Freshwater landscapes - management and restoration with climate change (FRESHREST)

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Introduction:

On a global scale, biodiversity is decreasing much faster than the natural background rate (Heywood, 1995, Jenkins, 2003), and freshwater habitats and organisms are among the most threatened ecosystems (Revenga et al., 2005, Strayer and Dudgeon, 2010). Freshwater habitats cover less than 1% of the Earth's surface area but contain about 10% of all known species (Strayer and Dudgeon, 2010). There has been substantial global losses of freshwater biodiversity and it is estimated that between 10,000 and 20,000 freshwater species have either become extinct or are seriously threatened, a number much higher than in all other ecosystems (Sala et al., 2000) Humans are now generally considered the dominant drivers of environmental change in the global water cycle and in freshwater aquatic ecosystems, reflecting the fact that we have now reached the Anthropocene (Dudgeon, 2010, Meybeck, 2003, Steffen et al., 2007). Global climate change is also predicted to severely affect streams, rivers and lakes, especially in combination with environmental stressors such as land use changes (e.g., Meyer et al, 1999, Moss, et al., 2010, Sala, et al., 2000).

Global climate change will have numerous effects on freshwater ecosystems through increases in CO_2 levels, air- and water temperatures as well as changes in precipitation and runoff regimes (Poff, et al., 2002). Globally, surface temperature averages have increased by 0.78°C when comparing the average of 1850-1900 with the 2003-2012 period, and according to IPCC (2013) "it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century". All future scenarios for year 2100 (IPCC, 2013) predict that the global average temperature will be 5 to 12 standard deviations above the mean Holocene temperature (Marcott, et al., 2013). At high northern latitudes (north of 45° N), both summer extreme temperatures and decadal averages measured in the last ten years have been warmer than those reported since 1400 (Tingley and Huybers, 2013). This is in agreement with the notion that glacial systems at high latitudes are likely to be disproportionally affected by the global climate change (Perkins et al., 2010). On a shorter time-scale more relevant for current freshwater restoration and management, simulations predict a temperature increase across Sweden, especially in the north (Eklund, et al., 2015). Precipitation will also increase across all seasons for the period 2021-2050, with the highest increases in autumn and spring. For large parts of the country spring floods are expected to be lower whereas winter floods will increase and at the same time decreasing water availability is expected in large parts of the country (Eklund, et al., 2015).

Freshwater ecosystems are already undergoing changes in temperature and hydrological regime with effects on biotic communities in lakes (e.g., Ruhland et al., 2008, Smol et al., 2005, Williamson, et al., 2009), streams, and rivers (e.g., Brown, et al., 2007, Finn, et al., 2010, Muhlfeld, et al., 2011). Many studies have predicted future changes in community composition in lakes and streams in response to climate change, including fish and benthic macroinvertebrates (Bonada et al., 2007, Rosset and Oertli, 2011). Benthic macroinvertebrates such as aquatic insects are affected by alterations in temperature and hydrological regime during their entire life cycle (e.g., Durance and Ormerod, 2007,

Haidekker and Hering, 2008, Vannote and Sweeney, 1980), as temperature affects their growth, metabolism, reproduction, emergence and distribution. Similarly, effects of climate changes on fish community structure, life history traits, feeding modes and behaviour may intensify effects of other human pressures, e.g. eutrophication (Jeppesen et al., 2010).

State of the art:

Liming of acidified waters makes up a considerable part of the Swedish budget for freshwater restoration (Abrahamsson et al. 2013). More than 20 years ago, it was already realized that additional measures would be needed to re-establish species that had been lost during the time period with most severe acidification. Bergquist (1995) described some ongoing measures in limed lakes and water courses, including building fish-ways, removing old dams, habitat improvement and restocking of previously lost species. The effects of combined measures to restore acidified ecosystems in a changing climate are, however, still insufficiently described in scientific literature and implemented in management schemes.. In the current century, changing climate has often been considered a confounding factor when studying ecosystem recovery after decreasing acidification, with or without liming to speed up water quality restoration. For example, wet winters increased acidity in Welsh streams sufficiently to offset much of the 25-year decrease in H+ concentration (Ormerod and Durance, 2009). Many freshwater systems along the northern hemisphere are becoming browner (Roulet and Moore, 2006), related to increasing concentrations of dissolved organic carbon (DOC). Increasing DOC in surface water may to a large extent be explained by decreasing acidification of soils in the catchments (Evans et al., 2012). Increasing DOC in Fennoscandian waters is observed across climatic gradients and catchment sizes, and continued brownification is predicted in scenarios of increasing precipitation (De Wit et al., 2016). As brownification has complex effects on aquatic communities (e.g. Hansson et al., 2012), it needs careful consideration in future water management and habitat restoration.

Many Swedish lakes are affected by other human pressures than acidification and/or climate change (VISS, http://viss.lansstyrelsen.se/), e.g., water level regulation for hydropower production, permanent decrease of water level to create land for agriculture, eutrophication, and shoreline exploitation. Natural water level fluctuations are important for vegetation belts and associated fauna in littoral lake habitats (Leira & Cantonati 2008). A recent review found no Swedish example of ecologically-adapted water level regulations (Degerman et al. 2017). Overall, lakes were the specific targets of less than 1% of the Swedish aquatic restoration projects reported in the national database on “Actions in water”(http://www.atgarderivatten.se/), where lime treatment is not included. Published studies on lake restoration mostly dealt with measures to mitigate eutrophication, and biomanipulation was often used as a complement to reduced nutrient loading (e.g., Hansson et al., 1998, Bernes et al., 2015). Biological measures aim at restoring food webs, by reduction of planktivorous and benthivorous fish, stocking of piscivorous fish, and/or introduction of submerged macrophytes. Positive effects of biomanipulation often have limited duration, and therefore need to be repeated. Global warming and future changes of water use seem to exacerbate the eutrophication process (Jeppesen et al., 2017), implying that nutrients need to be reduced to lower levels to attain a desired state.

The number of river restoration projects implemented across the world has increased during the last decades. Yet, scientific evidence on the long-term effects of such projects and the factors affecting their success or failure is sparse (Bennett et al., 2016, Hering et al., 2015). Species may respond to restoration in a direct way, i.e. depending on the recovery time or

size of the restored site, or indirectly, by altering other environmental variables upon which species depend. For example, many in-stream restoration projects aimed at enhancing habitat heterogeneity within the channel will also affect variables such as channel width or depth (Muhar et al., 2016), which are important in explaining the distribution and occurrence of fish species (Trigal and Degerman, 2015). Hence, restoration studies should look at both the characteristics of the restoration project as well as habitat quality factors that are important for the species under study (Hering et al., 2015). The current state-of-art regarding restoration of Swedish running water ecosystems has been compiled by Degerman et al. (2008). The three major types of restoration in running waters focuses on: (i) restoration of the local habitat including substratum composition, (ii) restoration of flows, (iii) and improved connectivity mainly along the water course e.g. through the construction of fishways or removal of dams or road culverts (e.g., Sandin et al., 2017). Most running water restoration efforts in Sweden focus on one or a few organism groups; mainly brown trout (*Salmo trutta*), salmon (*Salmo salar*), or the freshwater pearl mussel (*Margaritifera margaritifera)*. Thus information regarding the effectivity of restoration efforts focusing on other (e.g., redlisted or other sensitive) species is urgently needed. Interestingly the main type(s) of restoration has shifted, with dam removal being by far most common in the 1990´s whereas habitat restoration is the most common restoration practice since the beginning of the 2000´s (Sandin et al., 2017).

With the current knowledge of direct and indirect climate change effects on freshwater ecosystems in concert with a future need of restoration and mitigation of sensitive freshwater organisms and key habitats – it is vital to combine current knowledge and experiences in both fields to enhance and communicate how, and where we should focus our future conservation, restoration and mitigation.

The FRESHREST project therefore comprises of six work packages (WP) with the following aims (Figure 1):

- **WP1:** review direct and indirect effects of climate change on freshwater ecosystems
- **WP2:** identify multiple pressure effects on freshwater ecosystems,
- **WP3:** evaluate relevant evidence-based measures for conservation/protection and restoration for threatened habitats, processes and species,
- **WP4:** synthesise the results from our literature reviews and data analyses, and identify gaps in knowledge,
- **WP5:** propose guidelines and recommendations for future management,
- **WP6:** manage the project and communicate with stakeholders.

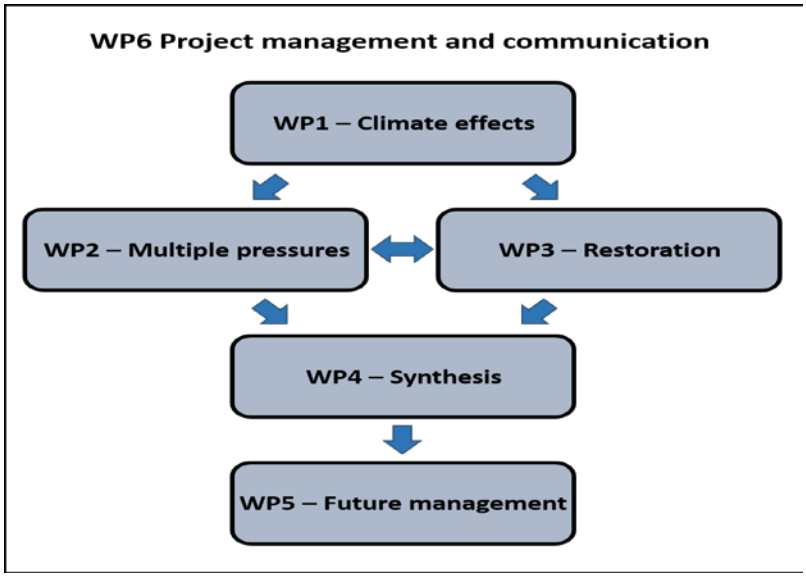


Figure 1. Relationships among the workpackages within the FRESHREST project

1. Methods and procedures

Workpackage 1: *review direct and indirect effects of climate change on freshwater ecosystems*

Workpackage 1 includes a literature review of how environmental parameters directly or indirectly influenced by climate change (e.g. temperature, amount and duration of water flow, changes in erosion, brownification, and land-use change) affect freshwater ecosystems (especially lakes, streams and wetlands including the riparian zone), as well as organisms, and ecosystem processes.

This will be done through a literature review (including published and grey literature) of climate change effects on lakes, running waters and wetlands focusing on fish, plants, algae, benthic fauna, possibly including endangered species (e.g. freshwater pearl mussels), as well as ecosystem processes such as nutrient cycling and communities dynamics. We will also evaluate a defined set of ecosystem types (e.g. based on the freshwater types as defined in the Habitats directive such as small streams in the boreal landscape, large subarctic lakes etc.) as well as key freshwater habitats, and for each summarize the direct and indirect effects of climate change.

Methods and data: Literature review of published scientific papers in combination with grey literature search from Swedish reports from e.g. Naturvårdsverket, Havs- och vattenmyndigheten, Länsstyrelserna, Sportfiskarna, among others. The ecosystem types and key habitats will be defined based on e.g. the Habitats directive list of Nordic freshwater types (Council Directive 92/43/EEC), existing reviews of climate change effects of freshwater ecosystems (e.g. Moss et al., 2010) as well as experiences within the research group.

Output → lists of potential climate change effects (L1; see the activity plan [4]) for each ecosystem type, and for key habitats, organisms and processes (L2), part of project report 1 (R1) on climate change and multiple pressure effects on freshwater ecosystems.

Workpackage 2: *identify multiple pressure effects on freshwater ecosystems*

Workpackage 2 focuses on the effects of climate change within an integrated framework including multiple pressures. We will evaluate the effects of climate change combined with human-driven disturbances such as e.g. damming, habitat modification, pollution runoff, and forestry practice, on sensitive key habitats and species. Furthermore we will develop a conceptual model that will address how specific characteristics (e.g. water volume, shading, nutrient content, brownification and sediment input) of freshwater key habitats and types are affected by combinations of climate change and human perturbations. This will allow first to disentangle the effects of different pressures on biotic and abiotic variables, and second to evaluate the combined effects of such multiple stressors. The consideration of potential synergistic or antagonistic effects (i.e. where the total effect is different than the sum of the single effects) will allow to further identify sensitive habitats and species in need of special protection (Darling and Côté, 2008, Piggott et al., 2015). Also, interactive effects of multiple pressures are especially relevant as they indicate a potential for non-linear threshold dynamics and regime shifts (Scheffer and Carpenter, 2003). As part of WP2 we will also analyse data on human impacts and climate change effects on freshwater ecosystems. This includes the investigation of climate change effects along gradients of human-related stressors on freshwater organisms, biodiversity and (if available) ecosystem processes. We will also try to provide quantitative estimates of effects as well as identify threshold values under single and multiple pressures.

Methods and data: We will search through the scientific literature for articles describing the sensitivity of freshwater ecosystems to (multiple) human pressures and climate effects. We will also search the national grey literature (reports from e.g. Naturvårdsverket, Havs- och vattenmyndigheten, Länsstyrelserna, Sportfiskarna) for any publications on this topic. In the data analysis step we will use existing large-scale national databases for e.g. electrofishing data (SERS; http://www.slu.se/en/departments/aquatic-resources1/databases1/database-for-testfishing-in-streams/, gillnetting data (NORS, http://www.slu.se/en/departments/aquatic-resources1/databases1/national-register-of-survey-test-fishing-nors/) and data on red listed and other freshwater species and habitats in the Swedish species information system); multivariate statistics and modelling tools such as Structural Equation Modelling to analyze how measured environmental variables (e.g. temperature, shading, brownification, flow characteristics) relates to organismal responses for the different ecosystem and habitat types.

Output → list of pressure types on freshwater ecosystems (L3), datasets including data related to human impacts and climate change effects on freshwater ecosystems (D1), and a report summarizing the combined effects of climate change and other human-driven pressures on freshwater ecosystems (R1).

Workpackage 3: *evaluate relevant evidence-based measures for conservation/protection and restoration for threatened habitats, processes and species*

Workpackage 3 focus on systematically identifying and quantifying the ecological effects of existing (and potential future) restoration tools and protective measures as well as climate change mitigation in freshwaters. It will include a literature review focusing on published scientific papers as well as national grey literature (reports from e.g. Naturvårdsverket, Havs- och vattenmyndigheten, Länsstyrelserna). We will also perform a meta-analysis on relevant restoration types, where enough published literature with data of high enough quality is available (earlier experience has taught us that the latter is a major obstacle for a good meta-

analysis). Finally we will analyse existing data from restoration projects (including case-studies), i.e. sites where restoration has taken place and where there is also sufficient (preferably before-and-after) biological data available. We will consider two major factors in the review of restoration and mitigation measures. Firstly the importance of spatial scale and connectivity (the landscape aspect) for restoration success. Much of the existing literature focuses on small-scale restoration efforts at single sites, whereas the importance of landscape connectivity as a major driver of restoration effects must not be underestimated (Sandin et al., 2017). Secondly it is rare to perform several types of restoration efforts simultaneously on larger scales (e.g. dam removal and improving the flow conditions for sensitive species), and we therefore aim at specifically review any publication and/or analyse any data on the effects of combined restoration measures.

Methods and data: identification of the existing restoration types/measures focused on habitat at risk in all freshwater environments will be based on the "Nationella databasen för åtgärder i vatten" (https://atgarderivatten.lansstyrelsen.se/) as well as the "Vatteninformationssystem Sverige; VISS (http://viss.lansstyrelsen.se/). We will set up a list of key search terms based on the restoration types in these databases as well as experiences from our earlier research project EKOLIV (Ecological and economical strategies for the optimization of hydropower related restoration measures) where we focused on stream restoration measures related to hydropower production. Data for the meta-analyses will also be extracted from literature based on the same search terms. In the data analysis step we will use large-scale national databases on fish abundance and conservation status in lakes and rivers, hosted by SLU Aqua and SLU Artdatabanken (see WP2) in combination with data on restoration in Swedish freshwater ecosystems e.g. from the "Nationella database för åtgärder i vatten" (https://atgarderivatten.lansstyrelsen.se/) as well as the "Vatteninformationssystem Sverige; VISS (http://viss.lansstyrelsen.se/).

We will use multivariate statistics and modelling tools such as Structural Equation Modelling to analyze how organisms (including red-listed species) and ecosystem processes (if data are available) are affected by single- and combined restoration efforts at different spatial scales, taking landscape connectivity aspects into account.

Output → list of relevant restoration measures in freshwater ecosystems (L4), datasets on the effects of restoration measures in freshwater ecosystems (D2), literature review of relevant conservation and restoration measures for freshwater ecosystems (R2), scientific publication "Ecological effects and efficiency of freshwater restoration" (S1).

Workpackage 4: *synthesise the results from our literature reviews and data analyses, and identify gaps in knowledge*

Workpackage 4 will summarize and synthesise the results from WP (1-3) and also identify knowledge gaps in the area of freshwater management, restoration and conservation.

Methods and data: Based on the reviews and data-analyses outputs on climate change effects on freshwater types and key habitats (WP1), the multiple pressure effects on freshwater ecosystems (WP2), and the effectiveness of restoration measures in freshwater ecosystems (WP3), we will synthesize the results into a conceptual model and a report on how climate change affects freshwater ecosystems and how this can influence the effectiveness and responses of restoration and mitigation actions in these ecosystems.

Output → a synthesis of the results of the project (R3) and a meta-data paper on extracted meta-data (S2).

Workpackage 5: guidelines and recommendations for future management

Workpackage 5 will draw upon all reviews, data analyses and synthesis within the FRESHREST project and produce recommendations for the future of management of freshwater ecosystems through protective measures and restoration in face of climate change.

Output → we will produce a guideline (G1) on how to take climate change effects into consideration when restoring freshwater ecosystems and a scientific paper "Adaptive freshwater management in a changing climate" (S3).

Workpackage 6: project management including stakeholder involvement and communication

Workpackage 6 includes overall project management, and will especially focus on stakeholder involvement, and internal and external communication. The project management will include 7 internal project meetings (4 in year 1 and 3 in year 2) including all project participants. We will organize 2 workshops with the most important stakeholders, focusing on (1) current restoration tools in freshwaters, and (2) future restoration and conservation actions in freshwater ecosystems. A large part of the workshop preparation is identifying and gathering the most suitable stakeholders to the workshops. We will also set up a reference group with representatives from e.g., Havs- och vattenmyndigheten, Länsstyrelserna, Sportfiskarna, SMHI, Svenska Naturskyddsföreningen, Skogsstyrelsen etc. We will meet with the reference group once every 6 months (three times in total) to get their feedback and input on crucial stages in the project development.

Output → Present the results from the project at national meetings such as "Vattendagarna", "Miljöövervakningsdagarna", Naturvårdsverkets forskningsdag, and local meetings with e.g. local Countyboards as well as at international conferences. The project will also organize a one day final workshop presenting and synthesising the outcome from the project to all interested parties. Finally 3 scientific manuscripts will also be produced within the FRESHREST.

2. Competences and experiences of the applicants

Leonard Sandin (LS) is Associate Professor and Head of Unit at the Department of Aquatic Resources, SLU has long experiences in leading and managing large applied interdisciplinary research projects with a strong stakeholder involvement. He has for example recently led the 2 year EKOLIV project (Ecological and economical strategies to optimize hydropower related environmental measures, total budget c. 5.5 MSEK). LS has also been responsible for the Swedish part of numerous EU funded projects such as REFORM - Restoring rivers for effective catchment management, REFRESH - Adaptive strategies to mitigate the impacts of climate change on European freshwater ecosystems, WISER - Water Bodies in Europe: Integrative Systems to assess Ecological status and Recovery, and Euro-limpacs - Integrated Project to Evaluate the Impacts of Global Change on European Freshwater Ecosystems. LS has been a Marie Curie senior research fellow at Aarhus University for 2 years working as a project leader of "Freshwater biodiversity and community composition in a changing climate: from ecosystem manipulation to biogeographical patterns". LS has a background in running water ecology focusing on human impact, monitoring, restoration and climate change

mitigation on freshwater organisms (mainly benthic macroinvertebrates and fish) and ecosystem functioning and services. LS has worked extensively with policy related issues such as the Water Framework Directive, Habitats Directive, and Swedish Environmental Objectives in many cases together with the Swedish Agency for Marine and Water Management, Swedish Environmental Protection Agency, Local County Boards and other state or private stakeholders.

Erik Degerman (ED) is an Environmental monitoring and assessment analyst (B. Sc.) at the Department of Aquatic Resources, SLU. He has long experience in working with restoration in freshwater ecosystems and is the editor of the existing manual on "Ecological restoration of running waters" used in the Swedish restoration work. Recently, also a report on "Physical restoration of lakes" was published with him as first author. He has been involved in several practical restoration projects in northern and southern Sweden, both in small and large rivers. ED has also worked much with the interaction of the riparian zone and freshwaters, resulting in guidelines for forest management along freshwaters used both by large forest companies and local stakeholders. He has over 60 peer-reviewed papers, three books on fishery management and over 200 published national reports. In the later years focus has been on effects of hydropower production on freshwater ecosystems as well as the effects of liming to counteract the effects of acidification.

Serena Donadi (SD) is currently a researcher at the Department of Aquatic Resources, SLU. She has conducted multidisciplinary work at different institutes and countries. SD is broadly interested in basic and applied ecology with the ultimate aim of providing advice to society and policy makers. Her research focused on questions such as: 1) how species interact with each other and with the environment, 2) how the outcome of such interactions vary across habitats, space and time, 3) how biotic feedbacks affect trophic structure, functioning and resilience of ecosystems, and 4) what are the direct and indirect consequences of anthropogenic impacts on the structure and functioning of aquatic ecosystems. SD conducted her PhD at the University of Groningen, where she focused on the role of economically valuable species (mussels and cockles) for the functioning of intertidal systems and the services provided to human society. During her first post-doc in Germany, SD investigated the relationships between functional diversity of benthic invertebrate communities and environment in order to improve current national monitoring programs. For 4 years she participated in the Zostera Experimental Network, a global network of scientists studying eelgrass ecosystems to improve conservation and restoration policies. SD conducted her second postdoc at Stockholm University, Sweden, where she focused on the role of large predatory fish for the good status of the Baltic Sea coastal ecosystems. Finally, she was recruited at the Department of Aquatic Resources, SLU, where she contributed to the assessment of dam removal and addition of woody debris as restoration measures for freshwater ecosystems. Due to her overarching interest for statistical analyses and quantitative ecology, SD developed a solid knowledge of statistical modelling and software. Throughout her career, SD was committed to increase the outreach of her research to the broader audience, and released several interviews for local newspapers, online journals and for the radio.

Kerstin Holmgren (KH) is Associate Professor at the Department of Aquatic Resources, SLU. After a PhD on life history issues aspects of the currently red-listed European eel, KH got a post-doc position within the EU project "Size-based tools for managing freshwater fish communities". Since then she has two decades of experience with running long-term monitoring of fish communities in lakes and to some extent in streams. She has studied fish

species composition, abundance, size and age structure from both basic and applied perspectives, covering different spatial and temporal scales. KH's fish monitoring is part of larger programs for national environmental monitoring and evaluation of effects of long-term liming of acidified waters. In the 21st century most work was funded by environmental agencies, and related to monitoring and ecological status assessment according to the Water Framework Directive. Research and assessment was often done within national or international networks. KH contributed to the broad use of European standard sampling methods, e.g. sampling of fish with multi-mesh gillnets (EN 14757), in Sweden and other countries. She acted as a data provider as well as user of data in the National Register of Survey test-fishing (NORS), currently covering standard sampling in more than 2000 Swedish lakes. She collated Swedish fish and environmental pressure data for use in Nordic and European fish databases, for use in research projects WISER and WATERS, as well as for cross-countries intercalibration of status assessment, guided by the CIS working group ECOSTAT. KH has established stakeholder contacts at many applied science conferences and meetings with end-users of advice on environmental monitoring and assessment.

Joep de Leeuw (JL) is associate professor and head of the Institute for Freshwater Research, Department of Aquatic Resources, SLU, responsible for the development of scientific research, higher education, management advice and information, as well as financial, technical and administrative support (ca 45 co-workers, ca 5 m€ annually). He works with a broad scope and knowledge within the fields of fisheries management and nature conservation of aquatic environments, with special focus on fish and bird ecology of large lakes, rivers and wetlands. He has been project leader, work-package leader and senior advisor for many ecological and management projects, such as EU-projects on ecological assessment methods (IBI-Meuse, FAME), ecological expert projects in Danube and Volga, as well as inland fisheries and ecological assessment projects in the Netherlands and Sweden, with a special interest in strategic issues regarding environmental changes and human impacts in relation to sustainable environmental and societal development.

Erik Petersson (EP) is Professor in Aquatic Ecology at the the Department of Aquatic Resources, SLU has long experiences from large applied research projects, both more basic projects and interdisciplinary projects with a strong stakeholder involvement. He started the academic life as a behavioural ecologist, with focus on insects. Post-doctoral stay at USDA (Gainesville, Florida, USA), still on insect behaviour. Employed by the National Board of Fisheries, the Board at the stream-water research laboratory in Älvkarleby, mainly focusing on differences between hatchery-reared and wild-borne salmons and brown trout, such behaviour, growth, maturation, smolt age, morphology, etc. The research done during the years in Älvkarleby resulted in contacts with fish farmers, hydroelectrical power companies, managers at county boards and other universities. Much of the work was done in collaboration with researchers from the departments of animal ecology and animal physiology at Gothenburg University. The research on how hatchery fish differ from wild inevitably opened up for two other topics – genetics and aquaculture**.** In the mid 1990's he was asked to be deputy supervisor for a student (Johan Dannewitz) that was interested in genetics. In the mid 1990's he was asked to be deputy supervisor for a student (Henri Engström) working on fishery-cormorant issues. This gave an opportunity to learn about humane-wild conflicts and he was appointed to represent fishery point of view in first an EU-founded project and later and in a COST-founded project on the relations between different stakeholders. Later on he supervised another student, Maria Ovegård, also working on cormorant-fishery issues. EP has long been interested and involved in animal welfare and laboratory animal science, especially regarding issues related to studies and experiments on

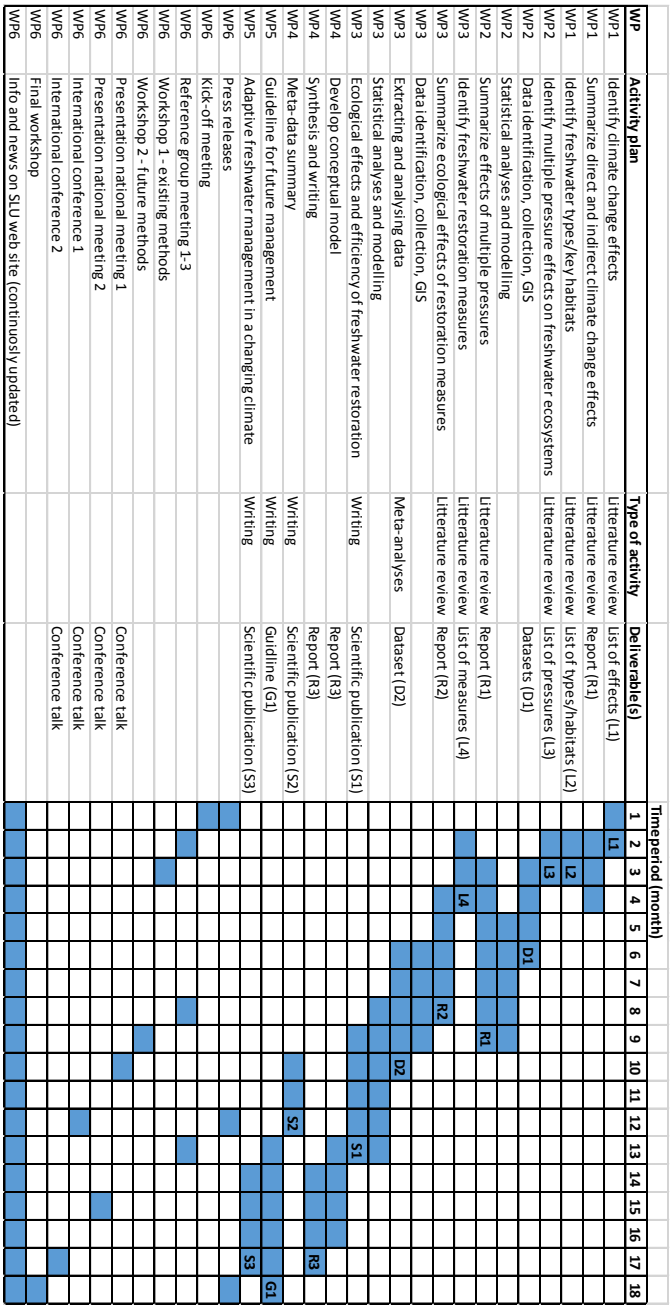
wild animals and fishes in general. This part of his expertise inevitably involves contacts and discussions with NGOs, researchers and managers.

Eddie von Wachenfeldt (EW) is a researcher in limnology at the Swedish Species Information Centre, SLU. EW is responsible for the Habitats Directive related habitat types in lakes, streams and wetlands. His work mainly focuses on reporting and policy related issues for the Habitats Directive including article 17 reporting on biogeographical assessment and conservation status of freshwater habitats. He has a joint responsibility for the Swedish Species Information Centre database on large mussels and is leading a project on valuable freshwaters – evaluation of the Swedish Environmental Objective. EW is often engaged as an expert for the Swedish Agency for Marine and Water Management, and the Swedish Environmental Protection Agency and Local County Boards on freshwater conservation issues. His former jobs include being a coordinator for freshwater management at the Local Countyboard in Gävleborg.

3. Management

In the FRESHREST application we have organized a multidisciplinary team consisting of seven senior scientists and two communication experts from two departments within the Swedish University of Agricultural Sciences (Department of Aquatic Resources, and the Swedish Species Information Centre). This will facilitate the management of the project by shortening communication routes, and thus no consortium agreement or similar will be necessary. Leonard Sandin will be responsible for all internal and external organization of project management, economical and scientific reporting etc. With such (relatively) few participants in the project all participants will participate in the overall project meetings (which will take place 4 times in the first year and 3 times in the second year, to better facilitate interactions within the project group and increase involvement in project development and deliveries according to plan.

4. Activity plan



5. Open access data and scientific publications

Data publication plan: the new data that will be generated within the FRESHREST project will be stored both internally in the databases for freshwater data being hosted at the Department of Aquatic Resources and at the Swedish Species Information Centre. Both organizations have long standing knowledge and experience with these kinds of databases and a large amount of the data is publically available through the database portals at the two organizations. Both are also “Data hosts” for national and regional freshwater data with dedicated staff and funding for making data available both through the data portals and by direct contact with interested parties. Within the project group we also have experience within open access data publication and data analyses as partners of the Swedish LifeWatch project (http://www.slu.se/en/subweb/swedish-lifewatch/), which is a research infrastructure

for biodiversity data. We also plan to publish a meta-data paper (S2; see activity plan) on all the data generated within the project and when publishing also deposit the data in a suitable data repository (Michener 2015), e.g. as a data paper in collaboration with GBIF (www.gbif.org). We will also early on in the project develop a data management plan for FRESHREST. The existing datasets that will be used for data analysis within the project is already within the public domain either through the two project partner organizations or other Swedish or international publically available databases.

Scientific publications: All scientific publications produced within the FRESHREST project or based on data or knowledge gained within the project will either be published in Open access journals or published Open access in parallel with traditional publishing. In case of parallel publishing the paper will be published open access within the SLU database Epsilon (http://pub.epsilon.slu.se/cgi/search/advanced).We have also dedicated part of the budget for publishing Open access

6. Communication plan

All activities in the communication plan can also be found and are referenced as part of the Activity plan (4).

Target groups: the main target groups for the FRESHREST project are decision and policy makers, practitioners and the scientific community within the field of freshwater management, conservation and restoration, both nationally and internationally. Other identified target groups include news media and the general public as well as students.

Reference group (mottagargrupp): we will set up a reference group for the FRESHREST project that will consist of (at least) experts from the Havs- och vattenmyndigheten, Skogsstyrelsen and Naturvårdsverket as well as key personnel within the area of freshwater management and protection from the Local County Boards. Within the project we know personally all potential candidates and will invite 6-10 of them to be part of the reference group for the project. We will also invite other stakeholder groups to participate in the reference group such as e.g. Sveriges Sportfiske- och Fiskevårdsförbund, Älvräddarna, WWF, and representatives from the Hydropower industry (e.g. Tekniska verken in Linköping). Within the Activity plan (4) there are 3 (physical) reference group meetings planned throughout the duration of the project and there will also be shorter video conference meetings in-between if and when deemed necessary. The two external workshops (see below and WP6) as well as the final workshop will involve a wider spectrum of stakeholders (practitioners, recognized scientific leaders in the field, as well as managers and policy makers. The workshops will therefore be an important platform for stakeholder involvement in the FRESHREST project.

External communication: All external communication activities will be planned and executed in close collaboration with the internal communicators at the Department of Aquatic Resources (2 personal months of funding within the FRESHREST project will be dedicated to the communicators supporting in report layout and publishing, press releases, organization of workshops etc). Communication from the FRESHREST project will focus (as defined above) on policy makers, practitioners and the scientific community within the field of freshwater management. The main communication outlets of the project will therefore be: (i) communication with the reference group, both at meetings and workshops as well as using the reference group to spread reports and results from the project to relevant parts of their organization, (ii) communication as part of the two workshops that we will hold during the lifespan of the project (see above), (iii) presentations at national (including Naturvårdsverkets

forskningsdag) as well as international conferences, (iv) three reports (in Swedish) aiming at managers and practitioners of freshwater restoration and conservation, (v) a guideline for the future management and restoration of freshwater ecosystems in a changing climate, and (vi) three peer-reviewed scientific publications (open access). Information and news about the project will be published on SLU web site. Press-releases and/or news articles on SLU web page will be published at the start of the project and when results/articles/reports are published. All news published will also be promoted via social media (Twitter, Facebook). Information on web and in news will be adapted and targeted at a wider identified target groups including news media and the general public.

7. Budget

Project costs: the salary costs (1) include a general monthly cost for the participants in the project and includes 2 PM:s of salary for communication experts. Travels (2) include the organization of three reference group meetings, and participation in two national and two international conferences. Other costs (3) is "lokalkostnad" (desk related fees) this is specified by SLU and not part of the general OH. Open access publications (4.1) of three manuscripts. Conferences and workshops organized by the project (4.2) includes two workshops with external experts as well as an open final workshop for all interested parties. Overhead costs (5) is now given as % of total cost applied for but is in reality a higher % that is only calculated on salary costs within the SLU OH system.

	SEK year 1	SEK year 2	Total
Project costs			
1. Salaries			
Salaries incl. Social fees/LKP (Use new row for each salary)	549 000 kr	249 000 kr	798 000 kr
2. Travels			
Travels (e.g. participation in conferences and meetings)	69 941 kr	70 000 kr	139 941 kr
3. Other costs			
Other project costs (Use new row for each cost)	45 000 kr	20 000 kr	65 000 kr
4. Cummunication			
4.1. Open access publications		35 000 kr	35 000 kr
4.2. Conference and workshops organized by the project group for dissimination of results	15 000 kr	50 000 kr	65 000 kr
4.3. Other communication costs (Use new row for each cost)			0 kr
Total 1-4	678 941 kr	424 000 kr	1 102 941 kr
5. Overhead costs			
university/college/institute where the funds will be administered **(%)** Use column E "Total"			36%
Total sum	923 360 kr	576 640 kr	1 500 000 kr

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Curriculum Vitae – Leonard Sandin 700731-0274

Degrees

2001 - Doctor of Philosophy in Environmental Assessment.
2004 - Post Doctoral Researcher, NorFa mobility grant: "Biological and physical environmental assessment of running waters". National Environmental Research Institute, Silkeborg, Denmark.
2008 - Docent (Associate Professor) Biology with specialization in Ecology, Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden.

Employments

2016 – Head of unit, Department of Aquatic Resources Swedish University of Agricultural Sciences, Drottningholm, Sweden.
2015 – 2016 Researcher, Department of Aquatic Resources, Swedish University of Agricultural Sciences, Drottningholm, Sweden.
2014 – **2015** Researcher, Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden.
2013 - Aarhus University Guest Researcher, Department of Bioscience, Aarhus University. Research Foundation (AUFF). A personal stipend to stay 5 months at Aarhus University.
2011 – 2013 Marie Curie senior research fellow, Freshwater Ecology Group & Ecoinformatics & Biodiversity Group, Department of Bioscience, Aarhus University.
2008 – 2011 - Associate Professor, Department of Aquatic Sciences and Assessment.
2008 S.I.L. 1987 Trust Guest Lecturer, Centre for Ecosystem Management and Modelling, Department of Ecology, Massey University, Palmerston North, New Zealand.
2002 – 2008 Researcher, Department of Environmental Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden.
2001 – 2002 Post Doctoral Researcher, Department of Environmental Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden.

Supervision

2008 – 2013 Emma Göthe, PhD thesis title: "Revisiting the importance of small headwater streams, environmental relationships and stream connectivity: exploring the riverscape for biodiversity".
2008 – **2014** Peter Carlson, PhD thesis title: "Ecological linkages between headwater streams and their surrounding terrestrial habitats".
2007 – 2011 Simon Hallstan, Fil. Lic thesis title: "Species distribution models – Biogeographical Applications for Environmental Assessment and Management of Biodiversity".
2003 – 2007 Jenny Bergfur, PhD thesis title: "Assessing the ecological quality (structure, function, and biodiversity) of running waters using different organism groups - the importance of spatial and temporal scale".
2000 – 2004 Joakim Dahl, PhD thesis title: "Detection of human-induced stress in streams. Comparison of bioassessment approaches using macroinvertebrates".

Experience of communicating results with stakeholders/end users

Long standing experience in communicating with stakeholders both at the regional, national and international level. Below a few examples of projects directly including strong stakeholder involvement and communication:

- *Management Committee member*, EU Cost action Science and Management of Intermittent Rivers and Ephemeral Streams (SMIRES)
- *Convenor/chairman* the European standards organisation (CEN) Technical committee 230, working group 24 – fish monitoring.

- *Project leader* Swedish Energy Agency, Energiforsk, and Swedish Agency for Marine and Water Management project: "EKOLIV - Ecological and economical strategies to optimize hydropower related environmental measures
- *Project leader* European Topic Centre for Biodiversity European Environment Agency project "Biodiversity Related Assessment".
- *Project leader* Swedish Environmental Protection Agency funded project "Background report on Biodiversity – Ecosystem Services relationships for the Swedish EU presidency meeting on new Biodiversity target beyond 2010".
- *Project leader* EU-funded project "RUBICODE (Rationalising biodiversity conservation in dynamic ecosystems)".
- *Project leader* Swedish Environmental Protection Agency funded project "A key to define Habitats Directive lake types from prediction and field assessment".

2002 – present Total amount received as PI: ca 3.156.000 Euro or 30.420.000 SEK

Member of examination boards
Two times external examiner of PhD theses (Finland and Ireland), seven times on PhD or Licentiate evaluation boards.

Reviewer for international journals
I have reviewed > 100 manuscripts for c. 40 journals including, Biological Conservation, Ecography, Ecological Applications, Ecosystems, Oecologia. Former section editor for Fundamental and Applied Limnology and Consulting editor for the journal *Aquatic Ecology*.

Publications
Total number of refereed journal publications: **55**
Total number of citations for all published papers (Google Scholar): **3752**

- Johnson, R.K., Angeler, D., Halstan, S., **Sandin, L.** and McKie, B. (2017). Decomposing multiple pressure effects on invertebrate assemblages of boreal streams, *Ecological Indicators* 77: 293-303.
- Göthe, E., Wiberg-Larsen, P., Kristensen, E.A., Baattrup-Pedersen, A., **Sandin, L.** & Friberg. N. (2015). Impacts of habitat degradation and stream spatial location on biodiversity in a disturbed riverine landscape. *Biodiversity and Conservation* 24: 1423-1441.
- **Sandin, L.**, Schmidt-Kloiber, A., Svenning, J-C., Jeppesen, E. & Friberg, N. 2014. A trait-based approach to assess climate change sensitivity of freshwater invertebrates across Swedish ecoregions. *Current Zoology* 60: 221-232.
- Göthe, E., **Sandin, L.,** Allen, C. & Angeler, A.G. (2014). Quantifying spatial scaling patterns and their local and regional correlates in headwater streams: implications for resilience. Ecology & Society 19(3) 1-15.
- Göthe, E., Friberg, N., Kahlert, M., Temnerud, J. & **Sandin, L.** 2014. Headwater biodiversity among different levels of stream habitat hierarchy. *Biodiversity and Conservation 23: 63-80.*
- Friberg, N., Bergfur, J., Rasmussen, J. & **Sandin, L.** 2013. Changing Northern catchments: Is altered hydrology, temperature or both going to shape future stream communities and ecosystem processes? *Hydrological Processes 27: 734–740.*
- **Sandin, L.** & Solimini, A.G. 2012. Spatial variation in lake benthic macroinvertebrate ecological assessment: a synthesis of European case studies. *Fundamental and Applied Limnology 80:185-191.*
- Moss, B., et al. (2009) Climate change and the future of freshwater biodiversity in Europe: a primer for policy-makers. *Freshwater Reviews 2: 103-130.*

CV for Erik Degerman

(erik.degerman@slu.se)

Born 1953 the 30th of May

Swedish University of Agricultural Sciences (SLU), Inst. of aquatic resources,
Pappersbruksallén 22, 702 15 Örebro

Current position: Senior scientist (forskare)

Education: Bachelor of Science (Filosofie Kandidat)

Employments: Has been with the Swedish Board of Fisheries 1978-2011, but at different local offices, e.g. Institute of Marine Research, Lysekil, and the Regional fisheries office, Göteborg. Since 1984 I am working at the Institute of Freshwater Research. In 2011 the Institute was moved to SLU (Swedish University of Agricultural Sciences, Inst. of aquatic resources).

Present work: My work is focused on aquatic fauna in running waters; sustainable use of fish, and the environment with maintenance of biodiversity. I am involved in six projects;
1) The Swedish Electrofishing RegiSter (SERS). I am using statistical techniques and GIS to extract information on fish and stream status.
2) Restoration of running waters with focus on fishways, buffer zones and river bed restoration. Here we have two projects gathered, examples: “Sustainable landscapes” (WWF) & “Restoration plans for Ångermanälven” (WWF, Älvräddarna).
3) Long term monitoring of Atlantic salmon and sea trout, working as national expert in ICES (International Counseil on the Exploration of the Seas). This project focuses also on management advice and restoration of habitats.
4) Evaluating the effects of hydropower activities on aquatic fauna. National expert leading a project 2012-2014 that will set national standards for requirements of fishways (up-stream & down-stream) and water regulation at hydropower dams. Program ends in October 2014.
5) Evaluating the effects of water flow regulation and habitat degradation on fish and large mussels on a national scale as a basis for the work with EU Water framework directive.
6) National expert on fish in Swedish red-list committee.

Publications: At present there are 52 peer-reviewed publications in scientific journals, several international working papers and over 170 national publications. The theme has mainly been fishery management, acidification, ecology of fish and mussels in running waters, river restoration, forestry and aquatic fauna.

I have also been the author and co-author of several books; e.g.”Ekologisk fiskevård” (Ecological fishery management; 1999),”Kräftor” (Crayfish; 2003), “Skogens vatten” (Forest streams and lakes, 2010), “Europe´s changing woods and forests: from wildwood to cultural landscapes”(2015).

International work & cooperation: I participate annually in ICES scientific working group on Atlantic salmon (WGNAS). During 2009-2011 I was chairman for ICES Study group on management of Baltic sea trout (SGBALANST). I’ve also been working in several international projects; e.g. the EU-funded research project FAME (Assessment of ecological status of running waters (2004-2007), and at the HELCOM-project SALAR (2009-2011).

Selected international peer-reviewed papers

Degerman, E, K. Andersson, H. Söderberg, O. Norrgrann, L. Henrikson, P. Angelstam, J. Törnblom, 2013. Predicting viable populations of freshwater pearl mussels (*Margaritifera margaritifera* L.) using instream and riparian zone land cover data. Aquatic conservation. 23:332-342.

Törnblom, J., Angelstam, P., Degerman, E., Henrikson, L., Edman, T. & J. Temnerud, 2011. Catchment land cover as a proxy for macroinvertebrate assemblage structure in Carpathian Mountain streams. Hydrobiologia.

Törnblom, J., Degerman, E. & P. Angelstam, 2011. Forest proportion as indicator of ecological integrity in streams using Plecoptera as a proxy. Ecological indicators 11:1366–1374.

Öhlund, G., Nordwall, F., Degerman, E. & T. Eriksson, 2008. Life history and large-scale habitat use of brown trout and brook trout – implications for condition-specific competition. Can. J. Fish. Aquat. Sci. 65: 633-644.

Beier, U., Degerman, E., Melcher, A., Rogers, C. & H. Wirlöf, 2007. Processes of collating a European fisheries database to meet the objectives of the European Union water framework directive. Fish. Mgmt and Ecol. 14:407-416.

Degerman, E., Beier, U., Breine, J., Melcher, A., Quataert, P., Rogers, C., Roset, N. & I. Simoens, 2007. Classification and assessment of degradation in European running waters. Fish. Mgmt and Ecol. 14:417-426.

Degerman, E., Sers, B., Törnblom, J. & P. Angelstam.2004. Large woody debris and brown trout in small forest streams – towards targets for assessment and management of riparian landscapes. Ecol. Bull. 51: 233-239.

Degerman, E., Näslund, I. & B. Sers, 2000. Stream habitat use and diet of juvenile (0+) brown trout and grayling in sympatry. Ecology of freshwater fish 9:191-201.

Appelberg, M., Bergquist, B.C. & E. Degerman, 1999. Using fish to assess environmental disturbance of Swedish lakes and streams – a preliminary approach. Verh. Internat. Verein. Limnol. 27:311-315.

Selected Swedish reports

Beier, U., Degerman, E., Sers, B., Bergquist, B. & M. Dahlberg 2007. Bedömningsgrunder för fiskfaunans status i rinnande vatten - utveckling och tillämpning av VIX. FINFO, Fiskeriverket Informerar, 2007:5.

Calles, O., Degerman, E., Wickström, H., Christiansson, J., Gustafsson, S. & I. Näslund, 2013. Anordningar för upp- och nedströmspassage av fisk vid vattenanläggningar. Underlag till vägledning om lämpliga försiktighetsmått och bästa möjliga teknik för vattenkraft. Havs- och vattenmyndighetens rapport 2013:14, 114 s.

Degerman, E. & P. Nyberg, 2002. The SILVA project – Buffer zones and aquatic biodiversity. Pp: 107-112. In: Sustainable forestry to protect water quality and aquatic biodiversity. Kungl. Skogs- och Lantbruksakademiens Tidskrift, nr 7, 154 s.

Degerman, E., 2008. Ekologisk restaurering av vattendrag. Naturvårdsverket & Fiskeriverket, Internet, 300 s.

Degerman, E., Alexanderson, S., Bergengren, J., Henrikson, L., Johansson, B.-E., Larsen, B.M. & H. Söderberg, 2009. Restaurering av flodpärlmusselvatten. Världsnaturfonden, WWF Solna, 62 s.

Degerman, E., Calles, O, Näslund, I. & H. Wickström, 2013. Påverkan på strömlevande fisk av anlagda lugnvatten. Underlag till vägledning om lämpliga försiktighetsmått och bästa möjliga teknik för vattenkraft. Havs- och vattenmyndighetens rapport 2013:15, 20 s.

Näslund, I., Degerman, E., Calles, O & H. Wickström, 2013. Fiskvandring – arter, drivkrafter och omfattning i tid och rum. Underlag till vägledning om lämpliga försiktighetsmått och bästa möjliga teknik för vattenkraft. Havs- och vattenmyndighetens rapport 2013:11, 41 s.

Olsson, I.C., Eklöv, A. & E. Degerman, 2009. Effekter av våtmarker och kraftverk på havsöringsmolt (*Salmo trutta* L.) och ål (*Anguilla anguilla* L.). Rapport Länsstyrelsen i Skåne län, nr 36, 61 s.

Svensson, M., Degerman, E., Florin, A-B, Hagberg, J., Kullander, S-O, Nathansson, J-E. & C. Stenberg, 2010. Fiskar – fish – Pisces. pp:323-332.Ur: Rödlistade arter i Sverige, ed: U. Gärdefors, 590 s.

Söderberg, H., Norrgrann, O., Törnblom, J., Andersson, K., Henrikson, L. & E. Degerman, 2008. Vilka faktorer ger svaga bestånd av flodpärlmussla? En studie av 111 vattendrag i Västernorrland. Länsstyrelsen i Västernorrland Rapport 2008:8, 28 s.

Serena Donadi - Curriculum vitae

Date of birth: 20th October 1982 in Italy

Nationality: Italian

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Emails: donadi.serena@gmail.com, serena.donadi@slu.se

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Research appointments and experience

Oct. 2016 – current: Researcher, Swedish University of Agricultural Sciences, Department of Aquatic Resources, Stockholm, Sweden

May 2016 – Jan. 2017: Researcher scholar, Stockholm University, Baltic Sea Centre

May 2014 – May 2016: Postdoctoral scholar, Stockholm University, Department of Ecology, Environment and Plant Sciences, Stockholm, Sweden

Oct. 2013 – Apr. 2014: Postdoctoral scholar, Hanse-Wissenschaftkolleg - Institute for Advanced Study, Delmenhorst, Germany

Apr. 2006 – Dec. 2008: Research assistant at the Marine Protected Area of Miramare, Trieste, Italy

Education

2009 – 2013: PhD in Marine Benthic Ecology, University of Groningen, The Netherlands

2005 – 2008: Master in Marine Biology, University of Trieste, Italy

2001 – 2005: Bachelor in Natural Science, University of Trieste, Italy

Awards, grants, fellowships

- *IFAD Fellowship* for technical assistance to identification and establishment of MPAs in São Tomé and Príncipe, ST&P. Oct 2015 – March 2016.
- *Postdoctoral research fellowship* from the Hanse-Wissenschaftskolleg – Institute for Advanced Studies, Delmenhorst, DL. Oct 2013 – Apr 2014
- *PhD fellowship* from the National Programme Sea and Coastal Research, NL. Mar 2009 – Jun 2013
- *Undergraduate Fellowship* from the Virginia Institute for Marine Science, VI, USA. Jun – Aug 2012
- *Outstanding Student Presentation Award* at ASLO Conference, Puerto Rico, USA. Feb 2011
- *Fondazione Brovedani Prize* for the best student at the Department of Mathematical, Physical and Natural Sciences, University of Trieste, Italy, Jun 2008
- *European Commission Youth Programme Fellowship*, Italy. Apr – Nov 2007

Teaching

- Co-supervision of PhD student Åsa Nilsson, Stockholm University, SE (2015-2016)
- Supervision of undergraduate students, Stockholm University, SE (2014-2016) and University of Groningen, NL (2010-2013)
- Assistant in the Marine Benthic Ecology course, University of Groningen, NL (2010-2012)
- Assistant in the Marine Biology course, University of Groningen, NL (2012)
- Non-academic teaching: marine environmental educator and snorkeling guide, Marine Protected Area of Miramare, Italy (2004-2008)

International Conferences

- 33rd Oikos Meeting, Lund, Sweden, 7-9 February 2017. Poster "Impacts of hydropower plants: strategies for healthier ecosystems"
- 23rd CERF biennial conference, Portland, Oregon, USA, 8-12 November 2015. Oral presentation: "Top-down control overrules environmental forcing in sheltered coastal bays".
- Hanse-Wissenschaftskolleg Fellow Lecture Series, Delmenhorst, Germany, 27 February 2014. Oral presentation: "The body-size structure of intertidal communities changes along abiotic gradients".
- 98th ESA Annual Meeting, Minneapolis, USA, 3-9 August 2013. Oral presentation: "Engineering networks structure coastal ecosystems".
- 50th ECSA Conference, Venice, Italy, 3-7 June 2012. Oral presentation: "Multiple ecosystem engineers facilitate microphytobenthos at different spatial scales".
- Netherlands Annual Ecology Meeting (NAEM) 2011, Lunteren, The Netherlands, 8-9 February 2011. Oral presentation: "Scale-dependent effects of an ecosystem engineer determine the spatial distribution of bivalves in an intertidal ecosystem".
- ASLO Aquatic Science Meeting, Puerto Rico, USA, 13-18 February 2011. Oral presentation: "Scale-dependent effects of an ecosystem engineer determine the spatial distribution of bivalves in an intertidal ecosystem".

Professional skills

Computer skills: Experience with Windows, Mac OS and Linux OS. Statistical analyses: R, Statistica, CANOCO, Amos, PAST. Programming languages: R. Data-base management: ACCESS. Geographic Information System: R, ArcGIS. Graphic: R, Sigmaplots. Bioacoustics: Biosonics Visual Analyzer.

Languages: Italian (native language), English (fluent), Portuguese (intermediate), Spanish (intermediate), Swedish (basic), Dutch (basic).

Others: - Referee expertise for peered reviewed journals: Estuarine, Coastal and Shelf Science, Biodiversity and Conservation, Estuaries and Coasts, Hydrobiologia, Marine Biodiversity, Journal of Sea Research.

- Advanced open water diving licence (PADI). Diving experience: ca 200 dives

LIST OF SELECTED PUBLICATIONS

Donadi S., Å.N. Austin, U. Bergström, et al (2017) A cross-scale trophic cascade from large predatory fish to algae in coastal ecosystems. Proc. Roy. Soc. London B 284:20170045

Duffy JE, Reynolds PL, Boström C, et al (2015) Biodiversity mediates top-down control in eelgrass ecosystems: a global comparative-experimental approach. Ecol Lett 18:696–705. doi: 10.1111/ele.12448

Donadi S, van der Heide T, Piersma T, et al (2015b) Multi-scale habitat modification by coexisting ecosystem engineers drives spatial separation of macrobenthic functional groups. Oikos 1–9. doi: 10.1111/oik.02100

Donadi S, van der Heide T, van der Zee EM, et al (2013a) Cross-habitat interactions among bivalve species control community structure on intertidal flats. Ecology 94:489–98.

Donadi S, Westra J, Weerman EJ, et al (2013b) Non-trophic interactions control benthic producers on intertidal flats. Ecosystems 16:1325–1335. doi: 10.1007/s10021-013-9686-8.

Curriculum Vitae – Kerstin Holmgren 591206-0208

Degrees

1996 - Doctor of Philosophy in Limnology.

2002 - Docent (Associate Professor) in Biology with specialization in Limnology, Department of Limnology, University of Uppsala, Uppsala, Sweden.

Employments

2011-: Researcher, Swedish University of Agricultural Sciences, Department of Aquatic Resources, Institute of Freshwater Research, Drottningholm, Sweden

2005-2011: Head of the "Environmental Research Group" at Swedish Board of Fisheries, Institute of Freshwater Research, Drottningholm, Sweden

1997-2004: Researcher, Swedish Board of Fisheries, Institute of Freshwater Research, Drottningholm, Sweden.

1995-1996: Position as PhD student, Department of Limnology, University of Uppsala.

1987-1995: Research assistant, Swedish Board of Fisheries, Institute of Freshwater Research, Drottningholm, including shorter periods at the Department of Genetics, University of Uppsala.

1983-1987: Laboratory and research assistant (from 1985), Department of Zoology, University of Stockholm, Sweden.

Supervision

2016-2017: *Teacher and case study mentor* at the course "Ecology for fish management and conservation" (BI1269) at the Swedish University of Agricultural Sciences.

2003-2008: *Assistant supervisor* of Henrik Ragnarsson, PhD thesis title: "Biological diversity of fish and bacteria in space and time".

Experience of communicating results with stakeholders/end users

I have communicated with stakeholders both at the regional, national and international level, as part of several projects e.g.:

- 2014-2016: Project leader in Norwegian-Swedish intercalibration of fish-based methods for assessment of ecological status in lakes.
- 2011-2016: *Project leader* of Work Package 4.5 Fish – Inland waters, within the project "Waterbody Assessment Tools for Ecological Reference Conditions and Status in Sweden (WATERS)", funded by the Swedish Environmental protection agency.
- 2010-2015: *Member* of the Coordination Group of Swedish LifeWatch (http://www.svenskalifewatch.se/en/).
- 2009-2012: *Member* of the Advisory Board of the project "Water Bodies in Europe: Integrative Systems to assess Ecological status and Recovery (WISER)" (EU 7th Framework programme, Theme 6, contract no. 226273).
- 2005-2012: *Project leader* of WFD-related projects funded by the Swedish Environmental protection agency, including development of assessment criteria for ecological status based on the fish fauna of lakes and streams, and acting as *national expert* in international intercalibration groups on fish in lakes.
- 2001-: *Project leader* for long-term monitoring of fish communities in lakes within "National environmental monitoring of fresh water (Nmö Sötvatten)".
- 2001-: *Project leader* for parts on fish communities within the national program "Integrated Studies of Effects of Liming of Acidified Waters (ISELAW)".
- 1989-1996: *Member* of the "EIFAC/ICES Working Group on Eel". Participated in 5 meetings, including 4 with oral presentations.

Projects as Principal Investigator

2001 – present Total amount received as Principal Investigator: 101.225.633 SEK

Member of examination boards

Member of PhD evaluation boards; four times at the University of Stockholm, twice at the Swedish University of Agricultural Sciences (twice), and once at the University of Uppsala and at the University of Gothenburg, respectively.

Member of the evaluation committee of Licentiate Theses; once at the Swedish University of Agricultural Sciences.

Reviewer for international journals

As a member of the editorial board of the journal "Ecology of Freshwater Fish", I reviewed 24 manuscripts and acted as a subject matter editor. I have also reviewed 32 manuscripts for: "Animal Biology", "Aquaculture", "Aquatic Ecology", "Boreal Environment Research", "Canadian Journal of Fisheries and Aquatic Sciences",

"Ecology and Society", "Environmental Monitoring and Assessment", "Environment International", "Fisheries Management and Ecology", "Freshwater Biology", "Hydrobiologia", "Journal of Fish Biology", "Journal of the World Aquaculture Society", "Nordic Journal of Freshwater Research", "Polar Biology", "The Biological Bulletin" and "Verhandlungen Internationale Vereinigung für Theoretische und Angewandte Limnologie".

Publications

Total number of refereed journal publications: **36**

Total number of citations for all published papers (Google Scholar): **1161**

- Trochine, C., S. Brucet, C. Argillier, I. Arranz, M. Beklioglu, L. Benejam, T. Ferreira, T. Hesthagen, **K. Holmgren**, et al. 2017. Non-native fish occurrence and biomass in 1943 Western Palearctic lakes and reservoirs and their abiotic and biotic correlates. *Ecosystems*, doi: 10.1007/s10021-017-0156-6.
- Arranz, I., T. Mehner, L. Benejam, C. Argillier, **K. Holmgren**, et al.. 2016. Density-dependent effects as key drivers of intraspecific size structure of six abundant fish species in lakes across Europe. *Canadian Journal of Fisheries and Aquatic Sciences* 73: 519-534.
- **Holmgren, K.**, E. Degerman, E. Petersson & B. Bergquist. 2016. Long term trends of fish after liming of Swedish streams and lakes. *Atmospheric Environment* 146: 245-251.
- Mehner, T., C. Keeling, M. Emmrich, **K. Holmgren**, C. Argillier, et al.. 2016. Effects of fish predation on density and size spectra of prey fish communities in lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 73: 506-518.
- Sandström, A., P. Philipsson, A. Asp, T. Axenrot, A. Kinnerbäck, H. Ragnarsson-Stabo & **K. Holmgren**. 2016. Assessing the potential of remote sensing derived water quality data to explain variations in fish assemblages and to support status assessments in large lakes. *Hydrobiologia* 780: 71-84.
- Emmrich, M., S. Pedron, S. Brucet, I.J. Winfield, E. Jeppesen, P. Volta, C. Argillier, T.L. Lauridsen, **K. Holmgren**, et.al. 2014. Geographical patterns in the body-size structure of European lake fish communities along abiotic and biotic gradients. *Journal of Biogeography* 41: 2221-2233.
- **Holmgren, K.** 2014. Challenges in assessing biological recovery from acidification in Swedish lakes. *Ambio* 43: 19-29.

Curriculum Vitae – Joep de Leeuw 640224-9178

Degrees

1988 - MSc Biology with specialisation Ecology, University of Groningen, the Netherlands.
1997 - PhD Animal Ecology and Behaviour, University of Groningen, the Netherlands
2016 - Associate Professor Biology with specialization in Ecology, Department of Aquatic Resources, Swedish University of Agricultural Sciences, Uppsala, Sweden.

Employments

2011-present. Senior researcher and head of the division Institute of Freshwater Research, Drottningholm, at Department of Aquatic Resources, Swedish University of Agricultural Sciences
2009-2011. Senior researcher and head of Institute of Freshwater Research, Drottningholm, at National Board of Fisheries, Sweden
1999- 2009. Wageningen IMARES, Institute for Marine Resources and Ecosystem Studies (until 2006: Netherlands Institute for Fisheries Research RIVO), IJmuiden, part of Wageningen University and Research Centre (WUR), the Netherlands. Senior researcher and head of research group Inland Fisheries and research group Ecology, respectively.
1997-1999. University of Wageningen, Aquaculture and Fisheries Group, Wageningen / Netherlands Institute of Ecology, Centre for Limnology, Nieuwersluis, the Netherlands. Postdoc researcher
1991-1997. University of Groningen, Groningen / Ministry of Transport and Public Works, Lelystad, the Netherlands. Researcher and doctoral student

Experience of communicating results with stakeholders/end users

Long standing experience in communicating with stakeholders both at the regional, national and international level, especially in issues related to aquatic ecological restauration and fisheries management. Some examples:
2009-2017. Advice to National Board of Fisheries / Swedish Agency for Marine and Water Management and county administrations on inland fisheries management and fish-based environmental assessment.
1999-2009. Advice to Ministry of Agriculture and Fisheries and member of stakeholder groups in regional fisheries management of Lake IJsselmeer, the Netherlands.
2003. Expert advisor River restoration and fish habitats. Russian-Dutch expedition rivers Don, Volga, Volga delta, Russia.
2002. Expert advisor River restoration and fish migration. Romanian-Dutch Centre of Excellence exchange program Danube Delta, Romania, Lake IJsselmeer.
1988-1997. Advice to Ministry of transport and public works, the Netherlands, on conservation and management of diving duck populations.

Teaching and supervision

2015-2017. Development and responsible course leader of new Master's Course *Ecology for Fish Management and Conservation* SLU-20128 (15 ECTS)
2009-2017. University of Stockholm. Guest lectures in the advanced course Fish Biology and Fisheries. Supervising student practical period at advanced level.
2009-present day. Co-supervisor PhD student (A.M. Keller). Institute for Marine Resources and Ecosystem Studies / Swedish Agricultural University, Department of Aquatic Resources.
2005-2009. Co-supervisor PhD student (K. Górski: *Floods and Fish. Recruitment and distribution of fish in the Volga River floodplain*, 2010) and postdoc (K.E. van de Wolfshaar). Institute for Marine Resources and Ecosystem Studies / Wageningen University and Research Centre.
2004-2006. University of Nijmegen. Guest lectures in Restoration ecology of rivers, Fish monitoring and ecological assessment.
1999-2009. Wageningen University and Research Centre, Institute for Marine Resources and Ecosystem Studies. Main supervisor of five MSc Thesis students.

1997-1999. University of Wageningen. Fish ecology. Ecological Assessment (Water Framework Directive). Lectures in basic education. Main supervisor of six MSc Thesis students.
1993-1997. University of Groningen. Animal Ecology. Lectures and practical assistant of advanced courses in Animal Ecology. Main supervisor of two MSc Thesis students

Member of examination boards

2013. Opponent and Grades Committee Licentiate Thesis Norbert Zanga: Towards Aquatic Assessment of Lake Tumba, DR Congo. Swedish University of Agricultural Sciences, Uppsala
2013. Opponent and Grades Committee Licentiate Thesis Adele Dianda Mputu: Aquatic Assessment in the Lake Tumba Landscape, DRCongo, Fish Diversity and Conservation. Swedish University of Agricultural Sciences, Uppsala
2001. Opponent and Grades Committee PhD Thesis Rob Grift: How fish benefit from floodplain restoration along the lower River Rhine, Wageningen University

Reviewer for international journals

Referee for journal papers in: Marine Ecological Process Series, Biological Conservation, ICES Journal of Marine Sciences, Journal of Sea Research, Journal of Fish Biology, Hydrobiologia, Fisheries Management and Ecology, Environmental Biology of Fishes, Journal of Avian Biology, Ardea, Journal of Wildlife Management, Wildfowl, Canadian Journal of Zoology, Physiological Zoology, Freshwater Biology, Canadian Journal of Fisheries and Aquatic Sciences
Editorial Board of 'Limosa', Netherlands Journal for Ornithology, 1992-2004

Publications

Total number of refereed journal publications: **32**
Total number of citations for all published papers (Google Scholar): **873**

Selection of publications:

- Górski, K., J.J. De Leeuw, H.V. Winter, V.V. Khoruzhaya, V.S. Boldyrev , D.A. Vekhov and L.A.J. Nagelkerke 2016. The importance of flooded terrestrial habitats for larval fish in a semi-natural large floodplain (Volga, Russian Federation). Inland Waters 6: 105-110
- Górski, K., J.J. de Leeuw, H.V. Winter, D.A. Vekhov, A.E. Minin, A.D. Buijse and L.A.J. Nagelkerke 2011. Fish recruitment in a large, temperate floodplain: the importance of annual flooding, temperature and habitat complexity. Freshwater Biology 56: 2210-2225
- De Leeuw, J.J. & H.V. Winter 2008. Migration of rheophilic fish in the large lowland rivers Rhine and Meuse, the Netherlands. Fisheries Management and Ecology 15: 409-415
- De Leeuw, J.J., W. Dekker & A.D. Buijse 2008. Aiming at a moving target, a slow hand fails! 75 years of fisheries management in Lake IJsselmeer, the Netherlands. Journal of Sea Research 60:21-31
- Teal, L.R., J.J. de Leeuw, A.D. Rijnsdorp & H. van der Veer 2008. Effects of climate change on growth of 0-group sole and plaice. Marine Ecological Progress Series 358: 219-230
- De Leeuw, J.J., R. ter Hofstede & H.V. Winter 2007. Sea growth of anadromous brown trout (Salmo trutta). Journal of Sea Research 58: 163-165
- De Leeuw, J.J., A.D. Buijse, G. Haidvogl, M. Lapinska, R. Noble, R. Repecka, T. Virbickas, W. Wiśniewolski & C. Wolter 2007. Challenges in developing fish-based ecological assessment methods for large floodplain rivers. Fisheries Management and Ecology 14: 483–494
- De Leeuw, J.J., A.D. Buijse, R.E. Grift, H.V. Winter 2005. Management and monitoring of the return of riverine fish species in the Netherlands. Large Rivers 15 (1-4) / Archiv für Hydrobiologie Suppl. 155: 391-412
- Degerman, E., Bergström, L., de Leeuw, J., Olsson, J., Soler, T. & H. Wennhage 2016. Fisk som miljöindikator. Aqua reports 2016:1 Supplement. Sveriges lantbruksuniversitet, Drottningholm

CURRICULUM VITAE - Erik Hilding Petersson (195505101112)

Exams/degrees

Dissertation, Ph.D. exam	1989-10-26
Post-doc.-grant., USDA, Gainesville, Florida, USA)	1992-08-12--1993-07-22
Associate Professor (docent) Animal Ecology, Uppsala univ.	1997-11-06
Professor in aquatic ecology, SLU	2014-11-04

Employments after dissertation

- 1990-06-01--1990-08-15 (100%, research assistant, Uppsala Univ.)
- 1991-07-01--1991-08-31 (100%, research assistant, Uppsala Univ.)
- 1991-10-01--1992-06-30 (100%, research assistant, National Board of Fisheries)
- 1993-08-07--1994-12-31 (100%, research assistant, National Board of Fisheries)
- 1995-01-01--2001-02-28 (100%, research leader, National Board of Fisheries)
- 2001-03-01--2001-12-31 (100% senior researcher, National Board of Fisheries)
- 2002-01-01--2008-10-31 (100% researcher, National Board of Fisheries)
- 2008-11-01--2009-02-28 (100% interim chief, Inst. Freshwater Research, National Board of Fisheries)
- 2009-03-01—2011-06-30 (100% researcher, National Board of Fisheries)
- 2011-07-01-- (100% researcher, Dept. Aquatic resources, SLU)

Commissions of thrust – last 17 years

- Responsible for issues within the National Board of Fisheries regarding animal welfare, 2001 – 2011
- Associate editor for Journal of Applied Aquaculture (2008 -)
- Director of postgraduate studies for Department of aquatic resources (2012 -)
- Responsible for coordinating animal welfare issues at Dept. aquatic resources (2012 -)
- Deputy coordinator for the environmental monitoring and assessment programme Lakes and Watercourses at SLU (2014-)
- Deputy chair of Försöksdjursrådet (Animal Welfare Body) at SLU (2014-)
- Member of Doctoral Education Committee at the NJ Faculty (2015-)

Experience of communicating results with stakeholders/end users

Below a few examples of projects directly including strong stakeholder involvement and communication:

- National delegate, responsible for fishes, in the work group about threaten species in the Baltic region 1994-1999.
- Official delegate of National Board of Fisheries in a coordinating group for re-establish Atlantic salmon in River Testeboån, central Sweden (2000 – 2006)
- Teaching at courses in fish tagging techniques; this involve ‘students’ from fish farming, county boards, universities, etc. (13 courses 2003-2016, more courses are planned)
- One of two official delegates in COST project on cormorant issues (2004-2008).
- Deputy member of Uppsala ethical committee for animal experimentation (2016-)

Supervising

Student	*Project title*	*Status of project*
Anna Bernmalm	Antipredatory behaviour wild and sea-ranched brown trout (undergraduate, 1-week project)	Completed 1999
Helena Lundström	Spawning behaviour of Atlantic salmon, brown trout and their hybrids (exam. project, 10 weeks)	Cancelled
Ana Camargo	Social and anti-predator behaviour of wild and sea-ranched brown trout and their crossings (Socrates-student, 20 weeks)	Completed 2000
Henri Engström	The effect of black cormorant on fish Populations (Ph.D. student)	Completed 2001

Lena Stoehr-Björklund	Behaviour and growth in brown trout (undergraduate, 27 weeks project)	Completed 2001
Lars Forsberg	Parentage of salmon young- - anadromous males vs mature parr (undergraduate, 10 weeks)	Completed 2001
Ana Camargo	Anti-predator training in hatchery-reared brown trout (ERASMUS 20 week project)	Completed 2002
Johan Dannewitz	Growth, life-history strategies and genetic of wild and domesticated salmonid fish (Ph.D. student)	Completed 2003
Marnie Demandt	Patterns of speciation in Swedish cyprinid (Ph.D. student)	Completed 2009
Daniel Brelin	Stress responses in brown trout. (Ph.D. student)	Completed 2007
Maria Boström	Fish predation by the Great Cormorant (*Phalacrocorax carbo sinensis*), or ecological approaches. (Lic)	Completed 2013
Niklas Sjöberg	Eel migration in Baltic Sea (Ph.D. student)	Completed 2015
Maria Ovegård	Fish predation by the Great Cormorant (*Phalacrocorax carbo sinensis*), or ecological approaches. (Ph. D. student)	Completed 2017
Linda Calamnius	Behaviour of grey seals (*Halichoerus grypus*) and their prey in pontoon traps. (Lic.)	In progress
Stefan Skoglund	Scales of density-dependence in a river environment: implications for population monitoring and assessment (Ph.D student)	In progress

Published scientific papers or book chapter last four years.

Total number of refereed journal publications: **86**
Total number of citations for all published papers (Google Scholar): **3050**

1. Rognell, B., Dannewitz, J., Palm, S., Dahl, J., Petersson, E. & Laurila, A. 2013. Adaptive divergence in body size overrides the effects of plasticity across natural habitats in the brown trout. *Ecology and Evolution* 3(7):1931-1941.
2. Petersson, E., Rask, J., Ragnarsson, B., Karlsson, L. & Persson, J. 2014. Effects of fin-clipping regarding adult return rates in hatchery-reared brown trout. *Aquaculture* 422–423:249–252.
3. Immler, S., Hotzy, C, Alavioon, C., Petersson, E. & Arnqvist, G. 2014. Sperm variation within a single ejaculate affects offspring development in Atlantic salmon. *Biology Letters* 10:20131040.
4. Bryhn, A., Andersson, J, & Petersson, E. 2014. Mortality of European glass eel (*Anguilla anguilla* juveniles) at a nuclear power plant. *International Review of Hydrobiology* 99: 312–316
5. Petersson, E. Camargo, A.V. & Järvi, J. 2015. Failure of predator conditioning: an experimental study of predator avoidance in brown trout (*Salmo trutta*). *Ecology of Freshwater Fishe*s 24: 329–337.
6. Petersson, E. 2015. Homing and Timing of Reproduction. In: Vladić, T. & Petersson, E. (eds). Evolutionary Biology of Atlantic Salmon. CRC Press, pp 44-59.
7. Petersson, E. & Järvi, T. 2015. Mating Behavior, Mate Choice and Mating Success in Atlantic Salmon. In: Vladić, T. & Petersson, E. (eds). Evolutionary Biology of Atlantic Salmon. CRC Press, pp 142-164.
8. Vladić, T. & Petersson, E 2015. Relationship between Size, Age and Maturity in Atlantic Salmon In: Vladić, T. & Petersson, E. (eds). Evolutionary Biology of Atlantic Salmon. CRC Press, pp 166-181.
9. Stéen, M., Olsson Ressner, I.-M., Olsson, B. & Petersson, E. 2016. Epizootiology of *Elaphostrongylus alces* in Swedish moose. Alces 52:1-16.
10. Sjöberg, N.B., Wickström, H., Asp, A., Petersson, E. 2016. Migration of eels tagged in the Baltic Sea and Lake Mälaren—in the context of the stocking question.. *Ecology of Freshwater Fish* (accepted) **DOI:** 10.1111/eff.12296.
11. Holmgren, K., Degerman, E., Petersson, E. & Bergquist, B. 2016. Long term trends of fish after liming of Swedish streams and lakes. *Atmospheric Environment* (accepted).

CURRICULUM VITAE – Eddie von Wachenfeldt

Utbildning och examensår

Fil. Dr. i biologi med inriktning limnologi. Uppsala Universitet. 2009

Forskarutbildning vid institutionen för ekologi och evolution, avdelningen för limnologi. Avhandlingstitel: ”Flocculation of allochthonous dissolved organic matter – a significant pathway of sedimentation and carbon burial in lakes”. Avhandlingen identifierar flockulering av löst organiskt kol av terrestert ursprung som en viktig länk för boreala sjöars kolflöde och bygger både på fält- och laborativa studier. Forskarutbildningskurser i bl.a. uni- och multivariat statistik, vetenskapligt skrivande och framställning, limnologi samt pedagogik. Egna muntliga och posterpresentationer vid internationella konferenser och workshops, ungefär 1 gång/år (2003-2009) och vid avdelningsseminarier (>1 gång/år). Huvud- och medförfattare till flertalet vetenskapliga artiklar i internationella tidskrifter.

Fil. Mag. Biologi, inriktning limnologi, Uppsala Universitet. 2002

Huvudinriktning limnologi, även kurser i bl.a. naturvård, ekologi, kemi, miljörätt och miljölagstiftning, toxikologi, biologisk dataanalys.

Naturvetenskaplig linje, Solberga gymnasium, Arvika. 1994

Arbetslivserfarenhet

ArtDatabanken, SLU, Uppsala 2012 jan -

Naturtypsansvarig för sjöar, vattendrag och våtmarker. Huvudsakliga arbetsuppgifter: art- och habitatdirektivet, sötvatten, våtmarker, biogeografisk uppföljning och miljövervakning. Utredningar och expertstöd bl a till Havs- och vattenmyndigheten, Naturvårdsverket och Länsstyrelsen. Bedömning av gynnsam bevarandestatus enligt art- och habitatdirektivet. Svarar på remisser, tar fram underlag för yttranden och GIS-analyser. Delansvarig för musselportalen. Projektledare för uppdrag om utvärdering av värdefulla vatten – utvärdering av miljömål. Deltagande i referensgrupp för bl a: Nationell strategi för åtgärder inom Vattenkraften, Color of Water – forskningsprojekt vid Uppsala Universitet, Revision av akvatisk miljöövervakning i Sverige.

Länsstyrelsen Gävleborg, Miljöanalysenheten, Gävle 2009 okt- 2012 jan

Huvudsakliga arbetsuppgifter: Samordnare för vattenförvaltningsarbetet för beredningssekretariatet i Gävleborg. Arbetar med kartläggning, analys och åtgärder. Extern kontaktperson gentemot vattenmyndigheten och länsstyrelserna i Bottenhavets distrikt. Extern samverkan gentemot andra myndigheter, vattenråd, kommuner och övriga intressenter. Arbetar med miljöövervakning och kalkeffektuppföljning för inlandsvatten. Projektledare för Gävleborgs länsstyrelses genomförande av vattenförvaltningens åtgärdsprogram. Tar fram underlag och yttranden och svarar på remisser inom sakområden. Delprojektledare för miljö- och klimatprojekt med fokus på vattenkvalitet i ett föränderligt klimat. Bistår med bedömningar och underlag till andra enheter inom länsstyrelsen.

Uppsala Universitet, avd för limnologi, Uppsala 2009 feb- 2009 sep

Post-Doc anställning vid avdelningen för limnologi, Uppsala Universitet
Forskning om kolprocesser in boreala sjöar, särskilt flockulering av löst organiskt kol. Regional uppskalning av resultat. Ta fram underlag för forskningsansökningar. Uppdragsforskning åt Vattenfall (4 mån).

Uppsala Universitet, avd för limnologi, Uppsala mar 2002 – maj 2003

Forskningsassistent inom flera olika forskningsprojekt

Handledning/Undervisning

Undervisning vid avd f limnologi (Uppsala Universitet), 2003-2008 20% av heltid. Föreläsningar, handledning och undervisning av studenter vid seminarier, laborationer, fältmoment, fältkurser, artkunskap, och rapportskrivning vid grund- och fördjupningskurser inom limnologi, ekosystemekologi samt vattenvård.

Huvudhandledare för ”Mireia valle Tobar, ”Algae influence flocculation of dissolved organic carbon in lakes”, examensarbete i biologi/limnologi 10p mar-jul 2006

Biträdande handledare för Kristen Schmidt, ”What´s in the sediment and where does it come from”, examensarbete i biologi/limnologi, 10p mar-jul 2004

Vetenskapliga publikationer

Guillemette, F., **Wachenfeldt, E.,** Kothawala, D. N., Bastviken, D., & Tranvik, L. J. (2017). Preferential sequestration of terrestrial organic matter in boreal lake sediments. Journal of Geophysical Research: Biogeosciences, 122(4), 863-874.

Koehler, B., **Wachenfeldt, E.,** Kothawala, D., & Tranvik, L. J. (2012). Reactivity continuum of dissolved organic carbon decomposition in lake water. Journal of Geophysical Research: Biogeosciences, 117(G1).

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