroecology	PhD Thesis	Aarhus University		2013	p. 109		
80	Daily net ecosystem production in lakes predicted from midday dissolved oxygen saturation: analysis of a five-year high frequency dataset from 24 mesocosms with contrasting trophic states and temperatures	AU	Nielsen, A.	Limnol. Oceanogr. Methods	11	ASLO		2013	202–212	http://dx.doi.org/10.4319/lom.2013.11.202	Yes
81	Assessing ways to combat eutrophication in a Chinese drinking water reservoir using SWAT	AU	Nielsen, A.	Marine and Freshwater Research	64	CSIRO Publishing	Australia	2013	475–492	http://dx.doi.org/10.1071/MF12106	Yes
9	Effects of changes in	AU	Nielsen, A.	Journal of	In press	John Wiley & Sons	UK	2014	In press		Yes

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	climate and nutrient loading on the water quality of shallow lakes assessed by ensemble PCLake model runs			Applied Ecology							
82	Spatial and annual variability of environmental and phytoplankton indicators in Lake Võrtsjärv: implications for water quality monitoring	EMU	Nõges, P.	Estonian Journal of Ecology	61	Estonian Academy Publishers		2012	227-246	http://www.kirj.ee/public/Ecology/2012/issue_4/ecol-2012-4-227-246.pdf	
83	Weak trends in ice phenology of Estonian large lakes despite significant warming trends	EMU	Nõges, P.	Hydrobiologia	n/a	Springer Netherlands		2013	1-14	http://dx.doi.org/10.1007/s10750-013-1572-z	
84	Morphometry and trophic state modify the thermal response of lakes to meteorological forcing	EMU	Nõges, P.	Hydrobiologia	667	Springer Netherlands		2011	241-254	http://dx.doi.org/10.1007/s10750-011-0691-7	
85	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	EMU	Nõges, P.	Hydrobiologia	667	Springer Netherlands		2011	255-270	http://dx.doi.org/10.1007/s10750-011-0649-9	

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86	Reconstructed long-term time series of phytoplankton primary production of a large shallow temperate lake: the basis to assess the carbon balance and its climate sensitivity	EMU	Nõges, T.	Hydrobiologia	667	Springer Netherlands		2011	205-222	http://dx.doi.org/10.1007/s10750-011-0647-y	
87	Review of published climate change adaptation and mitigation measures related with water	EMU	Nõges, T.	Publications Office of the European Union		Publications Office of the European Union	Luxembourg	2010	133	http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15801/1/lbna24682enc.pdf	
88	Climate change adaptation and mitigation strategies already in practice based on the 1st River Basin Management Plans of the EU Member States	EMU	Nõges, T.	Publications Office of the European Union		Publications Office of the European Union	Luxembourg	2010	127	http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15753/1/lbna24663enc.pdf	
89	Annex of the publication Review of published climate change adaptation and mitigation measures related with water	EMU	Nõges, T.	Publications Office of the European Union		European Commission		2010	n/a	http://dx.DOI.org/10.2788/13077	
	Effect of nitrogen loading, salinity, temperature and water level on the nitrogen retention capacity in lakes: an experimental approach.	AU	Olsen, S.							Submitted	

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90	Long-term effects of warming and nutrients on microbes and other plankton in mesocosms	METU	Özen, A.	Freshwater Biology	58	John Wiley & Sons Ltd	UK	2013	483–493	http://dx.doi.org/10.1111/j.1365-2427.2012.02824.x	Yes
	Water level and fish mediated cascading effects on microbial community in eutrophic warm shallow lakes: a mesocosm experiment	METU	Özen, A.							Submitted	
91	Contrasting roles of water chemistry, lake morphology, land-use, climate and spatial processes in driving phytoplankton richness in the Danish landscape	AU	Özkan, K.	Hydrobiologia	710	Springer	Netherlands	2013	173-187	http://dx.doi.org/10.1007/s10750-011-0996-6	
	Long-term trends and synchrony in lake plankton and abiotic characteristics driven by recovery from eutrophication and climate across 17 Danish Lakes.	METU	Özkan, K.							Submitted	
10	*Cross-taxon congruence in lake plankton largely independent of environmental gradients*	*AU*	*Özkkan, K.*	*Ecology*	*In press*	*Ecological Society of America*	*USA*	*2014*	*In press*		Yes
	Trophic interaction effects on size diversity in aquatic communities.	SYKE	Quintana, X.D.							Submitted	

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92	Controls on inorganic nitrogen leaching from Finnish catchments assessed using a sensitivity and uncertainty analysis of the INCA-N model	SYKE	Rankinen, K.	Boreal Environment Research	18	Boreal Environment Research Publishing Board	Helsinki, Finland	2013	373-386	http://www.borenv.net/BER/pdfs/ber18/ber18-373.pdf	Yes
	Size-dependent feeding of Nile tilapia (*Oreochromis niloticus*) in a macrophyte-dominated lake: implications for lake restoration and management.	AU	Rao, W.							Submitted	
93	The role of uncertainty in climate change adaptation strategies—A Danish water management example	AU	Refsgaard, J.C.	Mitigation and Adaptation Strategies for Global Change	18	Springer Netherlands		2013	337-359	http://dx.doi.org/10.1007/s11027-012-9366-6	Yes
	Bacterial diversity patterns along a pH gradient in freshwater lakes.	AU	Ren, L.							Submitted	
94	A trait based approach to assess climate change sensitivity of freshwater invertebrates across Swedish ecoregions	AU	Sandin, L.	Current Zoology	60	Current Zoology	Beijing	2014	n	http://www.actazool.org/paperdetail.asp?id=12325	Yes
95	Threshold-driven shifts in two copepod species: Testing ecological theory with observational data	FVB	Scharfenberger, U.	Limnol. Oceanogr	58	ASLO	USA	2013	741–752	http://www.aslo.org/lo/toc/vol_58/issue_2/0741.pdf	Yes

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96	Some Characteristics of the Vansjø-Hobøl (Morsa) Catchment	Bioforsk	Skarbøvik, E.	Bioforsk	n/a	Bioforsk		2010	44	http://www.vannportalen.no/Bioforsk_Report_5_128_2010_Morsa_Catchment_iL82w.pdf.file	
97	Using chlorophyll a and cyanobacteria in the ecological classification of lakes	AU	Søndergaard, M.	Ecological Indicators	11	Elsevier		2011	1403 - 1412	http://www.sciencedirect.com/science/article/pii/S1470160X11000550	
98	Lake Restoration	AU	Søndergaard, M.	Encyclopedia of Earth Sciences Series		Springer Netherlands		2012	455-458	http://dx.doi.org/10.1007/978-1-4020-4410-6_13	
99	Persistent internal phosphorus loading during summer in shallow eutrophic lakes	AU	Søndergaard, M.	Hydrobiologia	710	Springer Netherlands		2012	1-13	http://dx.doi.org/10.1007/s10750-012-1091-3	Yes
100	Winter ecology of shallow lakes: strongest effect of fish on water clarity at high nutrient levels	AU	Sørensen, T.	Hydrobiologia	664	Springer Netherlands		2011	147-162	http://dx.doi.org/10.1007/s10750-010-0595-y	
	Zooplankton response to climate warming: a mesocosm experiment at contrasting temperatures and eutrophication states.	AU	Šorf, M.							Submitted	
101	Bayesian uncertainty assessment of a semi-distributed integrated catchment model of phosphorus transport	NIVA	Starrfelt, J.	Environ. Sci.: Processes Impacts	Royal Society of Chemistry			2014	C3EM00619K p.10	http://dx.doi.org/10.1039/	Yes

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102	Effects of a long term water level reduction on the ecology and water quality in an eastern Mediterranean lake	PATRAS	Stefanidis, K.	Knowledge and Management of Aquatic Ecosystems	EDP Open			2013	pp14	http://dx.doi.org/10.1051/kmae/2013072	Yes
103	Zooplankton adaptation strategies against fish predation in Turkish shallow lakes	METU	Tavşanoğlu, N.	Department of Biology	PhD Thesis	Middle East Technical University	Ankara	2012	p. 181		
	Major latitude gradient changes in zooplankton size structure and diel movement in Anatolian shallow lakes influenced by risk of fish predation	METU	Tavşanoğlu, N.							Submitted	
104	Strengthening the link between climate, hydrological and species distribution modeling to assess the impacts of climate change on freshwater biodiversity	CNRS,	Tisseuil, C.	Science of the Total Environment	424	Elsevier	The Netherlands	2012	193 - 201	http://www.sciencedirect.com/science/article/pii/S0048969712002458	Yes
105	Dissolved organic matter and its ecological role in large and shallow water bodies	EMU	Toming, K.	Eesti Maaülikool (EMU)	PhD Thesis	Estonian University of Life Sciences	Tartu	2013	184		

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106	Contributions of autochthonous and allochthonous sources to dissolved organic matter in a large, shallow, eutrophic lake with a highly calcareous catchment	EMU	Toming, K.	Limnol. Oceanogr	58	ASLO		2013	1259–1270	http://dx.doi.org/10.4319/lo.2013.58.4.1259	no
107	Long-term changes of the underwater light field in large shallow lakes Peipsi and Võrtsjärv, North-East Europe	EMU	Toming, K.	Proceedings of the Estonian Academy of Sciences	62	Estonian Academy Publishers		2013	202–212	http://www.kirj.ee/public/proceedings_pdf/2013/issue_3/Proc-2013-3-202-212.pdf	yes
108	Effects of nutrient loading, temperature regime and grazing pressure on nutrient limitation of periphyton in experimental ponds	AU	Trochine, C.	Freshwater Biology	In press	John Wiley & Sons Ltd		2014	In press	http://dx.doi.org/10.1111/fwb.12314	Yes
109	Filamentous green algae inhibit phytoplankton with enhanced effects when lakes get warmer	AU	Trochine, C.	Freshwater Biology	56	John Wiley & Sons Ltd		2011	541–553	http://dx.doi.org/10.1111/j.1365-2427.2010.02521.x	
110	Advancing projections of phytoplankton responses to climate change through ensemble modelling	AU	Trolle, D.	Environmental Modelling & Software	In press	Elsevier		2014	1-9	http://www.sciencedirect.com/science/article/pii/S1364815214000541	Yes

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111	Predicting the effects of climate change on trophic status of three morphologically varying lakes: Implications for lake restoration and management	AU	Trolle, D.	Environmental Modelling & Software	26	Elsevier		2011	354 - 370	http://www.sciencedirect.com/science/article/pii/S1364815210002562	
112	A community-based framework for aquatic ecosystem models	AU	Trolle, D.	Hydrobiologia	683	Springer Netherlands		2012	25-34	http://dx.doi.org/10.1007/s10750-011-0957-0	yes
113	Planktonic ciliate community structure in shallow lakes of lowland Western Europe	AU	Van Wichelen, J.	European Journal of Protistology	49	Elsevier		2013	538 - 551	http://www.sciencedirect.com/science/article/pii/S0932473913000515	Yes
	Micro-evolutionary adaptation to the intra- and interspecific competitive environment in a natural zooplankton population.	SDLO	Vanoverbeke, J.							Submitted	
114	Mobility of lowland stream Trichoptera under experimental habitat and flow conditions	SDLO	Verdonschot, P.	Limnologica - Ecology and Management of Inland Waters	42	Elsevier		2012	227 - 234	http://www.sciencedirect.com/science/article/pii/S0075951112000047	
115	Application of the WFD cost proportionality principle to diffuse pollution mitigation: A case study for Scottish Lochs	JHI	Vinten, A.J.A.	Journal of Environmental Management	97	Elsevier		2012	28 - 37	http://www.sciencedirect.com/science/article/pii/S0301479711003963	

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116	Assessing lake typologies and indicator fish species for Italian natural lakes using past fish richness and assemblages	AU	Volta, P.	Hydrobiologia	671	Springer Netherlands		2011	227-240	http://dx.doi.org/10.1007/s10750-011-0720-6	Yes
117	The population biology and life history traits of Eurasian ruffe [Gymnocephalus cernuus (L.), Pisces: Percidae] introduced into eutrophic and oligotrophic lakes in Northern Italy	AU	Volta, P.	Journal of Limnology	72	PAGEPress	Pavia	2013	e22	http://dx.doi.org/10.4081/jlimnol.2013.e22	Yes
34	Introduction of non-native common bream (*Abramis brama*) led to a dominance of small individuals and associated deterioration in ecological state of a shallow Italian lake	AU	Volta, P.	Biological Invasions	15	Springer	Germany	2013	pp. 2065-2079	http://dx.doi.org/10.1007/s10530-013-0433-z	Yes
118	Consequences of changes in thermal regime for plankton diversity and trait composition in a polymictic lake: a matter of temporal scale	FVB	Wagner, C.	Freshwater Biology	56	John Wiley & Sons Ltd		2011	1949–1961	http://dx.doi.org/10.1111/j.1365-2427.2011.02623.x	

	TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Beneficiary	Main author	Title of the periodical or the series	Journal issue	Publisher	Place of publication	Year of publication	Pages	Permanent identifiers[1] (if available)	Is/Will open access[2] provided to this publication ?
119	A cost-effectiveness analysis of water security and water quality: impacts of climate and land-use change on the River Thames system	UREAD	Whitehead, P.G.	Phil Trans R Soc	371	Royal Society Publishing		2013	1471-2962	http://dx.doi.org/10.1098/rsta.2012.0413	Yes
120	Macronutrient cycles and climate change: Key science areas and an international perspective	UREAD	Whitehead, P.G.	Science of the Total Environment	434	Elsevier		2012	13 - 17	http://www.sciencedirect.com/science/article/pii/S0048969711009156	
121	Evidence needed to manage freshwater ecosystems in a changing climate: Turning adaptation principles into practice	UREAD	Wilby, R.L.	Science of the Total Environment	408	Elsevier		2010	4150 - 4164	http://www.sciencedirect.com/science/article/pii/S0048969710004870	
122	Hyperresolution global land surface modeling: Meeting a grand challenge for monitoring Earth's terrestrial water	UREAD	Wood, E.	Water Resources Research	47	John Wiley & Sons Ltd		2011	W05301, 1-10	http://dx.doi.org/10.1029/2010WR010090	
123	Linking carbon and nitrogen metabolism to depth distribution of submersed macrophytes using high ammonium dosing tests and a lake survey	AU	Yuan, G.	Freshwater Biology	58	John Wiley & Sons Ltd		2013	2532–2540	http://dx.doi.org/10.1111/fwb.12230	Yes

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124	The effect of benthic algae on phosphorus exchange between sediment and overlying water in shallow lakes: a microcosm study using 32P as a tracer	AU	Zhang, X.	Hydrobiologia	710	Springer Netherlands		2013	109-116	http://dx.doi.org/10.1007/s10750-012-1134-9	Yes
125	Effects of deposit-feeding tubificid worms and filter-feeding bivalves on benthic-pelagic coupling: Implications for the restoration of eutrophic shallow lakes	AU	Zhang, X.	Water Research	50	Elsevier		2014	135 - 146	http://www.sciencedirect.com/science/article/pii/S0043135413010002	
126	Sediments, not plants, offer the preferred refuge for Daphnia against fish predation in Mediterranean shallow lakes: an experimental demonstration	METU/AU	*Tavsanoğlu, N.UY*	Freshwater Biology	57	John Wiley & Sons Ltd	UK	2012	795–802	http://dx.doi.org/10.1111/j.1365-2427.2012.02745.x	Yes
	Experimental comparison of periphyton removal by chironomid larvae and Daphnia magna		Mahdy et al.	Freshwater Science				2013		Submitted	
	Effects of water temperature on summer periphyton biomass in shallow lakes: a pan-European mesocosm experiment		Mahdy et al.					2014		In preparation	

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	Climate, productivity and trophic cascade effects on the size diversity of aquatic assemblages in shallow Mediterranean lakes.	*METU*	*Sandra Brucet*			*Wiley*		*2014*		*Submitted to Ecography*	
	Water level and fish mediated cascading effects on microbial community in eutrophic warm shallow lakes: a mesocosm experiment	*METU*	*Arda Özen*			*Springer*		*2014*		*Submitted to Hydrobiologia*	
	Size-based diel migration of zooplankton in Mediterranean shallow lakes assessed from in situ experiments with artificial plants	*METU*	*Üllkü Nihan Yazgan Tavşanoğlu*			*Springer*		*2014*		*Submitted to Hydrobiologia*	
	Relatedness between contemporary cladocera and surface sediment sub-fossil cladocera assemblages in turkish lakes	*METU*	*Ayşe İdil Çakıroğlu*			*Springer*		*2014*		*Submitted to Journal of Paleolimnology*	
	Climate change impacts on lakes: an integrated ecological perspective based on a multi-faceted approach, with special focus on shallow lakes	*AU, METU*	*Erik Jeppesen*			*Pagepress*		*2014*		*Journal of Limnology, in press*	

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	Effect of nitrogen and phosphorus loading, salinity, temperature and water level on the nitrogen retention capacity in lakes: an experimental approach	*AU, METU*	*Saara Olsen,*			*Wiley*		*2014*		*Submitted to Freshwater Biology*	
	Ecological impacts of global warming and water abstraction on lakes and reservoirs due to changes in water level and salinity	*AU, METU*	*Erik Jeppesen*			*Springer*		*2014*		*Submitted to Hydrobiologia*	
	Fish community assemblages and diversity in Turkish lakes – role of temperature, altitude, and salinity.	*METU*	*Thomas Boll*			*NRC Research Press*		*2014*		*Submitted to Canadian Journal of Fisheries and Aquatic Sciences*	
	Multiscale landscape pattern affecting on stream water quality in agricultural watershed, SW Finland.	*SYKE*	Conzales-Inca Carlos et al.	*Water resource management (submitted)*						Submitted in August 2013	
	Environmental factors influencing macrophytes assemblages in a middle-sized Mediterranean stream.	*University of Patras*	*Manolaki P. & E Papastergiadou*	*River Research*						*Submitted*	*yes*

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	Effects of spatiotemporal changes of land cover/ uses and climate variability in two Mediterranean lakes	*University of Patras*	*Stefanidis K et al.*	*Water Resources Management*						*Submitted*	*yes*
	An interdisciplinary modelling approach assessing the cost effectiveness of agri-environmental measures on reducing nutrient concentration to WFD thresholds under climate change: the case of the Louros catchment	*Universities of Patras, Oxford and Reading*	*Skuras, D.*	*Operational Research*		*Springer*	*Berlin, Germany*			*Paper accepted for publication 2014*	*No*
	Effects of climate-induced increases in summer drought on riparian plant species: a meta-analysis	*UU-BIO*	*Annemarie Garssen*	*Freshwater Biology*	*In press*	*Wiley*	*-*	*2014*	*t.b.a.*	*t.b.a.*	*Yes*
	Effects of an increase in winter flooding on riparian plant species: a meta-analysis	*UU-BIO*	*Annemarie Garssen*							*In prep*	
	Comparative study on riparian vegetation biodiversity and functioning along an European climatic gradient	*UU-BIO*	*Annemarie Garssen*							*In prep*	
	Effects of a climate-driven increase in winter flooding on species composition and dynamics of European riparian plant communities	*UU-BIO*	*Annemarie Garssen*							*In prep*	

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	Effects of climate-induced increases in winter flooding on riparian ecology and functioning	*UU-BIO*	*Merel Soons*							*In prep*	
	PhD thesis Annemarie Garssen	*UU-BIO*	*Annemarie Garssen*		*n.a.*	*Utrecht University*	*Utrecht, NL*	*2015*	*-*	*In prep*	*Yes*
2	*Catchment scale recovery from diffuse pollution: some initial scenario exploration.*	*JHI*	*Dunn, S.M.*	*Water Science and Technology. SUBM*							
3	*Modelling Total Phosphorus in the Loch of Skene, Dee catchment*	*JHI*	*Helliwell, R.,*							*In prep*	
4	*Modelling maximum river temperature and ecological response to land use and climate change in the Gairn catchment.*	*JHI*	*Helliwell, R.*							*In prep*	
5	*INCA-P model evaluation*	*JHI*	*Jackson-Blake*							*In prep*	

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES										
NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
1	UCL	Internal REFRESH workshop	Martin Kernan	REFRESH – WP2/4 Experimental Design Meeting	1-3 Feb 2011	Wageningen, Netherlands				2 & 4
2	UCL	REFRESH Project Meeting	Rick Battarbee, Helen Bennion, Martin Kernan	REFRESH Start up Project Meeting	22-16 Mar 2010	Antalya, Turkey				All
3	UCL	Conference on Integrated River Basin Management under the Water Framework Directive	Martin Kernan	WFD – Lille 2010	26-28 April 2010	Brussels, Belgium				7
4	UCL	Joint ASLO/NABS summer meeting	Martin Kernan	Aquatic Sciences: Global Changes from the Center to the Edge	6-11 June 2011	Santa Fe, USA				7
5	UCL	International Conference	Martin Kernan	2010 International Climate Change Adaptation Conference	29 June – 2 July 2010	Gold Coast, Australia				7
6	UCL	Science policy interface workshop	Martin Kernan	'Water Science meets Policy' Event'	20 Sept 2010	Brussels, Belgium				7
7	UCL	Internal REFRESH Workshop	Martin Kernan	REFRESH Scenarios workshop	10 Nov 2010	London, UK				1 & 5
8	UCL	International workshop	Martin Kernan	Future of Alpine Freshwaters	13-14 Dec 2011	Zurich, Switzerland				7
9	UCL	International workshop	Martin Kernan	Workshop on science and data gaps in EU water-related projects	12-15 Jan 2011	Riederalp, Switzerland				7
10	UCL	External REFRESH workshop	Rick Battarbee, Martin Kernan	REFRESH High level stakeholders meeting	16-17 Mar 2011	London, UK				1
11	UCL	REFRESH Project meeting	Rick Battarbee, Helen Bennion, Martin Kernan, Gavin Simpson, Simon Turner	2nd REFRESH Project Meeting	4-8 April 2011	Aberdeen, UK				All
12	UCL	EEA External Advisory Group Meeting	Martin Kernan	EEA 2012 State of water assessment	27-28 April 2011	Copenhagen, Denmark				7

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13	UCL	International Conference	Martin Kernan	AEHMS 10 The Aquatic Ecosystem Puzzle: Threats, Opportunities and Adaptation	13-15 June 2011	Siena, Italy				7
	UCL	Conference Aquatic Ecosystem Management and Health Society	Martin Kernan	Managing freshwater ecosystems and freshwater biodiversity under changing climate	17-21 June 2013	Victoria, Canada	Scientific Community, Government, Water managers	70	International	All
	UCL	Conference Aquatic Ecosystem Management and Health Society	Martin Kernan	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	17-21 June 2013	Victoria, Canada	Scientific Community, Government, Water managers	70	International	All
	UCL	Conference - SIL Congress	Martin Kernan	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems – a case study from Europe	5-9 August 2013	Budapest, Hungary	Scientific Community	45	International	All
	UCL	Stakeholder workshop "Lake management needs a professional approach and detailed planning"	Martin Kernan	REFRESH Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems Introduction and context	11 October 2013	Tallin, Estonia	Scientific Community, Water department of the Ministry of the Environment, Environmental Agency, environmental consultancy enterprises, fishery managers, universities and the public.	40	Estonia, Latvia, Finland	All

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	UCL	Science Symposium 'Freshwater management in a Changing World' -	Martin Kernan	REFRESH Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems Introduction and context	6 November 2013	London, UK	Scientific Community, policy implementers and practitioners	120	International	All
	UCL	Stakeholder workshop 'Freshwater management in a Changing World' -	Martin Kernan	REFRESH - rationale and context for stakeholder engagement	6 November 2013	London, UK	Scientific Community, policy implementers representatives across freshwater stakeholder community	70	International	All
	UCL	Stakeholder workshop	Martin Kernan	REFRESH Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems Working and communicating with stakeholders	2 December 2013	Ankara, Turkey	Scientific Community, government ministries, nature conservation bodies	55	Turkey	WP6, WP7
	UCL	Seminar	Martin Kernan	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems – the REFRESH project	16 January 2014	Johannesb-urg, South Africa	Scientific Community	40	South Africa	All

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	UCL	Science Policy Event - WaterLives : new scientific horizons for biodiversity and water policy	Martin Kernan	A Symposium for Freshwater Life to present the scientific advances of REFRESH and BIOFRESH and, to discuss their implications for freshwater management in the EU and to come up with clear recommendations for policy making.	29-30 January 2014	Brussels, Belgium	Policy makers and stakeholders from the water, energy and conservation sector, NGOs and the scientific community	110	International	All
	UCL	Video	Martin Kernan	Video footage of presentations given at the 'Freshwater Management in a Changing World' dissemination event	Posted on Youtube November 2013	London, UK	All	Unknown	International	All
	UCL	Video and podcast	Martin Kernan	Video from Science Policy Event - WaterLives : new scientific horizons for biodiversity and water policy	Available on WaterLives web site	Brussels, Belgium	All	Unknown	International	All
	UCL	Conference 'UCL Environment Institute Inaugural Annual Conference: Responding to Environmental Complexity – A showcase of UCL research'	Helen Bennion	Assessing degradation and recovery pathways in lakes impacted by eutrophication	17-18 June 2014	London, UK	Fellow academics	100	International	WP3

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14	AU	REFRESH Project Meeting	Erik Jeppesen, Martin Søndergaard, Esben Kristensen, Carl Christian Hoffman	REFRESH Start up Project Meeting	22-16 Mar 2010	Antalya, Turkey				All
15	AU	REFRESH Project meeting	Erik Jeppesen, Martin Søndergaard, Esben Kristensen, Carl Christian Hoffman	2nd REFRESH Project Meeting	4-8 April 2011	Aberdeen, UK	Scientific Comm.			All
16	AU	Internal REFRESH workshop	Esben Kristensen	REFRESH – WP2/4 Experimental Design Meeting	1-3 Feb 2011	Wageningen, Netherlands	Scientific Comm.		Internat.	2 & 4
17	AU	Conference	Jeppesen E.	IWA conference	13-17 June, 2011	Granada, Spain	Scientific Comm.	100	Internat.	WP3
18	AU	Conference	Jeppesen, E.	Shallow lakes Conference	24-29 April, 2011	Wuxi, China	Scientific Comm.	200	Internat.	WP3
19	AU	Conference	Søndergaard, M.	Shallow lakes Conference	24-29 April, 2011	Wuxi, China	Scientific Comm.	200	Internat.	WP3
20	AU	Conference	Jeppesen, E.	EU-China Yangtzee Conference	13 April, 2011	Yangtzee, China	Scientific Comm.	100	Internat.	WP3
21	AU	Conference	Jeppesen E.	AQUASHIFT conference	4-7 October, 2010	Kiel, Germany	Scientific Comm.	100	Internat.	WP3
22	AU	Conference	Jeppesen E.	EXPO2010	13-14 September, 2011	Shanghai, China	Scientific Comm.	300	Internat.	WP3
23	AU	Conference	Søndergaard M.	SIL 2010	15-20 August, 2010	Cape Town, South Africa	Scientific Comm.	100	Internat.	WP3
24	AU	Congress	Jeppesen E.	the XVth Congress of the Iberian Association of Limnology	5-9 July 2010	Azores,Portugal	Scientific Comm.	50	Internat.	WP3

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25	UREAD	International workshop	Dr A Wade, Dr M Shahgedanova, Prof R Skeffington, Prof P Whitehead	REFRESH Project start-up meeting	23/03/10-27/03/10	Antalya, Turkey				All
26	UREAD	Project workshop	Dr A Wade, Dr M Shahgedanova	Project workshop to design and agree on scenarios to be modelled	10/11/10	UCL, London				1
27	UREAD	Project workshop	Dr A Wade	Project workshop to design the 'REFRESH' model	30/01/2011-01/02/2011	Alterra, Wageningen, The Netherlands				2, 5
28	UREAD	International stakeholder workshop	Dr A Wade	REFRESH Cross-European Policy Workshop	16/03/2011-17/03/2011	London				5, 6
29	UREAD		Dr A Wade, Dr M Shahgedanova, Prof R Skeffington, Prof P Whitehead (Oxford), Dr C Medici (Valencia), Dr J Crossman (Oxford)	2nd REFRESH Project meeting	03/04/11-08/04/11	The James Hutton Institute, Aberdeen, UK				All
30	UREAD	Project workshop	Dr A Wade, Prof R Skeffington, Prof M Acreman (CEH)	Project workshop to further the design the 'REFRESH' model and extend its scope	11/05/11-12/05/11	University of Utrecht, The Netherlands				4, 5

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31	SYKE	Project meeting	Ahti Lepistö, Marko Järvinen, Katri Rankinen, Randall Etheridge, Riku Varjopuro, Olga Mashkina	REFRESH 1st project meeting	22-25.3. 2010	Antalya, Turkey				MGT WP3 WP5 WP5 WP6 WP6
32	SYKE	National meeting and workshop with stakeholders	Entire SYKE project group, and Teija Kirkkala/Anne-Mari Ventelä from Pyhäjärvi Institute	REFRESH national workshop	2.11.2010	Helsinki, Finland				WP3, WP5 and WP6
33	SYKE	National meeting	Ahti Lepistö	9. National meeting for Ecosystem Modellers	3.2.2011	Lahti, Finland				WP5
34	SYKE	Project meeting	Ahti Lepistö, Marko Järvinen, Olli Malve, Katri Rankinen, Riku Varjopuro, Riina Pelkonen	REFRESH 2nd project meeting	3-8.4. 2011	Aberdeen, Scotland				WP5 WP3 WP3 WP5 WP6 WP6
35	SYKE	Workshop	Ahti Lepistö and other staff from SYKE /VMA unit, Pirkko Kortelainen SYKE/LK Martyn Futter, SLU Sweden	C miniworkshop	20-21.4. 2011	Helsinki				WP5
36	SYKE	International conference	Ahti Lepistö	IAHS symposium H04 held during IUGG2011 in Melbourne, Australia	4-7.7 2011	Melbourne, Australia				WP7 (not financed by REFRESH)

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37	UDE	REFRESH project meeting	Daniel Hering, Armin Lorenz, Yaron Hershkovitz	REFRESH start up meeting	04/04/2011	Aberdeen, Scotland				2,3,4,5
38	UDE	REFRESH workshop	Armin Lorenz	REFRESH – WP2/4 Experimental Design Meeting	01/09 – 03/09/2011	Wageningen, Netherlands				2,4
39	UDE	meeting	Daniel Hering	REFRESH second project meeting	22/03 – 26/03/2011	Antalya, Turkey				2,3,4,5
40	Alterra	project workshop	P. Verdonschot A. Besse	WP2 and WP4 REFRESH experimental set up meeting	1-3 February 2010	Wageningen, the Netherlands				2,4
41	Alterra	project meeting	P. Verdonschot A. Besse	REFRESH project kick-off meeting	22-26 March 2010	Antalya, Turkey				all WP's
42	Alterra	project training workshop	P. Verdonschot A. Besse A. van Oosten	Training workshop WP 2 and WP4 REFRESH	1-2 September 2010	Wageningen, the Netherlands				2,4
43	Alterra	modelling workshop	P. Verdonschot A. Besse	Conceptual modelling of rivers	31 January – 1 February 2011	Wageningen, the Netherlands				2,5
44	Alterra	project meeting	P. Verdonschot A. Besse A. van Oosten	REFRESH project meeting	4-7 April 2011	Aberdeen, UK				all WP's
45	Alterra	scientific conference	A. van Oosten	North American Benthological Society meeting	22-26 May 2011	Providence, Rhode Island, USA				2
46	SLU	conference	Prof Johnson, Dr Sandin, Dr Angeler, Emma Göthe, Karin Almlöf	North American Benthological Society joint meeting	7th to 11th of May 2010	Santa Fe, USA				WP2, WP3, WP4
47	SLU	conference		Societas Internationalis Limnologie congress	16th to 20th of August 2010	Cape Town, South Africa				WP2, WP3, WP4
48	NERC	Project meeting	Heidrun Feuchtmayr,	REFRESH start up meeting	22nd to 26th of March 2010	Antalya, Turkey				WP3

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49	NERC	Project meeting	Mike Acreman, Francois Edwards, Alex Elliot, Heidrun Feuchtmayr, Ian Jones	Second REFRESH project meeting	4th to 7th of April, 2011	Aberdeen, Scotland				WP2 WP3 WP4 WP5
50	NERC	NGO and government agencies involved in wetlands	M Acreman	Wetland futures	28-29 June 2011	UK				WP5
51	SLU	Conference	Dr Sandin	International Conference, "Climate adaptation in the Nordic countries",	8th and 9th of November 2010	Stockholm, Sweden				WP2, WP3, WP4
52	SLU	conference	Prof Johnson, Dr Sandin, Emma Göthe, Karin Almlöf	Nordic benthological Meeting	9th to 12th of May 2011	Aalborg, Denmark				WP2, WP4
53	SLU	conference	Prof Johnson, Dr Sandin, Dr Angeler, Dr McGoff, Emma Göthe, Karin Almlöf	International conference	7th to 10th of June, 2011	Uppsala Sweden.				WP2, WP3, WP4
54	SLU	workshop	Dr Sandin, Emma Göthe, Karin Almlöf, Dr McGoff	WP2 and WP4 REFRESH experimental set up meeting	1st to 3rd of February 2010	Wageningen, the Netherlands				WP2, WP4
55	SLU	Project meeting	Prof Johnson, Dr Sandin, Dr Angeler, Dr McGoff, Emma Göthe, Karin Almlöf	REFRESH start up meeting	22nd to 26th of March 2010	Antalya, Turkey				WP2, WP3, WP4
56	SLU	workshop	Dr Sandin, Emma Göthe, Karin Almlöf, Dr McGoff	Visit to Aarhus University to discuss REFRESH experiments setup	3rd to 4th of May 2010	Aarhus University				WP2, WP4

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57	SLU	workshop	Dr Sandin, Emma Göthe, Karin Almlöf, Dr McGoff	Training workshop WP 2 and WP4 REFRESH	1st to 2nd September 2010	Wageningen, the Netherlands.				WP2, WP4
58	SLU	Project meeting	Prof Johnson, Dr Sandin, Dr Angeler, Dr McGoff, Emma Göthe, Karin Almlöf	Second REFRESH project meeting	4th to 7th of April, 2011	Aberdeen, Scotland				WP2, WP3, WP4
59	SLU	National workshop	Prof Johnson	SEPA funding WATERS project meeting	18th to 20th April 2011	Göthenburg, Sweden				
	SLU	Joint Science – Policy Meeting	Prof Johnson	Joint REFRESH and BIOFRESH Science Policy Symposium for Freshwater Life "Water Lives: new scientific horizons for biodiversity and water policy	29–30 January 2014 in Brussels				Belgium	WP2,3
	MLURI	REFRESH project meeting	K.Waylen, B. Balana, S. Dunn, R. Helliwell, B. Slee, M Castellazzi, L Jackson-Blake, J Martin-Ortega	REFRESH start up meeting	04/04/2011	Aberdeen, Scotland				1,5,6,7
61	MLURI	Project meeting	*I Brown,* K.Waylen, B. Balana, S. Dunn, R. Helliwell, M Castellazzi, L Jackson-Blake, J Martin-Ortega, B. Slee, K. Blackstock, S. Cooksley	Second REFRESH project meeting	4th to 7th of April, 2011	Aberdeen, Scotland				1,5,6,7

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62	MLURI	Conference	*Martin-Ortega, J. et al* (2010)	*IV World Congress of Environmental and Resource Economists, Montreal*	*28 June -2 July 2010*	Montreal, Canada				6
63	MLURI	Conference	*Martin-Ortega, J. et al*	*Benchmarking Exercise and Recommendations on the Application of the WFD*	*21-26 March 2010*	*Aman, Jordan*				6
64	MLURI	International stakeholder workshop	Waylen, K., Slee, B., Helliwell, R.C., Brown, I., Morris, S., Kernan, M., Duel, H., Shahgedanova, Wade, A.	High level stakeholder workshop (Task 3.1)	*March 2011*	London, UK				1
65	MLURI	National meeting	Waylen, K., Blackstock, K., Dunglinson, J., Cooksley, S	Barriers to uptake of measures to protect the water environment	*November 2010*	Aberdeen, UK				1
66	MLURI	Conference	*Helliwell, R.C., Jackson-Blake, L., Wright, R.F., Ferrier, R.C., et al*	*Acid Rain 2011, Chinese National Conference Centre, Beijing*	*15-19 June 2011*	Beijing, China				5
67	MLURI	Local stakeholder/public	*Miller, D.R., Horne, P.L., Donaldson-Selby, G., Wang, C., Brown, I., Castellazzi, M.*	*Landscape Research Weekend*	*18-21 March 2011*	Ballater, UK				1
68	UU-BIO	workshop	M Soons, Annemarie Garssen	WP2 and WP4 REFRESH experimental set up meeting	1st to 3rd of February 2010	Wageningen, the Netherlands				WP2,4

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NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
69	UU-BIO	REFRESH project meeting	Jos Verhoeven, Merel Soons, Annemarie Garssen	REFRESH start up meeting	04/04/2011	Aberdeen, Scotland				WP2,4
70	UU-BIO	Project meeting	Jos Verhoeven, Annemarie Garssen	Second REFRESH project meeting	4th to 7th of April, 2011	Aberdeen, Scotland				WP2,4
71	UU-BIO	National research conference	Merel Soons, Annemarie Garssen	Netherlands Annual Ecology Meeting	8 and 9 February 2011	Lunteren, the Netherlands				WP4
72	UU-BIO	International conference	Annemarie Garssen	Plant Population Biology 2011 Conference	2 June 2011 to 4 June 2011	Oxford, Great Brittain				WP4
73	UU-BIO	National stakeholder meeting	Annemarie Garssen	Meeting 'Stream restoration in practice' ('Grootschalig beekherstel in de praktijk')	13 April 2010	Wageningen, the Netherlands				WP4
74	UU-BIO	National stakeholder meeting	Merel Soons, Annemarie Garssen	Meeting 'Stream valley symposium' ('beekdalen symposium)	10 February 2011	Arnhem, the Netherlands				WP4
75	CSIC	workshop	E Marti	WP2 and WP4 REFRESH experimental set up meeting	1st to 3rd of February 2010	Wageningen, the Netherlands				WP2,4
76	CSIC	international	M. Ribot, A Serra, C. Romero	Training workshop	1-3/09/10	Wagenningen				WP2 and WP4
77	CSIC	REFRESH project meeting	E. Marti, E. Martin, C. Romero, A. Serra	REFRESH start up meeting	04/04/2011	Aberdeen, Scotland				WP2 and WP4
	CSIC	international	E. Marti, E. Martin, C. Romero, A. Serra	2nd Annual REFRESH meeting	4-7/04/11	Aberdeen				WP2-WP4

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78	CSIC	International Conference	Clara Romero, Alexandra Serra, Eugènia Martí, M. Angels Puig	7th Symposium for European Freshwater Sciences. Girona, Spain	27/06/11-1/07/11	Girona, Spain				WP2-WP4
79	METU	REFRESH project meeting	Meryem Beklioğlu, İdil Çakıroğlu, Nihan Yazgan, Eti Levi, Tuba Bucak, Elçin Kentel	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				3,5,7
80	METU	REFRESH project meeting	Meryem Beklioğlu	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				
81	METU	Workshop	Tuba Bucak	SWAT Basic course	24-26th May 2010	Muğla-Turkey				WP5
82	METU	Workshop	Tuba Bucak	SWAT Advanced Course	13-14th June 2011	Toledo-Spain				WP5
83	METU	Conference	Tuba Bucak	International SWAT conference	15-17th June 2011	Toledo-Spain				WP5
84	FVB	REFRESH project meeting	Adrian, Mahdy, Scharfenberger, Tockner, Larsen	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				3,4,
85	FVB	Conference	Rita Adrian	SIL	August 2010	Cape Town				3
86	FVB	Conference	Rita Adrian	Internat. Conference on Biodiversity	December 2010	Frankfurt				3
87	FVB	ASLO meeting	Rita Adrian	ASLO	March 2011	Puerto Rico				3
88	FVB	REFRESH project meeting	Adrian, Mahdy, Scharfenberger, Tockner, Larsen	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				3,4
89	FVB	Conference	Tockner	2nd Biannual International Society of Rivers Science (ISRS) Conference	August 2011	Berlin				4
90	EC-JRC	Meeting	Tiina Noges, Sandra Brucet	REFRESH Kick-off Meeting	March 2010	Antalya				all

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91	EC-JRC	International Conference Not charged to the project	Nõges, T.	31st Congress of the International Society of Limnology (SIL)	August 2010	Cape Town (South Africa)				WP1
92	EC-JRC	International Conference Not charged to the project	Nõges, T.	4th International scientific Conference to commemorate Prof. G.G. Winberg: Modern problems of aquatic Ecology.	October 2010	St. Petersburg, (Russia)				WP1
93	EC-JRC	Meeting	Ana Cristina Cardoso, Sandra Brucet	REFRESH Mid term Project Meeting	April 2011	Aberdeen				all
94	Deltares	All partner meeting REFRESH	Harm Duel Victor Beumer	Kick off meeting REFRESH	22-25 March 2010	Antalya				WP1+3+5
95	Deltares	WP1 meeting	Harm Duel Leon van Kouwen	Scenarios workshop	10 Nov 2010	London				WP1 (WP5+6)
96	Deltares	European Stakeholder Meeting	Harm Duel	Stakeholder workshop	16-17 March 2010	London				WP1+WP6
97	Deltares	WP meetings	Harm Duel Victor Beumer, Simon Groot	REFRESH all partner meeting	4-8 April 2011	Aberdeen				WP1+3+5
98	Deltares	All partner meeting REFRESH	Harm Duel Victor Beumer	Kick off meeting REFRESH	22-25 March 2010	Antalya				WP1+3+5
99	BOKU	REFRESH project meeting	A. Schmidt-Kloiber	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				2,3,4
100	BOKU	REFRESH project meeting	A. Schmidt-Kloiber, W. Graf	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				2,3,4
101	BCAS	national conference	J. Hejzlar, B. Políčková, A. Volková	Revitalisation of Orlík Reservoir 2010	12-13/10/10	Písek, Czech Republic				5,6
102	BCAS	REFRESH project meeting	J. Hejzlar, J Kopacek, M. Lapka, E Cudlinova	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				3,5,6,7

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103	BCAS	REFRESH project meeting	J. Hejzlar, M. Sorf, H. Svejdarova, A. Volkova	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				3,5,6,7
104	EMU	REFRESH project meeting	Nõges, Peeter, Tuvikene, Lea, Tuvikene, Arvo, Zingel, Priit	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				1,3,7
105	EMU	meeting	Nõges, Peeter	International Workshop 'Climate Change Impacts and Adaptation: Reducing Water-related Risks in Europe'	6-9/7/10	Brussels				7
106	EMU	REFRESH project meeting	Nõges, Peeter, Tuvikene, Lea, Tuvikene, Arvo, Nõges, Tiina	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				1,3,7
107	UB	REFRESH project meeting	F. Sabater	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				WP4, WP5
108	UB	REFRESH project meeting	F. Sabater, J. Riera	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				WP4, WP5
109	UB	workshop	F. Sabater	WP2 and WP4 REFRESH experimental set up meeting	1st to 3rd of February 2010	Wageningen, the Netherlands				WP2,4
110	UB	International meeting of the European Society for Freshwater Sciences	F. Sabater, J. Riera	7th Symposium for European Freshwater Sciences (SEFS)	27-30 June	Girona (Spain)				WP4, WP5
111	UPAT	REFRESH project meeting	D Psaltopoulos, A. Kontolaimou E. Papastergiadou and K. Stefanidis	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				WP1, WP3, WP6, WP7
112	UPAT	REFRESH project meeting	D Psaltopoulos, D. Skuras, K. Stefanidis	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				WP1, WP3, WP6, WP7

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113	CNRS-EDB	REFRESH project meeting	Sovan Lek, Sithan Lek, G. Grenouillet	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				WP2,3,4
114	CNRS-EDB	REFRESH project meeting	G. Grenouillet, L Comte	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				WP2,3,4
115	CNRS-EDB	workshop	G. Grenouillet	WP2 and WP4 REFRESH experimental set up meeting	1st to 3rd of February 2010	Wageningen, the Netherlands				WP2,3,4
116	BIOFORSK	National/local stakeholders meeting.	Eva Skarbøvik Marianne Bechmann Rebekka Øvstegaard	Users meeting on lake level manipulation at Lake Vansjø	2/3/11	Våler, Norway				6
117	BIOFORSK	REFRESH project meeting	M. Bechmann, C. Farkas	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				5,6,7
118	BIOFORSK	REFRESH project meeting	E. Skarbøvik, M. Bechmann, C. Farkas	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				5,6,7
119	NIVA	REFRESH project meeting	Silje Holen, Jannicke Moe, Richard Wright	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				5,6,7
120	NIVA	REFRESH project meeting	Silje Holen, Jannicke Moe, Jostein Starrfelt, Richard Wright	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				5,6,7
121	TRENT	REFRESH project meeting	Helen Baulch	REFRESH start up meeting	21-27/3/10	Antalya, Turkey				WP5
122	TRENT	International conference	R. North (pdf)	Internat. Assoc. Gt. Lakes Res.	May 2011	Duluth MN				5
123	TRENT	Regional conference	P. Dillon, R. North, C. Quinn (MSc student)	Lake Simcoe Science Forum	May 2011	Barrie, ON				5
124	TRENT	Regional conference	P. Dillon, S. Oni (PhD student)	46th Central Can. Conf. Water Quality	February 2011	Burlington, ON				5
125	TRENT	National conference	P. Dillon, J. Miles (MSc student)	Society of Canadian Limnologists	January 2011	Toronto, ON				5

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126	Griffith	REFRESH project meeting	Stuart Bunn	REFRESH second project meeting	3-8/4/12	Aberdeen, Scotland				WP2,3,6,7
127	UCL	Science Policy Interface Event	Martin Kernan	Common Implementation Strategy (CIS) Science Policy Interface (SPI) Brainstorming Event	7 Nov 2011	Brussels				WP7
	UCL	CIWEM/CMS National Conference	Martin Kernan	Climate change and the Water Sector – Integrating Adaptation and Mitigation in Practice	17 Nov 2011	London				WP7
	UCL	CIWEM/CMS National Conference	Martin Kernan	Catchment Delivery Towards More Effective Environmental and Societal Benefits	23 Nov 2011	London				WP7
	UCL	EEA international meeting	Martin Kernan	Second advisory group meeting of EEA 2012 state of water assessment	29th Nov 2011	Copenhagen				WP7
	UCL	REFRESH workshop	Martin Kernan	REFRESH WP5 / WP6 Integration workshop	1-2 Feb 2012	Reading				WP5/WP6
	UCL	REFRESH Project meeting	Martin Kernan, Simon Turner	REFRESH Project Meeting	19-23 Mar 2012	Sitges, Spain				All WPs
	UCL	DEFRA /CIWEM national conference	Martin Kernan	The Catchment Based Approach - First Steps in Integrated Working, Delivery for Water and Land use Realising Multiple Benefits	25th April 2012	London				WP7

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NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
	UCL	SPI Special Session at the IWA World Congress on Water, Climate and Energy	Martin Kernan	WATERDiss side event 'Communicating research: Getting your message across' at IWA World Congress	14th May 2012	Dublin				WP7
	UCL	International conference	Helen Bennion, Martin Kernan, Simon Turner, Rick Battarbee?	The 12th International Symposium on Palaeolimnology	21-24 Aug 2012	Glasgow UK				WP3
	UCL	International conference	Martin Kernan	EcoSummit 2012 - Ecological Sustainability. Restoring the Planet's Ecosystem Services	1-5 Oct 2012	Columbus, Ohio, USA				WP5, WP6 and WP7
	UCL	REFRESH workshop	Martin Kernan	REFRESH WP5 workshop	13 Nov 2012	Reading				WP5
	UCL	Science Policy Interface Event	Martin Kernan	Third event of the Science Policy Interface (SPI) activity under the WFD Common Implementation Strategy (CIS) framework on "Water science meets policy: How to streamline knowledge to address WFD challenges?	14-15 Nov 2012	Brussels				WP7

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	UCL	SPI Special Session at The Integrated Water Resources Management Conference 2012	Martin Kernan	WATERDiss side event European innovation for sustainable water management: users meet researchers' at IWRM 2012	21 Nov 2012	Karlsruhe				WP7
	UCL	National Meeting	Martin Kernan	Centre for Regional Change in the Earth System (CRES) Annual Meeting	26-28 Nov 2012	Holbæk, Denmark				WP7
	UCL	Science Policy Interface Event	Martin Kernan	STEP-WISE and STREAM Final Conference "Building Bridges - Facilitating Water Information Exchange between Science, Policy and Industry"	3-4 Dec 2012	Brussels				WP7
	UCL	International meeting	Helen Bennion	Workshop on Human impact and climate change as inferred from palaeorecords of aquatic ecosystems	5 Dec 2012	Lund University Sweden				WP3
15	AU	Workshop	Erik Jeppesen	Global changes impacts of lakes	2-3 Dec 2013	Ankara, Turkey	Stake holders/scientific community	100	Turkish	
14	AU	Workshop	Martin Søndergaard	Vansjöworkshop	21 Oct. 2013	Dillingøy, Norway	Stake holders/scientific community	50	Norwegian	WP3
	AU	Conference	Esben Kristensen, Annette Battrup-Pedersen	Danish Freshwater Symposium 2012 (Ferskvandssymposium 2012)	January 2012	Odense, Denmark	Scientific	200	Denmark	WP 2, WP 4

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	AU	Project meeting	Erik Jeppesen, Martin Søndergaard, Esben Kristensen, Carl Christian Hoffmann,	REFRESH third project meeting	19-23 March 2012	Sitges, Spain				WP2,3,4,5
	AU	Conference	Esben Kristensen, Carl Christian Hoffmann	The 7th SWS European Chapter Meeting	17-21 June 2012	Aarhus, Denmark	Scientific Community	100	International	WP 4
	AU	Seminar	Martin Søndergaard	Invited speech at the Institute of Hydrobiology, Chinese Academy of Science,	10 October 2012	Wuhan, China				WP 3
	AU	Seminar	Martin Søndergaard	Invited speech at the Yangtze University	12 October 2012	Jingzhou, China				WP 3
	AU	Conference	Martin Søndergaard, Erik Jeppesen	The 15th international symposium on river and lake environments	17 October 2012	Zhangjiajie, China				WP 3
	UREAD	Project review	Prof A Wade	REFRESH Steering committee and project review	26-27 Oct 2011	Brussels, Belgium				5

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	UREAD	Workpackage meeting	Prof A Wade, Prof R Skeffington, Prof P Whitehead, Dr Martin Erlandsson, Dr Attila Lazar	WP5 & 6 joint meeting	1-2 Feb 2012	Reading, UK				5
	UREAD	Project meeting	Prof A Wade, Prof P Whitehead, Dr Martin Erlandsson	REFRESH 3rd Project meeting	19-23 Mar 2012	Sitges, Spain				5
	UREAD	Field visit and integration between WP5 and 6	Dr M Erlandsson	WP5 Field visit in preparation for modelling	5-13 May 2012	Louros, Greece				5
	UREAD	Local stakeholders	Prof R Skeffington	WP6 Thame workshop	7 Sep 2012	Thame, UK				5
	UREAD	WP2 and 5 meeting	Prof A Wade, Prof R Skeffington	REFRESH Bayesian Model Meeting	11-12 Oct 2012	Wageningen, The Netherlands				5
	UREAD	Project workshop	Dr A Wade, Prof R Skeffington, Prof M Acreman (CEH)	Project workshop to further the design the 'REFRESH' model and extend its scope	11/05/11-12/05/11	University of Utrecht, The Netherlands				4, 5
	UREAD	Workpackage meeting	Prof A Wade, Prof R Skeffington, Prof P Whitehead, Dr Martin Erlandsson, Dr Sarah Halliday	WP5 Review meeting	13-14 Nov 2012	Reading, UK				5

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	UREAD	Regional and National UK Stakeholders	Prof A Wade, Dr Martin Erlandsson	'The increasing risks of floods and droughts – what can the latest science tell us?' Walker Institute, University of Reading	30 Jan 2013	Royal College of Physicians, London, UK				All
	SYKE	Workshop	Katri Rankinen	INCA modelling workshop	6-10 Sept 2011	Blewbury, UK				WP5
	SYKE	Planning meeting	Riku Varjopuro, Riina Pelkonen	WP6 stakeholder seminar planning	7 Sept 2011	Pyhäjärvi Institute, Kauttua				WP6
	SYKE	Stakeholder seminar	Ahti Lepistö, Riku Varjopuro, Riina Pelkonen, Anna Tainio, Katri Rankinen Olli Malve, Timo Huttula	Kauttua stakeholder workshop	10 Oct, 2011	Pyhäjärvi Institute, Kauttua				WP5,WP6 and WP7
	SYKE	Workshop	Ahti Lepistö	Reading WP5/WP6 workshop	1-2 February, 2012	Reading University				WP5, WP6
	SYKE	Project Meeting	Ahti Lepistö, Marko Järvinen, Riku Varjopuro, Anna Tainio, Katri Rankinen, Niina Kotamäki	REFRESH 3rd Project Meeting	19-22 March, 2012	Sitges, Spain				WP3, WP5, WP6, WP7
	SYKE	Workshop	Ahti Lepistö, SYKE/VK Pirkko Kortelainen SYKE/LK Martyn Futter, SLU Sweden	C modelling workshop	11-12 April, 2012	SYKE, Helsinki				WP5

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	SYKE	Workshop	Ahti Lepistö, Niina Kotamäki, Katri Rankinen, Olli Malve /SYKE; Jostein Starrfelt and Koji Tominaga /NIVA	SYKE/NIVA modelling workshop	28-29 May, 2012	SYKE, Helsinki				WP5, WP3
	SYKE	Conference	Ahti Lepistö	BIOGEOMON 2012 Conference	16-19 July, 2012	Maine, USA				WP5 (not financed by REFRESH)
	SYKE	Workshop	Ahti Lepistö SYKE, Martyn Futter SLU Sweden	C modelling workshop	17 August 2012	SYKE, Helsinki				WP5
	SYKE	Conference	Katri Rankinen	Second Nordic International Conference on Climate Change Adaptation	29-31 August 2012	Helsinki				WP5
	SYKE	Course	Katri Rankinen	Course on sensitivity analysis using PEST	16-21 August 2012	Oulu				WP5
	SYKE	Workshop/meeting	Riku Varjopuro	WP6 meeting Patras	7-10 Oct 2012	Patras, Greece				WP6
	SYKE	Workshop	Ahti Lepistö, Katri Rankinen	Reading WP5 workshop	12-14 Nov 2012	Reading UK				WP5
	SYKE	Workshop	Ahti Lepistö, SYKE/VK Pirkko Kortelainen SYKE/LK Martyn Futter, SLU Sweden	C modelling workshop	28-29 Nov 2012	SYKE, Helsinki				WP5

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	SYKE	Stakeholder workshop	Riku Varjopuro, Anna Tainio, Riina Pelkonen	Kauttua stakeholder 2nd workshop	4 Dec 2012	Kauttua, Eura				WP6
	UDE	project meeting	Yaron Hershkovitz	REFRESH WP5 Progress Review Meeting	13-14 November 2012	University of Reading, UK,				5
	UDE	Conference	Armin Lorenz, Yaron Hershkovitz	REFRESH Annual Meeting	19-23 March, 2012	Sitges, Catalonia, Spain				2, 3, 4, 5
	UDE	Conference	Yaron Hershkovitz	39th Annual Conference of the Israel Society of Ecology & Environmental Sciences	27-28 June 2011	Megiddo Regional Council, Israel				2
	UDE	Seminar	Yaron Hershkovitz	Guest scientist presentation	10 July 2012	The Kinneret Limnological Laboratory (KLL), Israel				2
	Alterra	scientific experiment design discussion meeting	P. Verdonschot, A. Besse-Lototskaya	REFRESH WP2 stream experiment meeting	21-22 / 09 / 2011	Berlin, Germany				WP2
	Alterra	Review month 1-18	P. Verdonschot	REFRESH EU review meeting	27 / 10 / 2011	Brussels				All WP's
	Alterra	project annual meeting	P. Verdonschot, A. van Oosten-Siedlecka, A. Besse-Lototskaya	REFRESH meeting	19-25 / 03 / 2012	Sitges, Spain				All WP's
	Alterra	Conceptual modelling meeting	P. Verdonschot, A. Besse-Lototskaya	REFRESH conceptual model meeting	7-8 / 06 / 2012	Reading, UK				WP5

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	Alterra	Conceptual modelling meeting	P. Verdonschot, A. Besse-Lototskaya	REFRESH conceptual model meeting	17-19 / 07 / 2012	Wageningen, NL				WP5
	Alterra	Conceptual modelling meeting	P. Verdonschot, A. Besse-Lototskaya	REFRESH conceptual model meeting	11-12 / 10 / 2012	Wageningen, NL				WP5
	Alterra	Intercontinantal meeting, dissemination experimental results WP2	P. Verdonschot	North American Benthological Society meeting Scientific conference	21-25 / 05 / 2012	Louisville, KY, USA				WP2
	NERC	Meeting	Jonathan Newman, P. Rameshwaran	Macrophytes, nutrients and flow REFRESH scoping	17/02/12	Wallingford, UK				WP5
	NERC	Meeting	Alex Elliot	REFRESH meeting	Mar 2012	Blanes, Spain				WP3
	NERC	Meeting	Francois Edwards	3rd REFRESH project meeting	20-22/03/12	Sitges, Spain				WP2
	NERC	Meeting	Mike Acreman, Owen Mountford	Bayesian wetland modelling REFRESH review	27/06/12	Wallingford, UK				WP5
	NERC	Meeting	James Blake	REFRESH WP5 progress review meeting	13-14/11/12	Reading, UK				WP5
	SLU	meeting	Prof Johnson, Dr Angeler, MSc Boho	Consortium meeting (Spain)	19-23 March, 2012	Stiges, Spain				WPs 2, 3, 4
	SLU	Meeting	Prof Johnson	REFRESH first periodic review meeting	27 October, 2011	Brussels, Belgium				WP2
	JHI	International Conference	Julia Martin-Ortega	Catchment Science 2011	14-16 September 2011	Mansion House, Dublin, Ireland				WP6

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	JHI	National Conference	Julia Martin-Ortega	Joint SAC/SEPA Biennial Conference in association with Forest Research, The James Hutton Institute and Scottish Natural Heritage "Agriculture and the Environment IX: Valuing Ecosystems: Policy, Economic and Management Interactions"	3-4 April 2012.	Edinburgh				WP6
	JHI	International conference	Sarah Dunn	11th BHS National Hydrology Symposium	9-11 July 2012	University of Dundee, Scotland				WP5
	JHI	International conference	Sarah Dunn	International Association of Hydrological Sciences 90th Anniversary Symposium: Prediction in Un-gauged Basins	23-25 October 2012	Delft, Holland				WP5
	JHI	International workshop	Rachel Helliwell	Science camp	22-25 January 2013	Malaga, Spain				WP5
	UU-BIO	Symposium	Garssen, Soons, Verhoeven	CWE meeting Wageningen 2011	2011	Wageningen, The Netherlands				4
	UU-BIO	Conference	Garssen, Soons	Netherlands Annual Ecology Meeting (NAEM) 2012	2012	Lunteren, NL				4
	UU-BIO	Project meeting	Garssen, Soons	REFRESH project meeting	2012	Sitges, ES				2,4,5

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NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
	UU-BIO	Conference	Soons	EGU 2012	2012	Vienna, AU				4
	UU-BIO	Conference	Garssen, Verhoeven	SWS European Chapter Meeting 2012	2012	Aarhus, DK				4
	UU-BIO	Discussion group meeting	Garssen	Ecological Theory & Application	2012	Wageningen, The Netherlands				4
	CSIC	International	E. Martí, C. Romero, A. Serra, M.A. Puig	REFRESH annual meeting	19-13 March	Sitges (Spain)				WP2 and WP4
	CSIC	International	S. Bernal	EGU meeting	22-27 April	Vienna (Austria)				WP2
	CSIC	International	Whole CSIC group	XVIth AIL meeting	2-6 July	Guimaraes (Portugal)				WP2 and WP4
	METU	Steering group meeting	Meryem Beklioglu	Refresh meeting	November 2011	Brussels, Belgium				WP3, WP5, WP7
	METU	Project meetıng	Meryem Beklioğlu, A. İdil Çakıroğlu, Ü. Nihan Tavşanoğlu	3rd REFRESH project meeting	19-23 March 2012	Sitges, Spain				WP3, WP5, WP7
	METU	Dissemination meeting	Meryem Beklioğlu	Lake Beyşehir: problems and possible mitigation strategies	13th June 2012	Beyşehir, Konya				WP5-WP7
	METU	International symposium	Meryem Beklioğlu, Eti Ester Levi, A. İdil Çakıroğlu, Gizem Bezirci	The 12th International Paleolimnology Symposium	21-24 August 2012	Glasgow, Scotland				WP3
	METU	National symposium	Nihan Tavşanoğlu, Nur Filiz, Şeyda Erdoğan, Arda Özen	5th National Limnology Symposium	27-29 August 2012	Isparta, Turkey				WP3, WP5

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	FVB	International Conference	Rita Adrian	ASLO meeting 2012	07/07-13/07/12	Lake Biwa, Japan				WP3
	JRC-EC	International symposium and knowledge brokering event	Sandra Brucet	Final Climate Water Symposium 13-14 October 2011, Budapest - Co-organised event: PSI Connect Training workshop	12-14/10/11	Budapest, Hungary				WP7
	BOKU	meeting	Wolfram Graf, Astrid Schmidt-Kloiber	Refresh annual meeting	20-22/3/12	Sitges, Spain				WP2, 3, 4
	BOKU	conference	Wolfram Graf, Astrid Schmidt-Kloiber	Austrian Entomologists Conference 2012	13/10/12	Lunz, Austria				WP2, 3, 4
	BCAS	national conference	Josef Hejzlar, Miloslav Lapka, Berenika Políčková	4th national conference on Revitalisation of Orlík Reservoir 2011	4-5 October 2011	Písek, Czech Republic				WP5, WP6
	BCAS	local stakeholders meeting	Josef Hejzlar, Miloslav Lapka, Berenika Políčková, Hana Švejdarová, Eva Cudlínová	Workshop on collaborative scoping of solutions for improvement of ecological state of the Lomnice River, the Vltava catchment	31 October 2011	Mirovice, Czech Republic				WP6
	BCAS	local stakeholders meeting	Josef Hejzlar, Miloslav Lapka, Berenika Políčková, Hana Švejdarová, Eva Cudlínová	Workshop on collaborative scoping of solutions for improvement of ecological state of the Lipno Reservoir, the Vltava catchment	28 November 2011	Lipno nad Vltavou, Czech Republic				WP6

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	BCAS	International Conference	Clara Romero, Alexandra Serra, Eugènia Martí, M. Angels Puig	7th Symposium for European Freshwater Sciences. Girona, Spain	27/06/11-1/07/11	Girona, Spain				WP2-WP4
	EMU	Conference	Peeter Nõges	Science Policy Symposium	28.01-31.01.2014	Brussels			European Union	7
	EMU	Conference	Peeter Nõges	AEHMS11 Aquatic Ecosystems at the Edge: Managing for Sustainability	June 17-20, 2013	Victoria, BC, Canada	Scientific Community	200	World	7
	EMU	Conference	Tiina Nõges	Conference on Water Research Cooperation	9. Dec, 2013	Tallinn, Estonia	Scientific Community, Policy makers, Medias	100	Estonia	3, 7
	EMU	Seminar	Peeter Nõges	Excellence in research for climate change adaptation	19th of November 2013	Brussels	Scientific Community, Policy makers, Medias	30	European Union	7
	EMU	Conference	Peeter Nõges	FRESHWATER MANAGEMENT IN A CHANGING WORLD	November 6th and 7th, 2013	London	Scientific Community, Civil Society, Policy makers, Medias			
	EMU	Stakeholder workshop	Tiina Nõges, Peeter Nõges, Lea Tuvikene	1st Estonian REFRESH stakeholder workshop	8. mail 2013	Tartu, Estonia	Scientific Community, Policy makers, Medias	58	Estonia	7
	EMU	Stakeholder workshop	Lea Tuvikene, Peeter Nõges,	2nd Estonian REFRESH stakeholder workshop/ LakeAdmin workshop	11. Oct. 2013	Tallinn, Estonia	Scientific Community, Policy makers, Medias	36	Estonia, Latvia, Lithuania, Finland	7

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	EMU	Workshop	Lea Tuvikene, Peeter Nõges,	LakeAdmin workshop	24-26 September 2013	Volos, Greece	Scientific Community, Civil Society, Policy makers, Medias	20	EU	7
	EMU	Stakeholder workshop	Peeter Nõges,	REFRESH stakeholder workshop	2.-3.dets 2013	Ankara, Turkey	Scientific Community, Civil Society, Policy makers, Medias	100	Turkey	7
	EMU	Press release	Tiina Nõges	1st Estonian REFRESH stakeholder workshop	6. May, 2013	Tartu, Estonia	Scientific Community, Civil Society, Policy makers, Medias		Estonia	
	EMU	Press release	Lea Tuvikene, Peeter Nõges	2nd Estonian REFRESH stakeholder workshop/ LakeAdmin workshop http://uudisvoog.postimees.ee/?DATE=20131010&ID=323171. http://vikerraadio.err.ee/kuularhiiv?saade=422&kid=292	10. Oct. 2013	Tallinn, Estonia	Scientific Community, Policy makers, Medias		Estonia	

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	EMU	Media interviews	Peeter Nõges, Tiina Nõges	1st Estonian REFRESH stakeholder workshop http://teadus.err.ee/artikkel?id=9022&cat=1 http://www.maaleht.ee/news/loodus/loodusuudised/sajandi-lopus-eestis-jogedele-enam-jaakatet-ei-teki.d?id=66082272; http://podcast.kuku.ee/2013/09/01/kukkuv-oun-2013-09-01/; http://etv.err.ee/index.php?05629907&video=7929#.UlbNWhCSnW0	8. May, 2013	Tartu, Estonia	Scientific Community, Civil Society, Policy makers, Medias		Estonia	
	EMU	meeting	Nõges, Peeter; Tuvikene, Arvo; Nõges, Tiina; Zingel, Priit; Agasild, Helen	REFRESH annual meeting	19.-23.03.2012	Sitges, Spain				WP 3, 7
	EMU	conference	Agasild, H.	8th International Conference on Applications of Stable Isotope Techniques to Ecological Studies.	August 20-24, 2012	Brest, France				WP 3
	EMU	conference	Nõges, Tiina; Nõges, Peeter; Zingel, Priit	3rd European Large Lakes Symposium	October 08-12, 2012	University of Konstanz, Germany				WP 3

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	EMU	meeting	Agasild, H.	2nd NordSIR meeting (Nordic Network for Stable Isotope Research)	3-5. oktoober 2011	Søminestationen, Denmark				WP 3
	UB	International meeting of the **the Iberian Society of Limnology**	F. Sabater E. Martin	**XVIth Congress of the Iberian Society of Limnology.**	July 2012	**Guimarães,** Portugal.				WP4
	UB	International meeting of the European Geosciences Union General Assembly	S. Bernal F. Sabater	European Geosciences Union General Assembly.	22 – 27 April 2012	Vienna, Austria				WP4, WP5
	UPAT	Conference	2	16th International Symposium on Environmental Pollution and its Impact on Life in the Mediterranean Region	24-27 September, 2011	Ioannina, Greece				WP3
	UPAT	Conference	2	12th Hellenic Conference of Botanical Society	29 September – 2 October, 2011	Rethymno, Greece				WP3
	UPAT	Conference	2	6th Hellenic Ecological Conference	4-7 October, 2012	Athens, Greece				WP3
	CNRS	Training course	Lorenza Conti	Workshop on time series analysis	16-19 / 10 / 2011	Copenhagen				P2
	CNRS	Meeting	Lorenza Conti Gael Grenouillet	3rd Refresh Project Meeting	19-25 / 03 / 2012	Sitges				P2 P3
	NIVA	national	Jostein Starrfelt, Koji Tominaga, Silje Holen	Eutropia-REFRESH modelling workshop	10-11 May 2012	Fredrikstad, Norway				WP5, WP6
	NIVA	Local stakeholders meeting	Jostein Starrfelt, Richard Wright, Silje Holen	Vansjøkonferansen	30 August 2011	Ski, Norway				WP5, WP6, WP7

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	NIVA	River basin managers meeting	Jostein Starrfelt, Richard Wright, Silje Holen	MORSA scenarios	24 August 2011	Ås, Norway				WP5, WP6, WP7
	NIVA	national	Jostein Starrfelt, Richard Wright, Koji Tominaga, Silje Holen	Water resources management conference	27-28 February 2012	Oslo, Norway				WP5, WP6
	Griffith	Project Meeting	Samantha Capon	REFRESH Annual Meeting	20-23 March 2012	Barcelona, Spain				WP 2 and 4
	Griffith	Conference	Samantha Capon	Planet Under Pressure Conference	25-29 March 2012	London, England				WP 2 and 4
	Griffith	Conference	Samantha Capon	NCCARF Adaptation Conference	25-29 June 2012	Melbourne, Australia				WP 2 and 4
	Griffith	Workshop with Australian stakeholders	Samantha Capon	Future of Environmental Water Workshop	4-5 September 2012	Canberra, Australia				WP 2 and 4
	Griffith	Conference	Samantha Capon	Australian Society of Limnology Congress 2012	25-29 November 2012	Armidale, Australia				WP 2 and 4
	UCL	Poster	Martin Kernan	REFRESH: Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	17th Nov 2011	Climate change and the Water Sector - Integrating Adaptation and Mitigation in Practice, London	Managers, scientists	120	UK	WP7

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	UCL	Poster	Martin Kernan	REFRESH: Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	14-15 Nov 2012	Third event of the Science Policy Interface (SPI) activity under the WFD Common Implementation Strategy (CIS) framework on "Water science meets policy: How to streamline knowledge to address WFD challenges?, Brussels	Managers, Scientists, Policy makers	120	Pan European	WP7
	UCL	Poster	Martin Kernan	REFRESH: Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	21 Nov 2012	WATERDiss side event European innovation for sustainable water management: users meet researchers' at IWRM 2012	Mangers Scientists	Unknown		WP7
	UREAD	Poster	M. Erlandsson	Cost-effective mitigation measures to reduce P concentrations in the Thames – a REFRESH study	31 Jan 2013	Royal College of Physicians, London.	UK Stakeholders	100-150	UK	5, 6

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	SYKE	Poster	Kotamäki, N., Lepistö, A., Malve, O.	MyLake application to lake Pyhäjärvi as a part of the modelling chain	19-23 March 2012	REFRESH 3rd meeting Sitges, Spain.	REFRESH researchers	100		WP5, WP3
	SYKE	Poster	Lepistö A, Futter M, Kortelainen P	Increasing organic C and N fluxes from a northern boreal river basin – monitoring and modeling suggest climate related controls.	22-27 April, 2012	Vienna, Austria	Research scientists	several hundreds		WP5
	Alterra	Poster	P. Verdonschot, A. Besse-Lototskaya	Beken stromen: traag en het hele jaar door	12-13-12-2012	Soesterberg, NL	stakeholders, researchers, policy makers	200	NL	WP2-4
	Alterra	Poster	P. Verdonschot, A. Besse-Lototskaya	Beekbegeleidende zone: buffer en gradiënt	12-13-12-2012	Soesterberg, NL	stakeholders, researchers, policy makers	200	NL	WP2-4
	Alterra	Poster	P. Verdonschot, A. Besse-Lototskaya	Verondiepen en versmallen: hét alternatief voor meanderen	12-13-12-2012	Soesterberg, NL	stakeholders, researchers, policy makers	200	NL	WP2-4
	Alterra	Poster	P. Verdonschot, A. Besse-Lototskaya	Dood hout: goedkope en snelle maatregel	12-13-12-2012	Soesterberg, NL	stakeholders, researchers, policy makers	200	NL	WP2-4
	Alterra	Poster	P. Verdonschot, A. Besse-Lototskaya	Beekherstel: kijken naar de toekomst	12-13-12-2012	Soesterberg, NL	stakeholders, researchers, policy makers	200	NL	WP2-4
	Alterra	Poster	P. Verdonschot, A. Besse-Lototskaya	Bekenpraktijk ↔ -kennis: in beweging en ontwikkeling	12-13-12-2012	Soesterberg, NL	stakeholders, researchers, policy makers	200	NL	WP2-4

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	NERC & Reading University	Poster	Attila Lazar	Modelling wetland plant communities with an expert knowledge based Bayesian model	17-20/12/12	British Ecological Society Annual Meeting, Birmingham, UK	200	200	UK, EU	WP5
	Reading University & James Hutton Institute	Poster	M. Erlandsson; P.G. Whitehead; J. Crossman; B.B. Balana	Cost-effective mitigation measures to reduce P concentrations in the Thames – a REFRESH study	Jan. 2013	London	Stakeholders event	~40	England (Thames catchment)	WP5 and WP6
	James Hutton Institute	Poster	Vinten et al. (including Martin-Ortega and Balana)	WFD and the disproportionality principle A national scale assessment for diffuse pollution mitigation in Scottish lochs.	April 2012	Edinburgh	Stakeholder events	>100	Scotland	WP6
	UU-BIO	Poster	Garssen	Climate change effects on the colonization processes and biodiversity of European riparian plant communities	7 - 8 February 2012	Netherlands Annual Ecology Meeting	Researchers	350	The Netherlands	WP4
	UU-BIO	Poster	Garssen	Climate change effects on the colonization process and biodiversity of European riparian plant communities	17 - 21 June 2012	SWS 2012 - European Chapter Meeting, Aarhus University, Denmark	Researchers and practitioners	80	European countries	WP4

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	CSIC	Poster	Romero, C., A. Serra, M.A. Puig, and E. Martí	Canopy cover influence on water temperature and macroinvertebrate communities in Mediterranean streams.	2-6 July	Iberian Society for Limnology			**Guimarães, Portugal**	WP2
	UB/CSIC	Poster	Martín, E., C. Romero, A. Serra, F. Sabater, and E. Martí	Temporal variability in hydrological and biogeochemical linkages in a Mediterranean stream-riparian interface	2-6 July	Iberian Society for Limnology			**Guimarães, Portugal**	WP4
	METU	Poster	Ayşe İdil Çakıroğlu	Sub-fossil Cladocera as indicator of salinity based on surface sediment of 32 Turkish shallow lakes	21-24 August	Glasgow, Scotland			Turkey	WP3
	METU	Poster	Eti Ester Levi	Sedimentary Pigments in Turkish shallow lakes: assessing the relation to environmental variables and inferring the change in past phytoplankton communities	21-24 August	Glasgow, Scotland			Turkey	WP3

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	METU	Poster	Gizem Bezirci	Diatom assemblages as quantitative indicators of past environmental conditions in Turkish shallow lakes	21-24 August	Glasgow, Scotland			Turkey	WP3
	Deltares	Poster	V. Harezlak	Lake IJssel, water quality and ecosystem modelling	March 2012	Sitges, Spain	REFRESH Project Meeting	120	Netherlands	WP5
	EMU	Poster	Agasild, H., Tuvikene, L., Tuvikene, A., Timm, H., Feldmann, T., Kisand, A., Nõges, T., Jones, RI.	Biogenic methane contributes to the food web of a large shallow lake.	August 20-24, 2012.	Brest, France	8th International Conference on Applications of Stable Isotope Techniques to Ecological Studies.	250		WP 3
	EMU	Poster	Nõges, T., Nõges, P.	Temperature, ice and water level regimes of Estonian large lakes: weak trends and strong dependence on NAO.	October 08-12, 2012	University of Konstanz, Germany.	3rd European Large Lakes Symposium ELLS 2012	150		WP 3
	EMU	Poster	Zingel, P., Tuvikene, L., Tuvikene, A., Feldmann, T., Agasild, H., Karus, K. and T. Nõges	Enclosure experiments to follow climate change impacts in shallow lakes – preliminary results from Estonia	March 19.-23. 2012	Sitges, Spain	REFRESH annual meeting			WP 3

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	EMU	Poster	Agasild, H., Toming, K., Tuvikene, L., Tuvikene, A., Timm, H., Feldmann, T., Kisand, A., Salujõe, J., and T. Nõges	Food web structures and carbon sources in large shallow Lake Võrtsjärv	March 19.-23. 2012	Sitges, Spain	REFRESH annual meeting			WP 3
	UB	Poster	Martín, E., C. Romero, A. Serra, F. Sabater, and E. Martí	Temporal variability in hydrological and biogeochemical linkages in a Mediterranean stream-riparian interface.	July 2012	**XVIth Congress of the Iberian Society of Limnology. Guimarães,** Portugal.			international	4
	UPAT	Poster		Effects of tempterature, salinity, and water level on biotic communities and ecosystem metabolism: an outdoor mesocosm experience in Greece.	24-27 September, 2011	Ioannina, Greece				WP3
	UPAT	Poster		Effects of water level decrease on biotic communities: a mesocosm experiment in Greece. .	29 September – 2 October, 2011	Rethymno, Greece				WP3

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	UPAT	Poster		Climate change effects on biological communities of aquatic ecosystems: a mesocosm approach.	4-7 October, 2012	Athens, Greece				WP3
	Bioforsk	Poster	Csilla Farkas	Climate change impacts on the water regime of a brown forest soil.	15 Nov., 2012	Bratislava, Slovakia	Researchers and students	50	Slovakia, Hungary, Norway	WP5
		Poster	Mahdy	Water Management and climate change impacts in lakes and reservoirs	16-18th April 2012	Mekka, Saudi Arabia				
		Poster	Mahdy	Effects of water temperature on summer periphyton biomass in shallow lakes: a pan-European mesocosm experiment	22-25th April 2013	REFRESH project meeting, Antalya, Turkey				
		Poster	Mahdy	Grazing impact on periphyton biomass by natural predator communities, chironomids and zooplankton	9-13th, September 2013	27. Jahrestung der DGL, Potsdam, Germany				

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	UCL	Oral Presentation	Philippe Quevauviller presented REFRESH as part of a broader presentation of EU research projects	REFRESH: Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	7 Nov 2011	Common Implementation Strategy (CIS) Science Policy Interface (SPI) Brainstorming Event, Brussels	Policy makers, managers, scientists	100	Pan European	WP7
	UCL	Oral Presentation	Martin Kernan	REFRESH: Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	14 May 2012	WATERDiss side event 'Communicating research: Getting your message across' at IWA World Congress, Dublin	Scientists, managers	20	Pan European	WP7
	UCL	Oral Presentation	Martin Kernan	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	1-5 Oct 2012	EcoSummit 2012 - Ecological Sustainability. Restoring the Planet's Ecosystem Services	Scientists	40	Global	WP7
	UCL	Oral Presentation	Martin Kernan	REFRESH: Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	21 Nov 2012	WATERDiss side event European innovation for sustainable water management: users meet researchers' at IWRM 2012	Scientists	20	Pan European	WP7

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	UCL	Oral Presentation	Martin Kernan	REFRESH: Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	26-28 Nov 2012	Centre for Regional Change in the Earth System (CRES) Annual Meeting	Scientists, Managers	40	Danish	WP7
	AU	Oral Presentation	Esben A. Kristensen, Carl C. Hoffmann, Laurits Therkildsen, Annette Baattrup-Pedersen, Tenna Riis	The effects of experimental flooding of riparian wetlands on nutrient dynamics and plant communities in lowland streams	June 2012	Aarhus, Denmark	Researchers	> 50	International/ Europe	WP 4
	AU	Oral Presentation	Peter B. Kristensen, Tenna Riis, Esben A. Kristensen og Annette Baattrup-Pedersen,	Trofisk struktur og føderessourcer i skovbevoksede og åbne vandløb (In Danish).	January 2012	Odense, Denmark	Researchers and managers	>50	Denmark	WP 2
	AU	Oral Presentation	Martin Søndergaard, Rikke Bjerring, Erik Jeppesen	Lake restoration and the internal cycling of nutrients in lakes	17 October 2012	Zhangjiajie, China	Researchers	> 200	International/ World	WP 3
	AU	Oral Presentation	Martin Søndergaard	The European Water Framework Directive and lake management	10 October 2012	Institute of Hydrobiology, Chinese Academy of Science, Wuhan, China	Researchers	> 300	China	WP 3

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	AU	Oral Presentation	Martin Søndergaard	Danish lakes and their management	15 October 2012	Yangtze University, Jingzhou, China	Researchers/ students	>100	China	WP3
	UREAD	Oral Presentation	Medici C, Wade AJ	Does increased hydrochemical model complexity decrease robustness?	2012	University of Lancaster, UK	Academic	50-100	UK mainly	5
	UREAD	Oral Presentation	Lazar AJ, Wade AJ	'Validation' of complex ecological models.	2011	British Hydrological Society – National Meeting. , University of Birmingham	Academic	50-100	UK mainly	5
	UREAD	Oral Presentation	Prof R Skeffington	Linking Improved Modelling of Pollution to Innovative Development of Sensors	2012	Environment Agency, Kings Meadow House, Reading	Managers, water professionals	45	UK	5
	SYKE	Oral Presentation	Riku Varjopuro, Ahti Lepistö	Presentations at Kauttua stakeholder workshop	10 Oct, 2011	Pyhäjärvi Institute, Kauttua, Finland	Stakeholders	20		WP6
	SYKE	Oral Presentation	Katri Rankinen	Talk at NordicAdapt Conference: 'Adaptation to climate change in agricultural water protection – Catchment scale model analysis'.	29-31 August 2012	Helsinki, Finland	Research Scientists, specialists	50		WP5
	SYKE	Oral Presentation	Ahti Lepistö	Presentation at Reading WP5/WP6 workshop	1-2 Feb 2012	Reading University, UK	REFRESH researchers	20		WP5, WP6

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	SYKE	Oral Presentation	Ahti Lepistö, Marko Järvinen, Riku Varjopuro, Katri Rankinen	Presentations at REFRESH 3rd meeting workshops	19-22 March, 2012	Sitges, Spain	REFRESH researchers			WP3, WP5, WP6
	SYKE	Oral Presentation	Ahti Lepistö	Talk at BIOGEOMON 2012 Conference: 'Increasing organic C and N fluxes from a northern Finnish river basin – monitoring and modeling suggest climate-related controls'.	16-19 July, 2012	Maine, USA	Research Scientists	60-70		WP5
	SYKE	Oral Presentation	Ahti Lepistö, Katri Rankinen	Presentations at Reading WP5 workshop	13-14 Nov 2012	Reading University, UK	WP5	REFRESH researchers	20	Presentations at Reading WP5 workshop
	UDE	Oral Presentation		Managing climate change: "trees for cooler streams"	27-28 June 2011 (Y. Hershkovitz)	39th Annual Conference of the Israel Society of Ecology & Environmental Sciences	Scientists, stakeholders	70 ppl		2
	UDE	Oral Presentation		Refresh: an overview on its goals and experimental design	10 July 2012 (Y. Hershkovitz)	The Kinneret Limnological Laboratory (KLL), Israel	Scientists	10		2

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	Alterra	Oral Presentation	P. Verdonschot, A. Besse-Lototskaya	Restoring habitat heterogeneity, use conceptual models, ...??? "Looking for progress in stream restoration"	15-12-2011	Wageningen, NL	scientists	80	NL	WP2-4
	Alterra	Oral Presentation	P. Verdonschot, A. Besse-Lototskaya	Gevangen, ballingschap of vrijheid …. 30 jaar beekherstel in Nederland	14-12-2011	Wageningen, NL	stakeholders	120	NL	WP2-4
	Alterra	Oral Presentation	P. Verdonschot	Naar herstel op landschapsniveau van beekdalen in Nederland Over leven en werk van het OBN-deskundigenteam Beekdallandschap	04-06-2012	Zeist, NL	stakeholders, researchers	80	NL	WP2-4
	Alterra	Oral Presentation	P. Verdonschot, A. Besse-Lototskaya	Beekdalbreed Hermeanderen	12-13-12-2012	Soesterberg, NL	stakeholders, researchers, policy makers	200	NL	WP2-4
	Alterra	Oral Presentation	P. Verdonschot, R. Verdonschot	Verdonschot P. & Verdonschot R. 2012. From a multimetric towards an ecosystem functioning based diagnostic tool.	21/25-05-2012	SFS, Louisville, KY, USA.	researcher, water managers	50	17 worldwide	WP2
	WP3 leaders	Oral Presentation	WP3 leaders	CEH mesocosm experiment slides	Mar 2012	Blanes, Spain			EU	WP3

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	NERC	Oral Presentation	Alex Elliot	Ensemble modelling of Lake Engelsholm	Mar 2012	Blanes, Spain			EU	WP3
	NERC	Oral Presentation	Mike Acreman	Wetlands and climate change	05/07/12	Slimbridge, UK	50	50	UK	WP4, WP5
	NERC	Oral Presentation	Mike Acreman	Wetlands and climate change	12/12/12	Oxford, UK	40	40	UK	WP4, WP5
	NERC	Oral Presentation	James Blake	Wetland modelling	13/11/12	Reading, UK	20	20	EU, Canada	WP5
	SLU	Oral Presentation	Johnson, R.K.	"Response of species, habitats and ecosystems to impairment"	20-24 May, 2012	Louisville, USA		200		WP2, WP3
	James Hutton Institute	Oral Presentation	Julia Martin-Ortega	Economic aspects of the European water framework directive: Experiences and challenges in agricultural catchments	14-16 September 2011	Dublin, Ireland	Scientists and policy makers	>100	Europe	WP6
	James Hutton Institute	Oral Presentation	Dunn, S.M.	Reconciling questions with the need for answers. Invited oral presentation at IAHS 90th Anniversary PUB Symposium,	23-25 October 2012.	Delft, Holland	Scientists and policy makers	>100	Europe	WP5
	UU-BIO	Oral Presentation	Garssen	Effects of climate change on riparian plant communities along European lowland streams	15 December 2011	Wageningen University	Researchers and practitioners	80	The Netherlands, Belgium	WP2, WP4

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	UU-BIO	Oral Presentation	Garssen	Effects of increased flooding and drought on colonization processes and diversity of riparian plant communities	6 December 2012	Wageningen University	PhD students	30	The Netherlands	WP4
	CSIC	Oral Presentation	Bernal, S., D. von Schiller, E. Martí, and F. Sabater	Combining empirical and modelling approaches for assessing the potential of in-stream net uptake to regulate inorganic nitrogen export from catchments	22-27 April	European Geosciences Union General Assembly			Vienna	WP2
	UB/CSIC	Oral Presentation	Sabater, F., E. Martin, A. Porcher, L. Cañas, S. Poblador, C. Romero, A. Serra, E. Gacia, and E. Martí.	Spatial patterns of N2O and CO2 emissions during the growing season in a Mediterranean riparian zone	2-6 July	Iberian Society for Limnology			**Guimarães, Portugal**	WP4
	METU	Oral Presentation	Nihan Tavşanoğlu	Catchment scale biological monitoring of Lake Beyşehir	27-29 August	Isparta, Turkey	150	40	Turkey	WP5

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	METU	Oral Presentation	Nihan Tavşanoğlu	Effects of climate change combination with eutrophicaton and hydrology on structure and dynamics of lake ecosystem: mesocosm experiment	27-29 August	Isparta, Turkey	150	40	Turkey	WP3
	METU	Oral Presentation	Nur Filiz	Impacts of nutrients on periphyton growth and periphyton-macroinvertebrates interactions in shallow lakes: mesocosm experiment	27-29 August	Isparta, Turkey	150	40	Turkey	WP3
	METU	Oral Presentation	Nihan Tavşanoğlu	Habitat choice of zooplankton under predation pressure: macrophyte or sediment ?	27-29 August	Isparta, Turkey	150	40	Turkey	WP3
	BOKU	Oral Presentation	Astrid Schmidt-Kloiber	The power of freshwater invertebrates – relevance of the benthic invertebrate fauna for the monitoring of aquatic ecosystems	1/12/11	University Koblenz-Landau (Landau)	university researchers, students and	40	Germany	WP 2, 3, 4

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	BOKU	Oral Presentation	Wolfram Graf, Astrid Schmidt-Kloiber	Köcher- und Steinfliegen im Zeichen klimatischen Wandels ("Caddisflies and stoneflies under the influence of climate change")	13/10/12	Lunz	entomologists	50	Austria, Germany	WP 2, 3, 4
	BCAS	Oral Presentation	Miloslav Lapka	Socio-economic interests and possibilities to decrease phosphorus loading in the catchment of Orlík Reservoir [In Czech]	4-5 October 2011	4th ntl. conf. on Revitalisation of Orlík Reservoir, Písek, Czech Republic	local stakeholders, river authorities, public	80	Czech Republic	WP6
	BCAS	Oral Presentation	Josef Hejzlar	Long-term trends in pollution by nutrients in the catchment of Orlík Reservoir [In Czech]	4-5 October 2011	4th ntl. conf. on Revitalisation of Orlík Reservoir, Písek, Czech Republic	local stakeholders, river authorities, public	80	Czech Republic	WP5, WP6
	EMU	Oral Presentation	Kõiv, T., Cremona, F., Nõges, T.	A dynamic model for simulating internal carbon cycling in Lake Võrtsjärv, Estonia.	October 08-12, 2012	University of Konstanz, Germany.	3rd European Large Lakes Symposium ELLS 2012	150		WP 3
	EMU	Oral Presentation	Nõges, Peeter; Tuvikene, Lea	Spatial and year-to-year variability of environmental and phytoplankton variables in a large shallow lake: implications for water quality monitoring.	October 08-12, 2012	University of Konstanz, Germany.	3rd European Large Lakes Symposium ELLS 2012	150		WP 3

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	EMU	Oral Presentation	Zingel, Priit; Agasild, Helen; Karus, Katrit; Kangro, Kersti; Salujõe, Jaana; Nõges, Tiina	The relative importance of metazooplankters in regulating the community of planktonic ciliates in a shallow eutrophic lake.	October 08-12, 2012	University of Konstanz, Germany.	3rd European Large Lakes Symposium ELLS 2012	150		WP 3
	EMU	Oral Presentation	Nõges, Tiina	New perspectives of large lake studies in Estonia.	October 08-12, 2012	University of Konstanz, Germany.	3rd European Large Lakes Symposium ELLS 2012	150		WP 3
	UB	Oral Presentation	Sabater, F., E. Martin, A. Porcher, L. Cañas, S. Poblador, C. Romero, A. Serra, E. Gacia, and E. Martí.	Spatial patterns of N2O and CO2 emissions during the growing season in a Mediterranean riparian zone.	July 2012	**XVIth Congress of the Iberian Society of Limnology. Guimarães,** Portugal.			International	4
	UB	Oral Presentation	Bernal, S., D. von Schiller, E. Martí, and F. Sabater.	Combining empirical and modelling approaches for assessing the potential of in-stream net uptake to regulate inorganic nitrogen export from catchments.	22 – 27 April 2012	European Geosciences Union General Assembly. Vienna, Austria			International	4, 5

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	UB	Oral Presentation	Puig, M.A., C. Romero, E. Martín, A. Serra, F. Sabater, and E. Martí.	Effect of an experimentally induced drought in a permanent stream ecosystem on the macroinvertebrate community	July 2012	**XVIth Congress of the Iberian Society of Limnology. Guimarães,** Portugal.			International	2,4
	Bioforsk	Oral Presentation	Csilla Farkas, Johannes Deelstra and Marianne Bechmann	Process-based modelling of phosphorus losses from an agricultural dominated catchment in S-E Norway	3 Nov., 2011	International Workshop on Complex Systems in Chemistry, Physics and Biology, Budapest	Researchers, students	150	Norway, Hungary	WP5
	NIVA	Oral Presentation	Jostein Starrfelt	Modelling nutrients	27 Feb 2012	Oslo	Scientists, managers	Ca. 100	Norway	WP5
	NIVA	Oral Presentation	Silje Holen	Socio-economic impacts	27 Feb 2012	Oslo	Scientists, managers	Ca. 100	Norway	WP6
1	BCAS	Workshop	Cudlínová E	Social and economic impacts of water quality improvements in the basin of theOrlík reservoir	11 February 2013	Písek, Czech Republic	Scientific Community, Farmers, Fisheries, Civil Society	40	Czech Republic	WP6, WP5
2	BCAS	Conference presentation	Kopáček J	Long-term monitoring of water chemistry – a chronicle of socio-economic changes	22 February 2013	ASLO 2013 AQUATIC SCIENCES MEETING, 17-22 February 2013, New Orleans, USA	Scientific Community	40	Israel, USA, Germany, Lebanon	WP5

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3	BCAS	Conference presentation	Vojáček O	Cost effectiveness analysis of phosphorus reduction in Orlik catchment	15 May 2013	LakeAdmin INTERREG IVC project meeting, Vodňany, Czech Republic	Scientific Community	60	Czech Republic, Finland, Denmark, Estonia, Greece, Hungary, Ireland, Italy	WP6
4	BCAS	PhD Thesis	Krolová M	Factors affecting the occurrence of littoral vegetation in a reservoir with storage function	5 June 2013	University of South Bohemia, České Budějovice, Czech Republic	Academic	25	Czech Republic	WP3
2		Poster	Scharfenberger	Impact of climate on shallow lakes metabolism: Space for time approach in a mesocosm experiment across a North/South European gradient	9.-13.09.2013	Potsdam	Jahrestagung der Deutschen Gesellschaft für LImnologie	300	Sweden, Estonia, Germany, Czech Republic, Turkey, Greece	WP3
4		Workshop Presentation	Scharfenberger	CO2 flux and metabolism	29.04.2013	Antalya	REFRESH Project meeting	20	Sweden, Estonia, Germany, Czech Republic, Turkey, Greece	WP3
5		Workshop Presentation	Scharfenberger	Results from the German experimentation site	19-23.3.2012	Sitges	REFRESH Project meeting	20	Germany	WP3

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1	METU	Conference	Ülkü Nihan Yazgan Tavşanoğlu	International workshop for assesing the impacts of non-native freshwater fishes in the Mediterranean region	25-29th October 2010	Muğla/Turkey	Scientific community	200	Turkey	WP3
2	METU	International symposium	Eti Ester Levi	The 12th International Paleolimnology Symposium	21-24 August 2012	Glasgow, Scotland	Scientific community	200	Turkey	WP3
3	METU	International symposium	Gizem Bezirci	The 12th International Paleolimnology Symposium	21-24 August 2012	Glasgow, Scotland	Scientific community	200	Turkey	WP3
4	METU	International symposium	Ayşe İdil Çakıroğlu	The 12th International Paleolimnology Symposium	21-24 August 2012	Glasgow, Scotland	Scientific community	200	Turkey	WP3
5	METU	National symposium	Ülkü Nihan Yazgan Tavşanoğlu	5th National Limnology Symposium	27-29 August 2012	Isparta, Turkey	Scientific community	150	Turkey	WP3
6	METU	National symposium	Nur Filiz	5th National Limnology Symposium	27-29 August 2012	Isparta, Turkey	Scientific community	150	Turkey	WP3
7	METU	National symposium	Şeyda Erdoğan	5th National Limnology Symposium	27-29 August 2012	Isparta, Turkey	Scientific community	150	Turkey	WP3
8	METU	National symposium	Tuba Bucak	5th National Limnology Symposium	27-29 August 2012	Isparta, Turkey	Scientific community	150	Turkey	WP5
9	METU	Dissemination meeting	Meryem Beklioğlu	Lake Beyşehir: problems and possible mitigation strategies	13th June 2012	Beyşehir, Konya	Local people, Policy makers, Stakeholders	50	Turkey	WP5-WP7

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10	METU	PhD thesis	Arda Özen	Impact of top down and bottom up controls on the microbial loop in Turkish shallow lakes: space for time substitute, monitoring and mesocosms approaches	September 2012					
11	METU	MSc thesis	Nur Filiz	**Impacts of nutrients on periphyton growth and periphyton - macroinvertebrates interactions in shallow lakes : a mesocosm experiment**	September 2012					
12	METU	Workshop	Meryem Beklioğlu	Determining biological indices and ecological quality ratio	18-20th December 2012	Zonguldak/Turkey	Scientific community, Policy Makers	100	Turkey	WP7
13	METU	PhD Thesis	Ülkü Nihan Yazgan Tavşanoğlu	Zooplankton adaptation strategies against fish predation in Turkish shallow lakes	December 2012				Turkey	WP3
14	METU	Dissemination meeting	Meryem Beklioğlu,	REFRESH results dissemination meeting	2th December 2013	Ankara/Turkey	Scientific community, Policy Makers, Stakeholders	50	Turkey	WP7
15	METU	National congress	Meryem Beklioğlu	Third National Wetland Congress	23-25th October 2013	Samsun/Ankara	Scientific community, Policy Makers	150	Turkey	WP3-WP5

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16	METU	National congress	Şeyda Erdoğan	Third National Wetland Congress	23-25th October 2013	Samsun/Ankara	Scientific community, Policy Makers	150	Turkey	WP3
17	METU	National congress	Tuba Bucak	Third National Wetland Congress	23-25th October 2013	Samsun/Ankara	Scientific community, Policy Makers	150	Turkey	WP5
18	METU	National congress	Zeynep Ersoy	Third National Wetland Congress	23-25th October 2013	Samsun/Ankara	Scientific community, Policy Makers	150	Turkey	WP3
19	METU	PhD Thesis	Ayşe İdil Çakıroğlu	Salinity inference in inland Turkish shallow lakes based on paleoecology using sub-fossil cladocerans	January 2013				Turkey	WP3
20	METU	International congress	Meryem Beklioğlu	32nd Society of International Limnology	4-9th August 2013	Budapest/Hungary	Scientific community	300	Turkey	WP3
21	METU	International congress	Sandra Brucet	32nd Society of International Limnology	4-9th August 2013	Budapest/Hungary	Scientific community	300	Turkey	WP3
22	METU	National congress	Thomas Boll Kristensen	Turkey, Invasive Freshwater Species Workshop	12-14 th June 2013	İstanbul/Turkey	Scientific community	50	Turkey	WP3
23	METU	National symposium	Meryem Beklioğlu	**National Biodiversity Symposium**	22-23th May 2013	Muğla/Turkey	Scientific community, Policy Makers	150	Turkey	WP3, WP7
24	METU	Workshop	Meryem Beklioğlu	**METU Geology Engineering Department Water Workshop**	8th December 2013	Ankara/Turkey	Scientific community	70	Turkey	WP3, WP7
1	SYKE	Presentations in Project meeting workshops	Ahti Lepistö, Marko Järvinen, Riku Varjopuro	REFRESH 4th Project meeting	22-26 April 2013	Antalya, Turkey	Scientific Community/ project group	20-40	European	WP3, WP5, WP6, WP7,

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2	SYKE	Presentation in International Conference: 'Increasing organic C and N fluxes from a northern Finnish river basin - monitoring and modeling suggest climate- related controls'	Ahti Lepistö	Knowledge for the future. IAHS IAPSO IASPEI Joint Assembly.	22-26 July 2013	Gothenburg, Sweden	Scientific Community	50	International	WP5
3	SYKE	Presentation in International Conference: 'Cyanobacterial blooms in Finnish lakes – impacts of internal and external lake properties'	Marko Järvinen	XXXII Congress of the International Society of Limnology, SIL	5-9 August 2013	Budapest, Hungary	Scientific Community	50-80	International	WP3
4	SYKE	Presentation in International Conference: Integrated modelling of river-lake systems to assess the ecological response to projected environmental change: Lake Pyhäjärvi and River Yläneenjoki catchments, Finland + presentation in internal workshop	Ahti Lepistö Ahti Lepistö and Riku Varjopuro	REFRESH Science Symposium, London	6 November 2013 4 November 2013	London, UK London, UK	Scientific Community, Stakeholders project group	120-150 30	European European	WP5, WP6 WP5, WP6
5	SYKE	Presentation in national conference: 'Continuous measurement of water quality in lake and coastal stations - data reliability and the use of data in various applications'	Kari Kallio et al.	Finnish Limnological Symposium, Helsinki	10-11 April, 2013	Helsinki, Finland	Scientific Community, Stakeholders, Policy makers	80	Finland, (plus invited international keynote speakers)	WP3

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6	SYKE	Deliverable 5.5	Ahti Lepistö et al	Report on the biophysical catchment scale modelling of Yläneenjoki – Pyhäjärvi demonstration site.	2013		Scientific Community			WP5
7	SYKE	Deliverable 6.14	Riku Varjopuro et al	Cost-effectiveness analysis report for the Lake Pyhäjärvi including analysis of disproportionality	2013		Scientific Community			WP6
8	NERC, AU, SYKE,QMUL	Contribution to Deliverable 3.14 (in prep)	Marko Järvinen	Review on processes and effects on nutrients and organic material in lakes.	2014		Scientific Community			WP3
9	SYKE	Deliverable 7.16	Ahti Lepistö, Riku Varjopuro	Synthesis of work at Lake Pyhäjärvi/River Yläneenjoki catchment	2014		Scientific Community, Stakeholders, Policy makers			WP3, WP5, WP6, WP7
10	UREAD, SYKE et al.	Contribution to Deliverable 5.14	Andrew Wade, Richard Skeffington, Ahti Lepistö	Synthesis report	2014		Scientific Community			WP5
11	SYKE	Updated external web-pages of SYKE	Ahti Lepistö et al	REFRESH external web-pages of SYKE	January 2014	SYKE Helsinki	Scientific Community, Civil Society, Policy makers, Media		Finland	WP3, WP5, WP6, WP7,
12	SYKE	Briefing in internal web-pages of SYKE	Ahti Lepistö et al	Dissemination of major results of the project	January 2014	SYKE	Scientific Community, Experts and other stuff	650	Finland	WP3, WP5, WP6, WP7,

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13	SYKE	A presentation at the meeting of a Finnish environmental valuation research network "Arvoke"	Riku Varjopuro and Anna Tainio	Valuation of a small improvement in water quality	June 5th, 2013	SYKE, Helsinki	Scientific community	15	Finland	WP6
1	University of Patras	Conference	Stefanidis et al.	First International Conference on Remote Sensing and Geoinformation of Environment	8-10 April 2013	Paphos, Cyprus	Scientific community			WP3
2	University of Patras	Conference	Stefanidis et al.	13th Panhellenic Scientific Conference of Hellenic Botanical Society	3-6 October 2013	Thessaloniki, Greece	Scientific community			WP3
3	Universities of Patras, Oxford, Reading	Conference	Skuras et al.	133rd EAAE Seminar	14-16 June 2013	Chania, Greece	Scientific community	120		WP6
4	University of Patras	Policy – Science Symposium	Psaltopoulos, D. and Skuras, D.	WATER LIVES Policy - Science Symposium	29-30 January 2014	Brussels, Belgium	Scientific Community, NGOs, Policy Makers	200		WP7
1	UU-BIO	Lecture at conference	Merel Soons	Climate change and wetlands: water flows, plants move	23/01/2014	Utrecht	Scientific community, water boards, ngo's, consultancies, cilvil society, others.	250	NL, B, USA	WP4
2	UU-BIO	Lecture at conference	Merel Soons	REFRESH Science symposium: Freshwater management in a changing world	06/11/2013	London	Scientific community, water boards, ngo's, consultancies, cilvil society, others.	250	European	WP4

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3	UU-BIO	YouTube lecture	Merel Soons	Global change impacts on riparian wetlands	06/11/2013	Internet				WP4
4	UU-BIO	Lecture at conference	Merel Soons	Vegetation development following stream/river restoration (EGU2012)	26/04/2012	Vienna	Scientific community	50	European	WP4
5	UU-BIO	Key-note at SWS-Europe Conference	Jos Verhoeven	Wetlands in Europe: Perspectives for restoration of a lost paradise	14/06/2012	Aarhus	Scientific community, practitioners	90	European	WP4
6	UU-BIO	Lecture at conference	Jos Verhoeven	Climate change and wetlands: wetlands, a fascination	23/01/2014	Utrecht	Scientific community, water boards, ngo's, consultancies, cilvil society, others.	250	NL, B, USA	WP4
7	UU-BIO	Conference	Annemarie Garssen	Effects of climate change on riparian plant communities along European lowland streams	15/12/2011	Wageningen	Scientific community, water boards, consultancies.	80	NL, B	WP4
	Bio-Forsk	Seminar	Marianne Bechmann	Seminar for River sub-basin districts in the Glomma RBD.	27 September	Oslo, Norway	Management			
1	Bio-Forsk	Workshop	Eva Skarbøvik, Marianne Bechmann (separate speaches)	Workshop on Lake Vansjø	21-22 October 2013	Moss, Norway	Management, politicians, stakeholders, scientists			
2	Bio-Forsk	Symposium		Refresh Science symposium	6 November 2013	London, UK	Science, User communities			

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3	Bio-Forsk	Workshop	Eva Skarbøvik	Workshop on Climate Change and Agriculture; implications for water quality	December 11	Lillestrøm, Norway	User communities			
4	Bio-Forsk	**Report:** Bioforsk Report Vol. 8, No. 188, 2013, ISBN no. 978-82-17-01202-3	Eva Skarbøvik (editor)	Current knowledge, and knowledge gaps, on Lake Vansjø. Lake Vansjø Workshop Report. (In Norwegian)	December 2013		Management, politicians, stakeholders			
5	Bio-Forsk	**Web**: Update of web-based guidance on agricultural measures, especially on cost-effect of measures.	Eva Skarbøvik (editor)	Guidance on agricultural measures to reduce water contamination.	2013	www.bioforsk.no/tiltak www.bioforsk.no/agri_measures	Aimed at management/user communities			
1	JHI	7th International Phosphorus **Workshop,**	Jackson-Blake, L.A	How useful are complex catchment-scale phosphorus models? -	9 - 13 September 2013.	Uppsala, Sweden	Scientific community			WP5
2	JHI	**Conference paper:** Well-being and Equity within Planetary Boundaries. Biannual Conference of the International Society for Ecological Economics	Martin-Ortega, J.; Balana, B.; Cooksley, S.; Dunn, S.M.; Helliwell, R.C.; Jackson-Blake, L.; McKee, A.; Perni, A.; Slee, B. -.	A transdisciplinary approach to the economic analysis of the water framework directive	13-15 August 2014	University of Iceland	Scientific community			WP5/6
3	JHI	**Contract report:** Deliverable 5.3: REFRESH website.	Jackson-Blake, L.; Dunn, S.M.; Hershkovitz, Y.; Sample, J.; Helliwell, R.C.; Balana, B	Biophysical catchment-scale modelling in the River Dee, Scotland	2013		Scientific community/Policy makers			WP5

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4	JHI	**Contract Report** for EU FP7 REFRESH project (WP6 Deliverable 6.10).	Balana, B.B.; Kontolaimou, A.; Psaltopoulos, D.; Tainio, A.; Vajopuro, R.	Pan-European review of cost-effectiveness analysis of studies relating to water quality and Directive compliance challenges.	2013		Scientific community/Policy makers			WP6
5	JHI	**Contract report** for EU FP7 REFRESH project Deliverable 6:12	Martin-Ortega, J.; Balana, B.B.	Cost-effectiveness analysis report for the Thame sub-catchment including analysis of disproportionality	20132		Scientific community/Policy makers			WP6
6	JHI	**Contract report** for EU FP7 REFRESH project Deliverable 6.17	Martin-Ortega, J.; Psaltopoulos, D.; Perni, A.; Raya, I.; Varjopuro, R.; Tainio, A.; Skuras, D.; Policková, B.; Skarbovik, E.; Holen, S.; Pelkonen, R.; Slavikova, L.; Lapka, M.; Hejzlar, J.; Vojacee, O.	Scoping report on wider ecosystem services benefits arising from mitigation actions	2013		Scientific community/Policy makers			WP6
7	JHI	**Report** for EU FP7 REFRESH project	Balana, B.; Martin-Ortega, J.; Perni, A.; Slee, B.; Helliwell, R.C.; Jackson-Blake, L.; Cooksley, S.L.; Dunn, S.M	Cost-effectiveness analysis report for the Dee sub-catchment (Scotland) including analysis of disproportionality	2013		Scientific community/Policy makers			WP6

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NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
8	JHI	Intersezioni - **Online magazine** of the Agronomist Professional Association of Milano. Invited submission	Dunn, S.M.; Balana, B.B.	How effective are agricultural management measures at improving water quality?	2013		Scientific community/Policy makers			WP5/6
9	JHI	EU REFRESH Project **Meeting**	Helliwell, R.; Sample, J.; Potts, J.; Hrachowitz, M.; Mawby, G.; Pavlova, M	Modeling maximum river temperature and ecological response to land use and climate change in the Gairn catchment.	4-11-2013	London	Scientific community			WP5
10	JHI	**REFRESH Stakeholder Symposium**	Martin-Ortega, J.; Perni, A.; Slee, B.	Social and economic effects of improving water quality. Sharing scientific and local knowledge. Thame case study	6-11-2013	London	Scientific community/Land managers			WP6
11	JHI	**REFRESH Stakeholder Symposium**	Slee, B.; Balana, B.; Dunn, S.M.; Jackson-Blake, L.; Perni, A.; Helliwell, R.C.	Can modelling support integrated catchment management. Dee case study.	6-11-2013	London	Scientific community/Regulators/Industry			WP5/6
12	JHI	Ecosystem Approach **Working Group**, EAWG4 Workshop. Managing change: the role of scenarios in decision making, Scottish Government	Dunn, S.M.; Towers, W.; Sample, J.; Dawson, J.; Jackson-Blake,L.; Brown, I.; Castellazzi, M.; Helliwell, R.	Using land use and climate scenarios to explore impacts on future water quality	11-3-2013	Edinburgh	Scientific community/Regulators/Industry	50	Scotland	WP5
13	JHI	**Presentation** International Conference on Land Use and Water Quality, Reducing Effects of Agriculture	Dunn, S.M.; Balana, B.; Helliwell, R.C.; Jackson-Blake, L.; Vinten, A.J.A.	Modelling catchment scale effectiveness of a suite of diffuse pollution mitigation measures on water quality.	10-6-2013	Netherlands	Scientific community/Industry		International conference	WP5/6

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NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
14	JHI	REFRESH IV **General Project Meeting**	Martin-Ortega, J.; Perni, A.	Disproportionality analysis and wider benefits in the Thame and Dee sub-catchments.	25-4-2013	Turkey	Scientific community			WP6
15	JHI	REFRESH IV **General Project Meeting**	Jackson-Blake, L.; Dunn, S.M.; Helliwell, R.C	Progress report: biogeochemical modelling in the Dee catchment	25-4-2013	Turkey	Scientific community	20	WP5 contributors	WP5
16	JHI	REFRESH IV **General Project Meeting**	Helliwell, R., Donnelly,D., Jackson-Blake, L., Sample, J	Modelling Total Phosphorus in the Loch of Skene, Dee catchment	25-4-2013	Turkey	Scientific community	20	WP5 contributors	WP5
17	JHI	**Presentation** International Conference on Land Use and Water Quality: Reducing Effects of Agriculture	Jackson-Blake, L.; Dunn, S.M.; Helliwell, R.C.; Wade, A.J.	Process-based phosphorus modelling in a small agricultural catchment	10-6-2013	Netherlands	Scientific community/Industry		International conference	WP5/6
18	JHI	**Report** to staff at MRP and Scottish Government	Helliwell, R.C.; Irvine, R.J.	Towards developing a common understanding of scenarios in research and practice in Scotland	28/1/2013	Scotland	Scientific community/Policy makers		Scottish	WP1/5
19	JHI	**Policy/stakeholder briefing**	Martin-Ortega, J.; Perni, A.; Balana, B.; Slee, B	Improving water quality in the River Thame: sharing scientific and local knowledge. REFRESH Project: 2013	2013	UK	Scientific community/Regulators/Industry		UK	WP6
20	JHI	**REFRESH website**	Jackson-Blake, L.; Dunn, S.M	Synthesis of modelling results: the River Dee catchment, Scotland.	2013					WP5

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1	NIVA	workshop	Jostein Starrfelt	Eutropia-REFRESH modelling workshopEuropean Conference on Nanotechnologies	10-11 May 2012	Fredrikstad, Norway	Scientific community	20	Norway	WP5, WP6
2	NIVA, BIOFORSK	conference	Richard Wright	Vansjøkonferansen	30 August 2011	Ski, Norway	stakeholders	50	Norway	WP5, WP6
3	NIVA, BIOFORSK	workshop	Richard Wright	MORSA scenarios	24 August 2011	Ås, Norway	River basin managers	4	Norway	WP5, WP6
4	NIVA	conference	Jostein Starrfelt	Water resources management conference	27-28 February 2012	Oslo, Norway	Scientific community, policymakers	100	Norway	WP5, WP6
5	NIVA	conference	Richard Wright	Final Eutropia conference	30-31 May 2013	Oslo, Norway	Scientific community	45	Norway	WP3, WP5, WP6
6	NIVA, BIOFORSK	workshop	Richard Wright	Workshop om Vansjø	21- 22 October 2013	Dillingøy kurssenter	stakeholders	50	Norway, Denmark	WP3, WP5, WP6
7	NIVA	poster	S.J. Moe	Climate change and ecological status of phytoplankton: a Bayesian Network modelling approach.	4-7 November 2014	London, UK	Scientific community	150	Noway	WP3, WP5, WP6
8	NIVA	poster	S.J. Moe	Ecological signals of climate change in 40-year time series from Lake Mjøsa.	4-7 November 2014	London, UK	Scientific community	150	Noway	WP3, WP5, WP6
9	NIVA	poster	S.J. Moe	Climate change and ecological thresholds for cyanobacteria: analysis of 590 lakes in Northern Europe.	4-7 November 2014	London, UK	Scientific community	150	Noway	WP3, WP5, WP6
1	UDE	Conference	Yaron Hershkovitz	European Climate Change Adaptation Conference	18-19/3/2013	Hamburg, Germany	Scientific Community	50	International	2
2	UDE	Workshop	Yaron Hershkovitz	Understanding river restoration	25-26/6/2013	Utrecht, The Netherlands	Water managers, planners, Scientists	25	Europe	2

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3	UDE	Summer school	Yaron Hershkovitz	Increasing Sustainability in River Basin Planning and Management: Concepts and Tools for River Restoration	6-8/8/2013	Venice, Italy	PhD students	20	Europe	2,5
4	UDE	Workshop	Yaron Hershkovitz	Adaptation to climate change	16-18/12/2013	Udine, Italy	Water managers, planners, Scientists	35	Europe	2
5	UDE	Web site	Yaron Hershkovitz	www.climate-and freshwater.info		Web-based platform	Water managers, planners, Scientists, students	Web-users	International	2,3,4,5
6	UDE	"on-line" poster	Yaron Hershkovitz	www.climate-and freshwater.info	6-11-2013	London, U.K.	Water managers, planners, Policy makers Scientists, students	50	Europe	2,3,4,5
1	University of Reading	Workshop (JHI led)	Wade AJ, Shahgedanova, M	REFRESH Cross-European Policy workshop	16-17 March 2011	London	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers	10-20	UK	5,6
2	University of Reading	Symposium	Wade AJ	Water Lives: scientific horizons for biodiversity an water policy	29-30 January 2014	Royal Belgian Institute of Natural Sciences	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers	100-150	Broad cross-section of EU countries	5

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3	University of Reading	Conference	Wade AJ	Freshwater Management in a Changing World	06-07 November 2013	UCL	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers	100-150	Broad cross-section of EU countries	5, 6
4	University of Reading	Conference	Skeffington RA	Freshwater Management in a Changing World	06-07 November 2013	UCL	Scientific Community (higher education, Research), Industry, Civil Society, Policy makers	100-150	Broad cross-section of EU countries	5
5	University of Reading	WP6 stakeholder workshop led by JHI	Skeffington RA	Thame WP6 Stakeholder Workshop	20 April 2012	Whitchurch, UK	Scientific Community (higher education, Research), Industry, Civil Society, Farmers, Anglers	20-30	UK	5, 6
6	University of Reading	Stakeholder led meeting. UREAD invited.	Skeffington RA	EA-led Thame Meeting	27 March 2013	Thame, UK	Environment Agency, Pond Conservation, the River Thame Conservation Trust and Thames Water, local farmers.	50-100	UK	5,6

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7	University of Reading	Environment Agency and Atkins led report card	Wade AJ	Environment Agency and Atkins led expert working group to develop a climate change impacts report for the water sector.	2012-2013	Web-based http://www.lwec.org.uk/resources/report-cards/water	Scientific Community (higher education, Research), Industry, Civil Society	NA	UK	5
8	University of Reading	Conference	Wade AJ	TERENO – Terrestrial Environmental Observatories – From observation to prediction in environmental systems – an international conference.	29 September-02 October 2014.	Rheinische Friedrich-Wilhelms-Universität Bonn, Germany,	Scientific Community (higher education, Research), Industry, Civil Society	150-200	Broad International	5
9	University of Reading	Conference	Wade AJ	IAHS IAPSO IASPEI Joint Assembly, Gothenburg, Sweden,	22-26 July 2013	Gothenburg, Sweden,	Scientific Community (higher education, Research), Industry, Civil Society	40-50	Broad International	5
10	University of Reading	Conference	Wade AJ, Skeffington RA, Halliday SJ	New HS2.3 Monitoring Strategies: temporal trends in groundwater and surface water quality and quantity. European Geophysical Union 2013,	April 2013	Vienna, Austria.	Scientific Community (higher education, Research), Industry, Civil Society	80-120	Broad International	5

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11	University of Reading	Conference	Skuras D (UPAT), Wade AJ	133rd EAAE Seminar	15-16 June 2013	Chania, Crete, Greece.	Scientific Community (higher education, Research), Industry, Civil Society	80-120	Broad International	5
12	University of Reading	Symposium	Wade AJ	Assessing the impacts of environmental change on freshwater ecosystems. International Symposium on Resilience to Climate Change in Southeast Asia, 16-18 April 2013;	16-18 April, 2013	Johor Bahru, Malaysia.	Scientific Community (higher education, Research), Industry, Civil Society	60-80	International from Pacific Rim	5
13	University of Reading	Conference	Lazar AN	British Hydrological Society – National Meeting.	2011	University of Birmingham, UK	Scientific Community (higher education, Research), Industry, Civil Society	60-80	UK	5
14	University of Reading	Conference	Wade AJ	Hydrology 2010 (The Changing Physical and Social Environment: Hydrologic Impacts and Feedbacks) organized by Elsevier and is supported by UNESCO and Elsevier's Journal of Hydrology,	October 2010	San Diego, California, USA	Scientific Community (higher education, Research), Industry, Civil Society	150-200	Broad International	5

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14	University of Reading	Conference	Wade AJ (Medici C led)	Mediterranea XXIV Congresso Latinoamerican de hidraulica	November 2010	Punta del Este, Uruguay,	Scientific Community (higher education, Research), Industry, Civil Society	50-80	Broad International	5
14	University of Reading	Conference	Wade AJ (Medici C led)	European Geophysical Union, Vienna, April 2010.	April 2010	Vienna, Austria	Scientific Community (higher education, Research), Industry, Civil Society	50-80	Broad International	5
	UCL	Poster Presentation	Martin Kernan, Helen Bennion and Rick Battarbee	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems – the REFRESH Project	26-28 April 2010	WFD Lille 2010 - Conference on Integrated River Basin Management under the Water Framework Directive				
	Alterra	Poster Presentation	A. van Oosten, P. Verdonschot and A. Besse-Lototskaya	The effects of shade on water temperature and invertebrates in lowland streams	22-26 May 2011	The North American Benthological Society meeting, Providence, Rhode Island, USA.				
	SLU	Poster Presentation	Sandin, L and Almlöf, K.	Adaptation and mitigation to climate change in freshwaters – the EU REFRESH project.	8th and 9th of November 2010	International Conference, "Climate adaptation in the Nordic countries",				

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	UU-BIO	Poster Presentation	Annemarie Garssen, supervised by Merel Soons and Jos Verhoeven	Poster: 'Effects of climate change on colonization and biodiversity of riparian plant communities'	8 and 9 February 2011	Netherlands Annual Ecology Meeting 2010 Lunteren, The Netherlands				
	UU-BIO	Poster Presentation	Annemarie Garssen, supervised by Merel Soons and Jos Verhoeven	Poster: 'Effects of climate change on colonization and biodiversity of riparian plant communities'	02 June 2011 to 04 June 2011	Plant Population Biology 2011 Conference Oxford, UK				
	CSIC	Poster Presentation	Clara Romero, Alexandra Serra, Eugènia Martí, M. Angels Puig	Influence of riparian canopy cover on stream water temperature and benthic macroinvertebare communities.	27/06/11-1/07/11	7th Symposium for European Freshwater Sciences. Girona, Spain				
	FVB	Poster Presentation	Adrian, Rita; Veronika Huber; Carola Wagner and Dieter Gerten	To bloom or not to bloom: Heat waves and contrasting cyanobacteria response	April 2010	Academy Colloquium: Predictability of Plankton Communities in an Unpredictable World				
	FVB	Poster Presentation	Carola Wagner & Rita Adrian	Cyanobacteria blooms – quantifying the effects of climate change	April 2010	Academy Colloquium: Predictability of Plankton Communities in an Unpredictable World				

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	FVB	Poster Presentation	Carola Wagner, Rita Adrian	Changes in thermal regime during summer affect plankton diversity and species composition in a polymictic lake.	August 2010	SIL meeting 2010, Cape Town				
	FVB	Poster Presentation	Veronika Huber; Carola Wagner, Dieter Gerten and Rita Adrian	Changes in functionality versus biodiversity during heat wave events in lake ecosystems	December 2010	Internat. Conference on Biodiversity, Frankfurt, Germany				
	EMU	Poster Presentation	Tiina Nõges, Helgi Arst, Alo Laas, Tuuli Kauer, Peeter Nõges, Kaire Toming	Reconstructed long term time-series of phytoplankton primary production of a large shallow temperate lake	24–28/4/11	7th International Shallow Lake Conference; Wuxi, China				
	UB	**Poster Presentation**	A.Lupón & F.Sabater	**Relating nutrient uptake with transient storage zones: evidence from in-channel obstructers manipulation**	06/30/11	SEFS'11				
	UPAT	Poster Presentation	E. Papastergiadou, K. Stefanidis, Ch. Papadaki, and A. Samiotis	Effects of temperature, salinity, and water level on biotic communities and ecosystem metabolism: an outdoor mesocosm experiment in Greece.	September 24-27, 2011	MESAEP- 16th International Symposium on Environmental Pollution and its Impact on Life in the Mediterranean Region				

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	UPAT	Poster Presentation	E. Papastergiadou, K. Stefanidis, Ch. Papadaki, and A. Samiotis	First results from a mesocosm experiment in lake Lysimachia, Greece.	29/9-2/10, 2011	Hellenic Botanical Society, RETHYMNO, GREECE				
	UCL	**Oral Presentation**	Martin Kernan, Richard Skeffington, Andrew Wade, Richard Johnson	**The effects of interactions between climate change and other key drivers of change on freshwater ecosystems – the message for managers**	June 2010	ASLO/NABS Summer Meeting, Santa Fe				
	UCL	Oral Presentation	Martin Kernan	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	June/July 2010	NCCARF Climate Adaptation Futures Conference – Gold Coast				
	UCL	Oral Presentation	Martin Kernan	Challenges for management of freshwater ecosystems in Europe	July 2010	Seminar at National Water Commission, Canberra				
	UCL	Oral Presentation	Martin Kernan	Challenges for management of freshwater ecosystems in Europe	July 2010	Seminar at Monash Sustainability Institute, Melbourne				
	UCL	Oral Presentation	Martin Kernan	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems – the REFRESH project	January 2011	Workshop on Science and Data Gaps in EU Water-Related Projects				

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	UCL	Oral Presentation	Martin Kernan	Introduction to the REFRESH Project	March 2011	Workshop on Cross European Policy – Future challenges to WFD implementation				
	UCL	Oral Presentation	Martin Kernan	Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	June 2011	AEHMS 10 The Aquatic Ecosystem Puzzle: Threats, Opportunities and Adaptation				
	UREAD	Oral Presentation	Wade, A.J., Skeffington RA, Lazar AN, Butterfield D, Futter MN, Jarvie HP, Whitehead, PG.	An Assessment of the European Freshwater Ecological Response to Current and Future Changes in Hydrology and Biogeochemical Cycling	10-13 October 2010	Hydrology 2010 (The Changing Physical and Social Environment: Hydrologic Impacts and Feedbacks) organized by Elsevier and supported by UNESCO and Elsevier's Journal of Hydrology, San Diego, California, USA.				
	UREAD	Oral Presentation	Halliday SJ, Wade AJ, Neal C, Reynolds B, Norris D, Skeffington RA.	Long-term low-frequency or short-term high-frequency monitoring: are both necessary?	3-8 April 2011	European Geophysical Union 2011, Vienna, Austria.				

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	UREAD	Oral Presentation	Jin L, Whitehead, PG.	The Thames Case study- Impacts of climate change on flow and nitrogen	19-23 July 2010	British Hydrological Society Meeting				
	SYKE	Oral Presentation	Ahti Lepistö	Valuma-alue- ja järvimallien ketjutus REFRESH hankkeessa	3.2.2011	9. National meeting for Ecosystem Modellers				
	SYKE	Oral Presentation	Ahti Lepistö	Increasing organic C and N fluxes from a northern boreal river basin to the sea.	4-7.7. 2011	IAHS symposium H04 held during IUGG2011 in Melbourne, Australia.				
	SLU	Oral Presentation	Sandin, L & Bergfur, J.	Multiple stressor effects on ecosystem structure and function	7th to 11th of May 2010	North American Benthological Society joint meeting Santa Fe, USA,				
	SLU	Oral Presentation	Sandin, L.	Landuse dynamics at the local and regional scale – consequences for biodiversity in streams	16th to 20th of August 2010	Societas Internationalis Limnologie congress, Cape Town, South Africa,				
	SLU	Oral Presentation	Sandin, L.	Freshwater metacommunities, will they be affected by climate change?	9th to 12th of May 2011,	Nordic Benthological Meeting, “Food webs and climate change”,				

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	NERC	Oral Presentation	Acreman, M.C., Blake, J.	Projecting the impacts of climate change on wetlands in England and Wales	29 June 2011	Wetland Futures				
	MLURI	Oral Presentation	*Helliwell, R.C., Jackson-Blake, L., Wright, R.F., Ferrier, R.C., et al*	Long-term record of acidification and recovery.	*15-19 June 2011*	*Acid Rain 2011, Chinese National Conference Centre, Beijing*				
	MLURI	Oral Presentation	*Martin-Ortega, J. et al* (2010)	Benefit transfer and spatial heterogeneity of preferences in the valuation of water quality improvements	*28 June -2 July 2010*	*IV World Congress of Environmental and Resource Economists, Montreal*				
	MLURI	Oral Presentation	*Martin-Ortega, J. et al*	The non-market value of reclaimed wastewater for use in agriculture in the context of WFD.	*21-26 March 2010*	*Benchmarking Exercise and Recommendations on the Application of the WFD, Aman, Jordan*				
	MLURI	Oral Presentation	Helliwell, R.C., Schöep, W., Jackson-Blake, L (2011)	Development of air pollution scenarios for 8 demonstration catchments.	*March 2011*	High level stakeholder workshop, London				
	MLURI	Oral Presentation	*Alcon, F., Martin-rtega, J., Pedrero, F., Miguel, D.D.E. & Alarcon, J.J.*	Cost benefit analysis of the use of reclaimed waste-water in agriculture	*29 June - 2 July 2011*	*VI International Symposium-EWRA 2011, Water Engineering and Management in a Changing Environment, Catania, Italy*				

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	MLURI	Oral Presentation	*Gomez-Limon, J.A. & Martin-Ortega, J.*	The economic analysis in the implementation of the water framework directive in Spain	*29 June - 2 July 2011*	*VI International Symposium-EWRA 2011, Water Engineering and Management in a Changing Environment, Catania, Italy*				
	MLURI	Oral Presentation	*Martin-Ortega, J. & Balana, B.B.*	Cost-effectiveness analysis in the implementation of the water framework directive: approaches, experiences and challenges.	*29 June - 2 July 2011.*	*VI International Symposium-EWRA 2011, Water Engineering and Management in a Changing Environment, Catania, Italy,*				
	MLURI	Oral Presentation	*Mesa-Jurado, M.A., Martin-Ortega, J., Ruto, E. Y. & Berbel, J.*	The economic value of guaranteed supply for irrigation under scarcity conditions	*29 June - 2 July 2011.*	*Annual Conference of the European Association of Environmental and Resource Economists, 18th, Rome*				

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	UU-BIO	Oral Presentation	Dr. Merel Soons	'Development of local diversity in riparian zones along restored streams: dispersal and colonization'	8 December 2010	Centre for Wetland Ecology symposium: It's all about dispersal, germination, establishment and succession, Wageningen The Netherlands				
	CSIC	Oral Presentation	Susana Bernal, Daniel von Schiller, Eugènia Martí, and Francesc Sabater.	Temporal variability of in-stream net uptake: implications for inorganic nitrogen export from catchments	30/06/11	7th Symposium for European Freshwater Sciences. Girona, Spain				
	CSIC	Oral Presentation	Eugènia Martí, Daniel von Schiller, Susana Bernal, Miquel Ribot, and Francesc Sabater.	Patterns of temporal variation in net and gross in-stream nutrient uptake.	30/06/11	7th Symposium for European Freshwater Sciences. Girona, Spain				

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	METU	Oral Presentation	Ü. Nihan Tavşanoğlu, A. İdil Çakıroğlu, Eti E. Levi, Arda Özen, Korhan Özkan, Didem Oğuzkurt,Tuba Bucak, Gizem Bezirci, Erik Jeppesen & Meryem Beklioğlu	Preliminary Study on Native & Non-native Fish Species Community in Shallow Lakes of Turkey	25-29th October 2010	International workshop for assesing the impacts of non-native freshwater fishes in the Mediterranean region				
	FVB	Oral Presentation	Carola Wagner, Rita Adrian, Jürgen Alheit,Thorsten Blenckner, Stephanie E. Hampton, Franz Hölker, Daniel E. Schindler	Regime shifts in marine and lake ecosystems: Teleconnection patterns.	August 2010	SIL meeting; Cape Town				
	FVB	Oral Presentation	Klement Tockner	Real-time ecosystem ecology	2011	ISRS Conference Berlin				

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	EC-JRC	Oral Presentation	Nõges, T.	Adaptation and mitigation strategies of climate change impact on water quality. Potential cross-sectorial conflicts of climate change adaptation, mitigation and restoration strategies in River Basin Management scale.	August 2010	31st Congress of the International Society of Limnology (SIL)				
	EC-JRC	Oral Presentation	Nõges, T., Cardoso, AC, Brucet, S, van de Bund, W., P. Nõges.	The Impact of Climate Change on Lake Ecosystems.	October 2010	4th International scientific Conference to commemorate Prof. G.G. Winberg: Modern problems of aquatic Ecology.				
	BCAS	Oral Presentation	Hejzlar J., Borovec J., Mošnerová P., Polívka J., Turek J., Volková A., Žaloudík J.	A mass balance study of nutrient sources in the catchment of Orlík Reservoir (Bilanční studie zdrojů živin v povodí nádrže Orlík)	12/10/10	Conf. Revitalisation of Orlík Reservoir 2010, Písek, Czech Republic, October 12-13, 2010				

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NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
	EMU	Oral Presentation	Nõges, T., A.C. Cardoso , W. van de Bund.	Climate change and water: potential cross-sectorial trade-offs between adaptation, mitigation and restoration measures in river basin management.	15-20/8/10	International Society of Limnology (SIL) Congress 2010, Cape Town, Republica of South Africa				
	EMU	Oral Presentation	Kernan, M., Nõges, P.	Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems.	6-9/710	International Workshop 'Climate Change Impacts and Adaptation: Reducing Water-related Risks in Europe'				
	EMU	Oral Presentation	Nõges, T., Cardoso, A.C., Brucet, S. , W. van de Bund.	The impact of climate change on lake ecosystems.	11-15/10/10	International Congress 'MODERN PROBLEMS OF AQUATIC ECOLOGY', Institute of Zoology, RAS, St. Petersburg				

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES										
NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
	EMU	Oral Presentation	Nõges, P.	River-basin scale adaptation to climate change	31/5-11/6/10.	Nordic Research Training Course "Advanced Technologies in Measurements of Physical and Biological Interactions in Pelagic Systems of Large Lakes" that will take place at the University of Eastern Finland, Joensuu, Finland.				
	UB	Oral Presentation	Francesc Sabater, Joan Lluis Riera, Eugènia Martí, Maddi Altuna, Joaquim Comas, Joserra Díez y Arturo Elosegi	STREAMES 1.0©, an Environmental Decision Support System for stream management with emphasis on ecosystem functionality at reach scale	06/27/11	SEFS' 11				
	UPAT	Oral Presentation	K. Stefanidis, Eva Papastergiadou	Relationships between lake morphology and macrophyte species abundance and distribution in Greek lakes.	September 24-27, 2011	MESAEP- 16th International Symposium on Environmental Pollution and its Impact on Life in the Mediterranean Region				

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES										
NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
	BIOFORSK	Oral Presentation	Farkas Cs., Deelstra J. and Bechmann M.	Process-based modelling of phosphorus losses from an agricultural dominated catchment in S-E Norway	30/9/10	6th International Phosphorus Workshop, Seville, Spain				
	BIOFORSK	Oral Presentation	Farkas Cs., Deelstra, J., Stålnacke, P., Barkved, L.J., Kaste, Ø.	Pros and cons of INCA-P in modelling of run-off abatement measures: tillage, fertilization, buffer strips and wetlands	14/9/10	Workshop on Integrated Monitoring and Modelling of the effects of various Measures on Nutrient Runoff in the Morsa Catchment. Ås, Norway				
	BIOFORSK	Oral Presentation	Farkas, Cs.	Modeling mitigation measures in Sealink and Refresh in Morsa.	14/9/10	Workshop on Integrated Monitoring and Modelling of the effects of various Measures on Nutrient Runoff in the Morsa Catchment. Ås, Norway				

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES										
NO.	Beneficiary	Type of activities[1]	Main Leader (Author)	Title	Date/Period	Place	Type of audience[2]	Size of audience	Countries addressed	Related to which WPs
	TRENT	Oral Presentation	North, R. L., J. Winter and P. J. Dillon	Phosphorus bioavailability to phytoplankton in Lake Simcoe	May 2011	International Association of Great Lakes Research (IAGLR) Conference. Duluth, Minnesota				
	TRENT	Oral Presentation	Oni, S. K, M. N. Futter, P.J Dillon	Hydrological consequences of climate change in the Lake Simcoe, Ontario watershed: a statistical downscaling approach	May 2011	2011 Lake Simcoe Protection Plan Science Forum. Barrie, Ontario				
	TRENT	Oral Presentation	Oni, S. K., M. N. Futter and P. J. Dillon	Environmental controls of carbon budget and hydrology in Lake Simcoe	February 2011	46th Central Canadian Symposium on Water Quality Research. Burlington, ON				
	TRENT	Oral Presentation	Miles, J. J., P. J. Dillon, R. L. North and M. C. Eimers	Forms of phosphorus in the Beaver River Watershed of Lake Simcoe, Ontario	January 2011	Society of Canadian Limnologists Conference. Toronto Ontario				
	TRENT	Oral Presentation	North, R. L., J. Winter and P. J. Dillon	Phosphorus bioavailability in Lake Simcoe tributaries: is it correlated with land use?	May 2011	2011 Lake Simcoe Protection Plan Science Forum. Barrie, Ontario				

Section B (Confidential[2] or public: confidential information to be marked clearly)
Part B1

There are no applications for patents, trademarks, registered designs, etc. associated with REFRESH

TEMPLATE B1: LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.					
Type of IP Rights[3]:	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)

[2] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.

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

Part B2
Please complete the table hereafter:

Type of Exploitable Foreground[4]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[5]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
General advancement of knowledge	*Increased undertsanding of climate and land use change impacts on freshwater ecosystems*	*NO*	*n/a*	*n/a*	*A Agriculture, forestry and fishing* *Environmental management*	*n/a*	*n/a*	*IPR rules apply*
Application of improved knowledge	*Guidelines and best practice strategy for management of freshwater ecosystems*	*NO*	*n/a*	*n/a*	*A Agriculture, forestry and fishing* *Environmental management*	*n/a*	*n/a*	*IPR rules apply*

Most of the exploitable foreground in REFRESH comes in the form of advancement in knowledge, in particular, how streams, lakes and riparian wetlands will respond to changes in future land use, climate, water resource use and atmospheric pollution. The purpose of this was to provide the scientific knowledge required to underpin management of freshwater ecosystems now, and in future. This information will be of value for policy makers, practitioners and water managers, particularly those tasked with implementing the Water Framework Directive. The knowledge is immediately applicable for attempts to reach compliance in the ecurrent phase of the WFD and, in future, to advise as part of any revisions to improve the Directive.

[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

Below the key expected outcomes from the project are highlighted along with the impact and use of these in terms of increased scientific understanding and policy and management value.

Improved prediction capacity of impacts on water, water resources and related natural systems in river basins and wetlands
A modelling framework has been developed that takes integrated scenarios of climate, land management, water use and atmospheric deposition change as input to biophysical catchment models that represent connected river-lake-wetland systems, and determines the long-term, and is some cases, seasonal changes in flow and water quality and key ecological indicators. This framework is applicable on a catchment-by-catchment basis and thereby considers the nuances of each and is compatible with the basic management unit on which the Water Framework Directive is based: the river catchment. The biophysical modelling framework has been used in conjunction with cost-effectiveness analysis to identify which measures will best help reduce nutrient pollution today and fifty years hence when set against the background of projected environmental change. A new generation of models, based on Bayesian Networks, have been trialled to incorporate multiple stresses on key ecological indicators.

New information for adaptation strategies and response to climate change
REFRESH will have a major impact on restoration planning by:
The provision of new information from REFRESH experiments has been generated on the impacts of increased temperature and changes in drought and flooding on stream and riparian wetland functioning and biodiversity, and how nutrent loading interacts with these climate driven stresses. Lake experiments have increased our understanding of how increased water temperature, decreased water level and increases in nutrients and organic matter constrain management success in lakes.
Production of a set of guiding principles have been produced for managers and policy makers to support management stretgies for lakes. Key messages for stream and wetland managers highlight how measures can be taken to reduce the potential impacts of climate and land use change on freshwater ecosystems.
Developing a new trait-based index to identify potentially sensitive species of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), to the impacts of climate change was developed and tested. Data and information on indicators are held on the freshwaterecology.info web site and database.
Developing and testing a modelling framework at the REFRESH case study catchments where a range of scenario analyses fed into hydrochemical models which also incrported the effects of a range of different adaptive measures designed to ensure compliance with Water Framework and Habitats Directive requirements.
providing a methodology that will allow the cost-effectiveness of alternative adaptive strategies to be modelled and evaluated at the sub-catchment and catchment scale; the cost effectiveness analysis undertaken in tandem with the modelling effort at six REFRESH demonstration catchments developed and tested this methodology and highlighted where measures were cost effectiveness, whether these were proportionate and flagged additional benefits.

New ecological indicators and information for re-adjusting reference conditions in view of climate change

In REFRESH we developed key indicators for reference conditions and WFD class boundaries related to climate change, enabling the indicators to be incorporated into WFD monitoring schemes. REFRESH also focused on functional indicators**.** REFRESH addressed the problem of defining and potentially re-adjusting **reference conditions** in face of climate change. The concept of "reference state" adopted by the WFD is a static one, yet natural ecosystems are constantly varying in response to natural climate variability and the underlying baseline is shifting as waters warm and flow regimes alter. Comprehensive reviews were undertaken to assess how climate change may require a re-evaluation of site specific reference conditions before programmes of measures are revised.

Implications for WFD and HD implementation and the sustainable management of water

REFRESH is of direct relevance to the WFD in several ways. It has:

identified how compliance with the mandatory standards set by the WFD can be achieved where climate change exacerbates water quantity and quality problems;

demonstrated how to allow for the effects of climate change on the definition of reference conditions and the use of the reference state as a restoration target;

showed how climate change will affect the ecological thresholds currently used to set the WFD target good/moderate status class boundary;

showed how managers can intervene at the local, sub-catchment and catchment scale either to adapt to or mitigate the effects of climate change;

provided a methodology for assessing vulnerability to the effects of climate change; and

provided guidelines for managers to assess the cost-effectiveness of alternative adaptive measures at the catchment scale.

enabled the vulnerability of habitats and target species to climate change to be assessed;

indicated and provide a methodology for the measures that need to be taken to adapt to the effects of climate change at conservation sites.

This was achieved as part of the integrated work programme. Reviews in WP1 highlighted adaptation strategies used and available at a range of scales from local measures through to principles that can be adopted as part of national and international management strategies. The output from the experimental, analytical and review work in WPs 2, 3 and 4 were translated into management guidelines and principles and presented at stakeholder events across Europe. The modelling studies in the REFRESH case study catchments, through the use of scenario analysis and coupled hydrochemical modelling, showed how changes in climate, land use, water resource use and atmospheric pollution might present affect compliance with the WFD. Working with WP6, the efficacy of a series of management measures designed to achieve compliance was incorporated in the modelling and the cost effectiveness, proportionality and potential wider benefits were assessed.

4.3 Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	**244121**
Title of Project:	Adaptive strategies to Mitigate the Impacts of Climate Change on European
Name and Title of Coordinator:	Dr Martin Kernan

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) :	***NO***
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (hESCs)?	
• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	

• Were those animals cloned farm animals?	
• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	NO
• Research having the potential for terrorist abuse	

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	1	1
Work package leaders	4	10
Experienced researchers (i.e. PhD holders)	52	73
PhD Students	25	9
Other	30	29

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	18
Of which, indicate the number of men:	11

D Gender Aspects

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

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

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

○ 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?

○ 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)?

X Yes- please specify

Open days, summer schools and research projects using REFRESH material

○ No

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

X Yes- please specify

Lecture materials and climate-and-freshwater.info web site

○ No

F Interdisciplinarity

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

1.4 Main discipline[6]:

1.5 Associated discipline[6]: | 5.4 | 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 ○	Yes No

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

○ No

X Yes- in determining what research should be performed

X Yes - in implementing the research

X Yes, in communicating /disseminating / using the results of the project

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

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)?	○ X	Yes No

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

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

13b If Yes, in which fields?

Agriculture	2	**Energy**	2	Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise	1	Institutional affairs	
Competition		**Environment**		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		**Regional Policy**	2
Development Economic and Monetary Affairs		Food Safety		**Research and Innovation**	2
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

13c If Yes, at which level?

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

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	**172**
To how many of these is open access[7] provided?	**51**
How many of these are published in open access journals?	
How many of these are published in open repositories?	
To how many of these is open access not provided?	**121**
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 X no suitable open access journal available X no funds available to publish in an open access journal X lack of time and resources ❑ lack of information on open access ❑ other[8]: ……	

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:		

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
X	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:*

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

Difficult to estimate / not possible to quantify	❑

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?

○ Yes X No

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

○ Yes X 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
X	Media briefing	X	Coverage in general (non-specialist) press
X	TV coverage / report	X	Coverage in national press
X	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
X	DVD /Film /Multimedia	X	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]