

FORSKNINGS- OCH UTVECKLINGSINSTITUTET

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2015

ARONIA



VID ÅBO AKADEMI OCH YRKESHÖGSKOLAN NOVIA

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# The 4th Pan-European Duck Symposium 2015

The fourth PEDS meeting was held in Hanko 7-11 April 2015. The Organizing committee, co-chaired by Mikael Kilpi (Novia) and Alekski Lehtikoinen (Finnish Museum of Natural History) succeeded in staging an event drawing a hundred duck researchers from Europe and beyond to discuss ongoing research.

The Symposium featured top-notch plenary speakers David Coons (Utah, USA “Next-gen studies of waterfowl population dynamics”), Robert G. Clark (Saskatoon, Canada “Effects of climate change on duck populations: the obvious and the less-than-obvious”) and Markus Öst (Åbo Akademi, Finland “Eider sociality, personality and cognitive performance in the face of predation”), nearly 40 talks and a poster session covering some 30 poster presentations.

The sessions covered topical presentations for an array of themes including population dynamics, habitats and management, monitoring, migration and wintering ecology, hunting and management, conservation and demography and population trends. The intensive program also included a field trip to the Hanko Bird Observatory and the tallest lighthouse in the Nordic countries at the island of Bengtskär, as well as a banquet. The venue, Hanko, provided nice spring weather as anticipated.

The delegates at the symposium were encouraged to submit research to the journal *Ornis Fennica* (editor-in-chief Andreas Lindén), which proved to be successful, as seven papers from the symposium have now been published (see also Öst, M., Lehtikoinen, A., Pöysä, H. & Lindén, A. 2016: European ducks in a changing world: human impacts, population processes and species interactions. – *Ornis Fennica* 93:1-2).

All in all, a scientifically rewarding symposium and beyond any doubt one of the highlights of the year!

The PEDS was supported by a number of organisations; Novia, the Natural Resources Institute, Finland (LUKE), the Ministry of Agriculture and Forestry (MMM), Helsinki University, the Finnish Museum of Natural History (LUOMUS), BirdLife Finland, Hanko Bird Observatory, Wetlands International (Duck Specialist Group), Tour Du Valat, the Town of Hanko, the Walter and André de Nottbeck Foundation and TSV (Tieteellisten Seurain Valtuuskunta).



# Climate change-induced effects on Baltic Sea plankton

Jonna Engström-Öst, Anna-Karin Almén, Olivier Glippa, Louise Lindroos & Anni Rein

**Our main aim is to understand climate effects in the marine environment now, in the past and in the future. We work with zooplankton, and look into their reproductive success, stress levels and population dynamics in a changing environment.**

The aim of our research, funded by Academy of Finland until 2018, is to study warming and acidification effects on zooplankton reproductive output, stress levels and adaptation. We conduct experiments both in the laboratory and the field, and by analysing long-term monitoring data, changes in the environment can be detected. In 2016, a new PhD student Pankaj Pant will start his work, studying global warming effects on epigenetic transgenerational effects in a small fish, the three-spined stickleback. This work is conducted in collaboration with Ulrika Candolin (University of Helsinki).

licate the zooplankton monitoring carried out annually at the station. The weather conditions and the zooplankton vertical migration are expected to influence the sampling event. This work is a collaboration with Andreas Lindén.

In January Olivier Glippa started as post-doc, working with zooplankton and climate change- related questions. In June, we visited the Espeland Marinbiologisk Stasjon in Bergen to participate in the mesocosm field campaign on CO<sub>2</sub> effects on aquatic organisms. The study was set up by GEOMAR - Helmholtz Zentrum für Ozeanforschung Kiel. The first results show that *Calanus sp.* re-



Mesocosms deployed in Raunefjord off Bergen, Norway. Photo: Olivier Glippa

Anna-Karin Almén and co-authors studied the effects of lowered pH on copepod reproduction during a mesocosm experiment conducted offshore Tvärminne. They found no effect of pH on offspring production, whereas copepod food (algae) had a strong positive effect on numbers of offspring. Polyunsaturated fatty acids in the females were reflected in the eggs and had also a positive effect on offspring production. From these experiments they conclude that the copepod seems fairly robust against direct exposure to ocean acidification. The copepod may not have experienced acute pH stress in the treatments as the species naturally face large pH fluctuations during daily migrations to the deep (Almén et al. under review).

Louise Lindroos started her PhD work during the summer with zooplankton sampling at Tvärminne Zoological Station. The aim is to estimate the sampling repeatability to make abundance estimates more accurate and to rep-

Back Row: Andreas Lindén, Olivier Glippa. Front row: Anni Rein, Louise Lindroos, Jonna Engström-Öst. Photo: Anni Rein



## Klimat effekter på plankton i Östersjön

Vårt främsta forskningsintresse är klimatförändringens effekter i den marina miljön både i historiskt perspektiv, nu och i framtiden. Vi jobbar i huvudsak med djurplankton och undersöker deras reproduktionsframgång, stressnivåer samt populationsdynamik i en förändrad miljö. Projektet är finansierat av Finlands Akademi fram till 2018. Vi kommer främst att använda oss av data från fält och experiment samt långtidsdata för att bredda vår kunskap gällande dessa frågor.

spired more in elevated pCO<sub>2</sub> conditions than in normal conditions. We collected also plenty of copepods aimed for oxidative stress analyses (Glippa et al. in prep.).

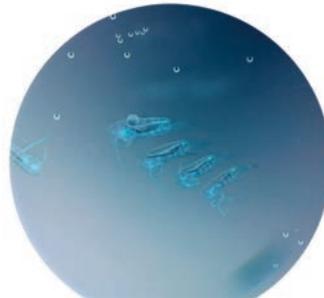
We have also recently taken an interest in the long-term data analysis. Indeed, we already know that the rise in pCO<sub>2</sub> causes ocean acidification and is detected in the Baltic Sea. The first analysis showed that pH has decreased in the Gulf of Finland both at the surface and in deeper layers, except for one more easterly station, off Kotka. These results are currently under preparation for publication in a special issue.

Anni Rein collected data for her BSc thesis at Tvärminne Zoological Station in August. The aim was to measure the copepod *Acartia biflosa*'s production and stress levels vary with depth, time of day and the environment (food, pH, temperature). She collected copepods at different depths according the time of day and incubated males, females and eggs in the lab to assess hatching success. Female respiration was also measured using a microrespiration system and samples of copepods were taken for oxidative stress work (Glippa et al. in prep.).

### Collaboration

- Alenius Pekka, Finnish Meteorological Institute, Finland (long-term data)
- Brutemark Andreas, Calluna Ab, Sweden (plankton ecology)
- Candolin Ulrika, University of Helsinki, Finland (fish behaviour)
- De Stasio Bart, Lawrence University, U.S.A. (cyanobacteria-zooplankton interactions)
- Gorokhova Elena & team, Stockholm University, Sweden (oxidative stress, molecular analyses)
- Laugen Ane T, ARONIA & Swedish University of Agricultural Sciences, Sweden (invasion ecology)
- Lehtinen Sirpa, Finnish Environment Institute, Finland (long-term data)
- Lehtiniemi Maiju, Finnish Environment Institute, Finland (long-term data)
- Lindén Andreas, ARONIA, Finland (statistical modelling)
- Pettersson Heidi, Finnish Meteorological Institute, Finland (long-term data)
- Riebesell Ulf & team, GEOMAR - Helmholtz Centre for Ocean Research Kiel, Germany (ocean acidification)
- Scheinin Matias, Tvärminne Zoological Station (zooplankton ecology)
- Vehmaa Anu, University of Helsinki, Finland (zooplankton, ocean acidification)
- Vuori Kristiina, University of Turku, Finland (biomarkers)

Jonna Engström-Öst and Anni Rein filtering the water in Storfjärden. Photo: Olivier Glippa



Calanus copepods. Photo: Olivier Glippa

### Publications

#### Scientific publications

Brutemark, A., Engström-Öst, J., Vehmaa, A. & Gorokhova, E. (2015) Growth, toxicity and oxidative stress of a cultured cyanobacterium (*Dolichospermum* sp.) under different CO<sub>2</sub>/pH and temperature conditions. *Phycol. Res.* 63: 56-63.

Brutemark, A., Vandellannoote, A., Engström-Öst, J. & Suikkanen, S. (2015) A less saline Baltic Sea promotes cyanobacterial growth, hampers microcystin production and leads to intra-specific differences in allelopathy. *PLOS ONE* 10: e0128904.

Engström-Öst, J., Brutemark, A., Vehmaa, A., Motwani, N.H. & Katajisto, T. (2015) Consequences of cyanobacteria blooms on copepod reproduction, mortality and sex ratio. *J. Plankton Res.* 37: 388-398.

Engström-Öst, J., Savatijevic Rasic, I., Brutemark, A., Rancken, R., Subakov Simić, G. & Laugen, A.T. (2015) Can *Cylindrospermopsis raciborskii* invade the Baltic Sea? *Env. Rev.* 23: 161-169.

#### Thesis published

Johnson, J. (2015) The effects of ocean acidification on three-spined stickleback (*Gasterosteus aculeatus*) larval growth and development. M.Sc. Thesis, University of Helsinki. 41 pp.

#### Popular publication

Engström-Öst, J.: Vi är på G. Västra Nyland 10.9.2014.  
Glippa, O.: Undervattenslivet i våra hav. Västra Nyland 3.6.2015.  
Lindroos, L.: Kan man ha för mycket ljus? Västra Nyland 26.11.2015



# Functional and evolutionary ecology under environmental change

Patrik Karell

In this research project we collect and use individual-based data from wild populations, and apply lab-based molecular methods and statistical modelling approaches to answer fundamental questions in evolutionary ecology. The focus has been to understand mechanisms of natural selection, host-parasite interactions and genotype-environment interactions in the study system of colour polymorphic tawny owls.

In 2015 the project was not kicked off until in the latter part of the year after my parental leave. In September 2015 I joined Aronia as a senior researcher in the coastal zone research team after my previous position as an Åbo Akademi affiliated post doc researcher associated with Aronia.

Since the start of the project the focus has been to investigate the mechanisms by which genetic colour polymorphism is maintained and altered in natural populations. According to theory colour morphs are adaptations to different environments. In the model system – the tawny owl – individuals vary in colour ranging from pale grey to reddish brown. Based on survival analyses of individual based data from 1981 onwards on tawny owl colour morphs we have previously found that survival of the brown morph is markedly lower than that of the grey morph in cold and snow-rich winters (Karell et al. 2011). Theory and previous studies predict that potential causes for lower survival probability in the brown morph in harsh winters are that it has greater energy requirements than the grey one. In order to understand the mechanisms of selection and more generally the factors affecting the evolution and maintenance of (colour) polymorphism, we have this year looked into potential differences between morphs in feather (plumage) insulation capacity, parasite defence and behaviour.

Based on my student Katja Koskenpato's MSc thesis (University of Helsinki) we wrote a scientific paper which was published this year (Koskenpato et al. 2015). In this paper we found that the grey morph has denser and proportionally more of the insulating feather structures compared to the brown morph, which suggests that the brown morph requires more energy to maintain body temperature than the grey one. In cold and snow-rich winters when food is scarce, higher energy requirements due to poorer insulation of the plumage may lead to increased risk of mortality. Research on this topic will be continued as Katja has now received funding for PhD work under my supervision.

In another study (Brommer et al. 2015) we used the long-term individual-based data on tawny owl reproduction to investigate if males exert any influence on family planning. In many species, the father provides no care for his offspring (e.g. many mammal species), but in birds such as tawny owls dads typically do provide care, e.g. in feeding the offspring. Because caring is time consuming and costly, it is expected that also dads have something to say about family planning. We found that male tawny owls influence their partner to produce offspring early in the breeding season and that there are large differences between individual males in their ability to do this. Reproducing early in the season is clever family planning, because offspring produced early in the season have a higher survival probability after fledging! The number of eggs to be laid is, on the other hand, solely a decision of the female.

Continuing on tawny owl family planning, MSc Atte Lindqvist completed his MSc thesis at Åbo Akademi University on colour morph-specific growth strategies and fitness prospects of tawny owl offspring under fluctuating food conditions. He found that offspring raised early in the season are heavier at fledging. Interestingly, he also found that the brown morph grows larger than the grey morph irrespective of the prevailing food conditions. This result suggests that the brown offspring may have a benefit over the grey during the juvenile stage, and the next step will be to investigate if and how the superior condi-



Five ringed tawny owl young in their nest box a few days before they leave the nest. Photo: Patrik Karell

## Funktionell och evolutionär ekologi

Hur anpassar sig organismer till förändringar i miljön och vilka är urvalsprocesserna? Projektet arbetar med att förstå mekanismer bakom naturligt urval med kattugglan som modellorganism – en art med två genetiska färgtyper, en brun och en grå. Den bruna kattuggletypen har sämre chans att överleva kalla och snörika vintrar än den gråa. De centrala frågorna vi ställer oss är vad detta beror på och hur det påverkar populationen.

”Mikroskopanalys visar att den gråa färgmorfens kroppsfjädrar har tätare struktur och därmed bättre isoleringsskapacitet än den bruna (Koskenpato et al. 2015, *Journal of Avian Biology*)”

”Kroniska sjukdomar förorsakade av blodparasiter försnabbar åldrandet och resultaten tyder på att denna fysiologiska process är snabbare hos den bruna än hos den gråa färgtypen (Karell et al. submitted).”

”Hos kattugglan har pappan sitt att säga om när häckningen påbörjas medan mamman ensam fattar beslut om antalet ägg (Brommer et al. 2015, *Behavioural Ecology and Sociobiology*).”

”Kattuggleungar i tidiga kullar och speciellt de av den bruna färgtypen har den snabbaste tillväxten, vilket betyder att de kräver mera föda men också att de har de bästa förutsättningarna att klara sig senare i livet (Lindqvist 2015, pro gradu ÅA).

tion of the brown morph fledglings over the grey ones is associated with the probability to return to the breeding population as adult.

Together with my collaborators at Lund University and Karolinska Institute we have found interesting results on the impact of blood parasite disease on the tawny owl colour morphs. Using molecular qPCR analyses of tawny owl blood samples collected in the field we found that a malaria related blood parasite disease infers costs to the host on the molecular level. Telomeres, which are the protective end capsules on the chromosomes (their degradation is a proxy of molecular senescence), were shorter in those owls which were infected with the disease. Furthermore, the telomeres were shorter in the brown colour morph compared to the grey one. These results imply that the parasites are costly and shortens life expectancy and that the effects appear to be more severe in the brown morph. Finally, the project is also involved in other international collaborations and meta-analyses on avian population demography (Sæther et al. In review) and behavioural ecology (coordinated by W. Forstmeier at Max Planck Institute of Ornithology). I have also been developing other new projects within this field of research with extensions towards more applied implementations.

### Publications

Koskenpato, K., Ahola, K., Karstinen, T. & Karell, P. Is the denser contour feather structure in pale grey than in pheomelanic brown tawny owls (*Strix aluco*) an adaptation to cold environments? *Journal of Avian Biology*, In press

Öst, M., Ramula, S., Lindén, A., Karell, P. & Kilpi, M. 2015. Small-scale spatial and temporal variation in the demographic processes underlying the large-scale decline of eiders in the Baltic Sea. *Population Ecology*, In press.

Brommer, J.E., Karell, P., Aaltonen, E., Ahola, K. & Karstinen, T. Dissecting direct and indirect parental effects on reproduction in a wild bird of prey: Dad affects when but not how much. *Behavioural Ecology and Sociobiology*, 69: 293–302.

Thesis published

Lindqvist A. 2015. Tillväxtstrategier och fitnessförutsättningar hos kattugglans (*Strix aluco*) färgmorfer under varierande födotillgångar. MSc-thesis, Åbo Akademi University, Finland, 36 pp.



A reddish brown male tawny owl taking a nap in the sun while being ringed and measured. Photo: Patrik Karell

### Current collaborators

- Prof. Staffan Bensch, prof. Jan-Åke Nilsson, Lund University, Sweden (Molecular immunology and ecological energetics)
- Dr. Muhammad Asghar, Karolinska Institute Stockholm, Sweden (Infectious diseases and senescence)
- Prof. Jon E. Brommer, University of Turku (Quantitative genetics)
- Univ. Lecturer Hannu Pietiäinen, Dr. Jari Valkama, University of Helsinki (Owl ecology)
- Senior Lecturer Patrik Byholm, Novia UAS & Aronia (Biodiversity and forestry)
- Univ. Lecturer Markus Öst, Åbo Akademi university (Eider demography)
- Dr. Andreas Lindén, Aronia (Bioacoustics in tawny owls)

# Invasion ecology and plant population dynamics

Satu Ramula

Miia Jauni (University of Turku), Sonja Hurskainen (University of Oulu), Hanna Wiklund (Åbo Akademi University)

We examine the life history evolution of invasive plant species and environmental factors that contribute to invasion establishment. Moreover, we aim to understand the drivers of spatial and temporal variation in plant population dynamics.

## Plant invasions and their management

Genetic variation is generally important for populations as it provides the basis for phenotypic variation, upon which natural selection can act. However, genetic variation is often lost during the invasion process, calling into question its role in invasive populations. Using data from 37 populations of the invasive perennial herb *Lupinus polyphyllus*, we investigated the effect of genetic variation on plant survival, growth, fecundity, and the long-term population growth rate. We found that although neutral genetic variation facilitated seedling establishment, it was not associated with the long-term population growth rate, indicating that established invasions may be able to grow equally well regardless of their genetic diversity (Li et al., in press).

Hanna Wiklund collected data on the annual invasive weed *Impatiens glandulifera* for her MSc thesis during the summer. She examined how the timing of management (hand pulling) affected the density and performance of *I. glandulifera*. She discovered that management conducted in July when the plants were flowering reduced weed density and performance more efficiently than management conducted in June prior to flowering.

## What does an earlier spring mean for populations?

Many organisms have advanced their phenology due to ongoing climate change as indicated by an earlier onset of flowering or breeding. Such phenological advances may have consequences for wild populations. Our literature survey of 62 studies on diverse taxa revealed that the consequences of phenological shifts are typically assessed for a few fitness components of individuals, which may not be enough to reveal the consequences for population size (Ramula et al. 2015). Moreover, the existing literature is taxonomically biased, with birds and mammals being overrepresented, while studies on the most abundant taxonomic group, insects, are underrepresented.



Setting up a study site for the global plant network. Photo: Satu Ramula

## The global plant network

Determining the environmental and biological drivers that contribute to population dynamics is essential for understanding local population increases or declines. PlantPopNet is a recently launched network on spatial plant population dynamics, which uses the herbaceous *Plantago lanceolata* as a study system. Volunteers from different parts of the world have established study transects to collect data according to the same protocol. We contributed to this global plant network by setting up a study site in southwestern Finland during the summer of 2015.

## Invasionsökologi och växternas populationsdynamik

Vi undersöker hur invasiva växtarters karakteristiska egenskaper tillsammans med omgivningsfaktorer påverkar sannolikheten för att en permanent invasion skall ske. Vi undersöker samtidigt hur rumslig och tidsmässig variation driver växternas populationsdynamik.



Cutting the flower stalks off before the seeds disperse is essential for controlling the invasive *Lupinus polyphyllus*. Photo: Satu Ramula

### Publications

Scientific publications:

Jauni, M. & Ramula, S. 2015. Meta-analysis on the effects of exotic plants on the fitness of native plants. *Perspectives in Plant Ecology Evolution and Systematics* 17:412-420.

Jauni, M., Gripenberg, S. & Ramula, S. 2015. Non-native plant species benefit from disturbance: a meta-analysis. *Oikos* 124:122-129.

Li, S.-L. & Ramula, S. 2015 Demographic strategies of plant invaders in temporally varying environments. *Population Ecology* 27:373-380.

Li S.-L., Vasemägi A. & Ramula, S. Genetic variation facilitates seedling establishment but not population growth rate of a perennial invader. *Annals of Botany*, in press.

Li, S.-L., Vasemägi, A. & Ramula, S. Genetic variation and population structure of the garden escaper *Lupinus polyphyllus* in Finland. *Plant Systematics and Evolution*, in press.

Ramula S., Jauni M. & van Ooik T. 2015. Propagule pressure governs establishment of an invasive herb. *Acta Oecologica* 68:18-23.

Ramula S., Johansson J., Lindén A. & Jonzén N. 2015. Linking phenological shifts to demographic change. *Climate Research* 63:135-144.

Öst M., Ramula S., Lindén A., Karell, P. & Kilpi, M. Small-scale spatial and temporal variation in the demographic processes underlying the population decline of eiders in the Baltic Sea. *Population Ecology*, in press.

Book chapters:

Gremer, J., Ramula, S., Pedersen, B., Crone, E., Lesica, P., Jäkäläniemi, A. & Tuomi, J. Complex life histories and senescence in plants: Avenues to escape age-related decline? in *The evolution of senescence in the tree of life* edited by Shefferson, R.P., Owen, R.J. and Salguero-Gómez, R., Cambridge University Press, in press.

### Current collaborators

- Dr. Anne Jäkäläniemi, Administration of Forests, Finland
- Dr. Anne Muola, Swedish University of Agricultural Sciences, Uppsala
- Dr. Jouni Sorvari, University of Eastern Finland
- Prof. Juha Tuomi, University of Oulu
- Prof. Anti Vasemägi, University of Turku

Hanna is counting the number of flowers for the invasive *Impatiens glandulifera*. Photo: Satu Ramula



# Non-native species, size-selective fishing, and other anthropogenic stress in marine ecosystems

Ane Timenes Laugen, Patrick Mooney & Stuart Ravenscroft

Our research combines field surveys with laboratory experiments, statistical analyses, and mathematical modelling, to answer questions about how human-induced environmental stress influence ecological and evolutionary processes. Being question-driven rather than system-driven, our on-going research includes a variety of study organisms such as commercial fish stocks, coastal-zone bivalves, and invasive cyanobacteria. We also run side projects on insects in agro-ecosystems.

This year has mainly revolved around investigating causes and consequences of the Pacific oyster invasion on the Swedish west coast. Two Novia students have carried out field- and labwork at the marine station at Tjärnö, Strömstad, in collaboration with researchers at University of Gothenburg (GU). We have initiated further collaboration with researchers at GU to model ecological niches of a number of coastal zone oysters and mussels in Europe to forecast their future distribution under global warming. A smaller, but important, effort has also been allocated to further develop methods for applying evolutionary principles to fisheries management

## Do native shore predators prefer native mussels or invasive oysters as prey?

Together with my GU colleague, Åsa Strand, I have investigated different aspects of the relationship between two native coastal generalist predators (shore crabs; *Carcinus*

*maenas* and sea stars; *Asterias rubens*) and their native prey (blue mussel; *Mytilus edulis*) and the potential new prey (Pacific oyster; *Crassostrea gigas*). Our results suggest that while both predators recognize oysters as prey, they still prefer mussels when given a choice. This suggests that native predators may have little to no effect on the population growth of the oysters.

## Can Pacific oysters adapt to lower salinities?

During July 2015 coastal management-student at Novia Patrick Mooney performed experiments on fertilization success of Pacific oysters. He found fairly good fertilization success in salinities between 19 and 34 psu. Fertilization success in 14 psu was, however, severely impaired, suggesting that oyster colonization of the Baltic Sea is no imminent threat (or possibility, depending on your point of view).

## Prevalence and causes of the recent summer mortality in Pacific oysters

During fall 2014 heavy mortality was reported in oyster localities along the Swedish and Norwegian coastlines. Analyses detected the presence of an oyster herpes virus, the first detection of this pathogen in Scandinavian waters. We performed a thorough survey of localities in Bohuslän and found that northern populations were more affected than southern, and also large variation in mortality among the northern populations. On-going laboratory analyses by Novia student Stuart Ravenscroft will reveal if the virus can explain the observed mortality patterns.

## Using niche modelling to predict competition between and future distribution of coastal bivalves in Nordic waters

Using a modelling framework developed specifically to determine species ecological niches, we have initiated a highly interesting project on the current and future distribution of six European

Stuart Ravenscroft and Åsa Strand getting ready for field work. Photo: AT Laugen



## Hur kan stillahavsostronet ha ökat till 250 000 ton sedan 2006 ?

Under mitt tredje år som medlem av Aronias Kustlandsteam har min grupp fokuserat på stillahavsostron i nordiska vatten. Hur kommer det sig att de klarar sig så bra? Hur överlever de kalla vintrar? Äts de inte av lokala predatorer som krabbor och sjöstjärnor? Är de mycket bättre på att konkurrera om födan än andra bivalver som platta ostron och blåmusslor? Delar av denna forskning kan ni läsa om i ett kapitel i en bok om invasiva arter som jag och mina kollegor har skrivit (se publiceringslistan).

Ane Timenes Laugen at Tjärnö Marine Station in Strömstad. Photo: Åsa Strand

coastal zone bivalves of the genera *Ostrea*, *Mytilus*, and *Crassostrea*. The projects aims at 1) describing the current ecological and geographic overlap, 2) predicting geographic range shift of all six species under global warming scenarios, and 3) describe future trends in competition between the species.

### The strength of fisheries-induced selection

The prevalence and importance of fisheries-induced evolution has been hotly debated among fisheries biologists and evolutionary biologists for more than a decade. Most of the debate so far has revolved around the so-called probabilistic maturation reaction norm approach, which is an attempt to separate environmental factors from potential genetic change when explaining observed temporal trends in maturation. There will probably never be a general consensus about the appropriateness of this method. The members of the ICES Working Group for Fisheries-Induced Evolution (WGEVO) are therefore approaching the question of fisheries-induced evolution from another angle, namely estimating the strength of fisheries-imposed selection using the selection differential approach. We are currently analysing as many different stocks as possible to evaluate the robustness of the methods.

### Publications

Laugen AT, Hollander J, Obst M, Strand Å (2015). The Pacific Oyster (*Crassostrea gigas*) invasion in Scandinavian coastal waters: impact on local ecosystem services. In: J. Canning-Clode (ed.) *Biological Invasions in Changing Ecosystems. Vectors, Ecological Impacts, Management and Predictions*.

Engström-Öst J, Savatijevic Rasic I, Brutemark A, Rancken R, Šubakov Simić G, Laugen AT. Can *Cylindrospermopsis raciborskii* invade the Baltic Sea? (2015). *Environmental reviews*. 23: 161-169.

Öberg M, Arlt D, Pärt T, Laugen AT, Eggers S, Low M (2015). Rainfall during parental care reduce both reproductive and survival components of fitness in a passerine bird. *Ecology and Evolution* 5: 345-356.

SVA (2015). Analys av ökad dödlighet av japanskt jätteostron (*Crassostrea gigas*), utmed svenska västkusten hösten 2014. Rapport till Havs & Vattenmyndigheten.

Patrick Mooney at work in the oyster lab. Photo: AT Laugen



### Collaboration

- Jonna Engström-Öst, Aronia Coastal Zone Research Team
- Anna Lundhagen, Christer Solbreck, Stina Drakare, and Ivana Rasic, Swedish University of Agricultural Sciences, Uppsala
- Åsa Strand, Matthias Obst, and Jon Havenhand, University of Gothenburg, Sweden
- Johan Hollander, Lund University, Sweden
- Bruno Ernande, Research Institute for Exploitation of the Sea (Ifremer), France



# Parental care strategies, reproductive success and environmental stress in eiders

Kim Jaatinen & Markus Öst

Our research combines intensive fieldwork, laboratory-based methods and theoretical modelling to study a range of basic and applied questions in evolutionary and behavioural ecology, population dynamics and conservation biology. Despite different objectives, each subproject benefits from the others and from a unique twenty-year data set on eider ducks, our main study species, from Tvärminne, SW Finland.



The field season was initiated in high spirits! Photo: Heikki Eriksson

We have made progress in understanding the basis for reproductive decision-making in female eiders and how the cognitive capacity of these birds shape reproductive strategies. We published two pioneering papers on the connections between brain size and behaviour in breeding female eiders. In the first paper (Öst & Jaatinen 2015) we were able to show that “smart” females with larger brains were more successful when the conditions for breeding were harsh (e.g. severe predation pressure), whereas females with smaller brains did better in more benign breeding conditions. Furthermore, brood tending females with large brains were more reactive to the reigning predation regime: when predation pressure was high they rapidly joined brood rearing groups in order to enjoy the relative safety provided by group life and safety in numbers, whereas when predation pressure was low they took a markedly long time to join such groups. In the second paper (Jaatinen & Öst 2016) we showed that breeding strategies are closely linked to brain size in eiders. Females with larger brains nest later in the breeding season, which is generally thought to be more challenging time to rear you than early in the season. In line with the first paper (Öst & Jaatinen 2015) female with large brains were able to make up for this

delay and did even better than small brained females who did reasonably well, but only if they were able to nest early in the season. Also, large brained females were able to produce offspring of good quality despite them selves being in sub-optimal condition for breeding. Together these two papers set the stage for a new and highly promising avenue of research.

We published another important paper in collaboration with Prof. Keith Hobson showing that eider females do not, as earlier thought, produce their eggs solely from stored reserves collected at the wintering grounds in the Danish Straights. This paper strongly suggests that the yolk of the egg is produced from both local protein sources, obtained by feeding on Finnish blue mussels, as well as from stored reserves. We also found that the proteins used to form the albumen of the egg are practically produced solely from locally obtained resources.

Our group also published one paper on the population dynamics of eiders showing that the population boom in the early 1990’s could not have been the result of reproduction alone, but required immigration from other areas; a finding challenging beliefs about the natal philopatry of the species. We also published a purely theoretical paper on the evolution of natal and breeding dispersal together with Prof. Hanna Kokko and her student Anna Harts.

Finally, the fruits of hard fieldwork during the spring of



This female eider has recently completed her clutch and started incubating. Next she will need to assess the reigning predation pressure and make several good decisions in order to successfully fledge her young. A large brain may aid her in the decision making process... Photo: Heikki Eriksson

## Föräldraskapsstrategier, framgång och miljöstress hos ejder

Vi har gjort viktiga framsteg i att förstå vad ejderhonor baserar sina förökningsbeslut på, samt hur honornas kognitiva kapacitet inverkar på dessa beslut. Vi fann att "smarta" honor med stora hjärnor var mer framgångsrika i sin häckning då omständigheterna för förökning var svåra (Öst & Jaatinen 2015). Honor med mindre hjärnor klarade sig bättre än de smarta honorna då omständigheterna var gynnsamma (Öst & Jaatinen 2015). Vi har också kunnat påvisa intressanta samband mellan honornas hjärnstorlek och häckningstidpunkt: honor med stora hjärnor klarar av att häcka senare på säsongen, då det är svårare att lyckas, och ändå klara sig lika bra, som honor med små hjärnor som häckar tidigt då omständigheterna är som bäst (Jaatinen & Öst 2016). Tillsammans med en kanadensisk kollega påvisade vi att ejderhonor producerar sina äggvitor och ägg gulor med olika allokeringsstrategi. Ägg gulorna produceras till ca. 50% av proteiner samlade från lokala Finska musslor medan andra hälften av proteinerna kommer från lagrade resurser och härstammar därmed från danska musslor (Hobson et al. 2015). Ejdrarnas äggvitor är så gott som helt uppbyggda av proteiner från Finska musslor. I år har vår forskningsgrupp även påvisat att ejderns populationsdynamik är mer påverkad av immigration än tidigare antagits. Denna insikt har betydelse i att förklara 1990-talets starka ökning i ejderstammen, vilken inte varit möjlig utan immigration.

### Current collaborators

- Keith Hobson, Western University, Canada
- Tuomas Leinonen, University of Helsinki, Finland
- James Herbert-Read, Uppsala University, Sweden
- Hanna Kokko, University of Zurich, Switzerland
- Anna Harts, Australian National University, Australia
- Pat Monaghan, Glasgow University of Glasgow, UK

This female has made her brief but important contribution to the population monitoring scheme conducted for three decades in the Tvärminne archipelago. Elin Lönnberg and Aki Aintila oversee as Kim Jaatinen releases the female after a brief session of measuring and ringing. Photo : Heikki Eriksson



2011 paid off in the form of the first collaborative publication with the eider and ecotoxicology team in Norway. This paper shows that the blood concentrations of persistent organic pollutants (POPs) in Baltic eiders were higher than documented in any other eider population, and comparable to seabirds feeding at higher trophic position in the food chain. When comparing Baltic eiders to those nesting in the pristine arctic environment of Svalbard, it is not all that surprising that most of the contaminants showed higher levels in Baltic eiders, but unexpectedly, concentrations of chlordanes pesticides were higher in Svalbard eiders, while concentrations of HCB flame retardants did not differ between the two populations. Although the similar HCB levels may partly be explained by HCBs high transport potential, unknown factors may have been more important than distance to sources and long-range transport potential for the chlordanes. One plausible explanation may be that the fasting-related redistribution of POPs from fat to blood was greater throughout the incubation in arctic eiders, causing them to have higher blood levels of these POPs at the end of incubation.

### Publications

Scientific publications:

Öst, M., & Jaatinen, K. (2015). Smart and safe? Antipredator behavior and breeding success are related to head size in a wild bird. *Behavioral Ecology*, arv093.

Jaatinen, K., & Öst, M. (2015). Brain size-related breeding strategies in a seabird. *Oecologia*, 180: 67-76.

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Harts, A. M., Jaatinen, K., & Kokko, H. (2015). Evolution of natal and breeding dispersal: when is a territory an asset worth protecting?. *Behavioral Ecology*, arv148.

Fenstad, A. A., Jenssen, B. M., Gabrielsen, K. M., Öst, M., Jaatinen, K., Bustnes, J. O., ... & Krøkje, Å. (2015). Pop Levels and The Importance of Source Proximity in Baltic and Svalbard Breeding Common Eiders. *Environmental Toxicology and Chemistry*, in press.

# Population and movement ecology of forest raptors and archipelago birds

Patrik Byholm

In 2015 the scientific work on birds became more diverse as this year not only forest raptors were in focus of the research, but also the enigmatic Caspian tern of the Baltic Sea. The methods used involve monitoring of demographic parameters and GPS-tracking.



The movements of two GPS-tracked Caspian terns in early June 2015 breeding in Porvoo SE of Helsinki at the Finnish south coast.

young birds equipped with trackers so far) into the breeding population. This bird nicknamed 'Lars' was hatched in Närpes in 2011 and he established a territory of his own less than 30 km from the natal site. Evidently the recruitment of young birds is a process that lasts many years in the honey buzzard. This 'slow lifestyle' together with the surprisingly low survival of young birds, partly as a consequence of human activities, is likely to be a major reason for why the Finnish honey buzzard population is declining. The whereabouts of a selection of birds can be followed at: <http://www.luomus.fi/en/satellite-honey-buzzards>

As a result of new cooperation with BirdLife Suomi ry., Lund university and Sveriges Ornitologiska Förening (SOF) new work involving the caspian tern was initiated. The aim of this study is to investigate the home range behavior, habitat use and movement ecology of the species in its Baltic breeding range. Also migration behavior is in focus. As a pilot study, five adult breeding birds were captured during the summer and their movements during the breeding season were followed. Although it was well known from before that Caspian terns can make long fishing trips while foraging it was with surprise we were able to document that Finnish birds breeding at the south coast regularly travel over the Gulf of Finland to catch prey.

In similar with 2014, also 2015 was a difficult year for the monitored goshawk (*Accipiter gentilis*) population in Southern Ostrobothnia. Especially alongside the coast in Närpes and Kristinestad the number of breeding pairs remained few and the broods were small. Further inland in Kauhajoki the situation was somewhat better. Possibly this entails a brighter future for the population in the forthcoming years. Given that the number of breeding pairs has dropped with almost 50% in the coastal municipalities since the early 2000s, and that the goshawk was listed as near threatened in the 2015 red list assessment of Finnish birds, this would at least be to hope for.

The GPS-tracking of honey buzzards (*Pernis apivorus*) continued. During 2015 only one new bird was equipped with a tracker. Unfortunately this young of the year did not survive but for a few weeks after leaving the natal territory. Altogether this was the 42nd Finnish honey buzzard that have been equipped with a tracing device. The highlight of the year was the confirmation of the first successful recruitment of a young honey buzzard (of the +30

## Populations- och rörelseekologi hos skogsrovfåglar och skärgårdsfåglar

Duvhökarna i Syd-Österbotten gick kräftgång ännu ett år 2015, och om inget positivt sker i förökningsframgången de kommande åren kommer denna situation sannolikt att fortgå framöver. Bivråkarnas rörelsemönster fortsattes att följas med, och även om bara en ny fågel försågs med en sändare erbjöd året på en intressant händelse: en ung satellitsändarförsed bivråken rekryterades för första gången nu till häckningsspopulationen. Längs den finländska kusten initierades ett nytt projekt för att intensivstudera rörelsemönstren av skräntärna m.h.a. GPS-sändare.

### Current collaborators

- Prof. Willem Bouten, University of Amsterdam, Institute for Biodiversity and Ecosystem Dynamics
- Dr. Daniel Burgas, University of Helsinki, Department of Biosciences
- Prof. Artti Juutinen, Natural Resources Institute Finland and University of Oulu
- Prof. Susanne Åkesson, Lund university, Evolutionary ecology
- Dr. Vincenzo Penteriani, Estación Biológica de Doñana, C.S.I.C.
- Dr. Jari Valkama, University of Helsinki, Finnish Museum of Natural History

### Publications:

Byholm, P 2015a: Suomalaiset räyskät GPS-seuranassa. *Tiira* 3: 8.

Byholm, P 2015b: Metsäpetolinnut monimuotoisuuden lähettiläinä. *Hippiäinen* 43: 52-55.

Byholm, P 2015c: Mehiläishaukkojen satelliittimatkat. *Hippiäinen* 43: 21.

The color polymorphism in the honey buzzard is striking: even within the same brood birds can be looking quite differently! Photo: Patrik Byholm



# Statistical Population Ecology

Andreas Lindén, Louise Lindroos, Sara Fraixedas (University of Helsinki), Patrik Korn (Åbo Akademi)  
& Andreas Otterbeck (University of Oslo)

Our aim is to do basic and applied research in the field of population ecology using sound statistical analysis. We use and develop methods that makes effective use of data and provides quantitative answers with as little bias as possible.

Our research interests encompass a wide range of topics within the field of population ecology, including population dynamics, demographic parameters, monitoring, spatial ecology, phenology, bird migration and bioacoustics. The activity in 2015 has been diverse and productive, with research and publications from most subfields of interest.

While our research has largely focussed on the ecology of bird populations, we have started a new project on plankton population dynamics. We also published a multidisciplinary collaborative paper in the field of social sciences, relating the opinions towards wind power – both the level of support and degree of NIMBYism – to municipality level socio-economic variables. While, this study is far from our core scope, the topic and underlying phenomena studied are potentially important also in applied conservation biology.

Currently two PhD students and two MSc students are involved in our activity, being supervised by A. Lindén.



Many bird species preferring mature forest habitat types are declining at an accelerating pace in southern Finland. One of the species of large concern is the Wood Warbler (*Phylloscopus sibilatrix*). Photo: Aleksii Lehtikoinen

Below are brief descriptions about the progress of their work.

Louise Lindroos started her PhD work at Aronia in July to find out how environmental variables like salinity, temperature and wind affect the population dynamics of phyto- and zooplankton. The time-series have been collected by the Finnish Environment Institute and will be analysed using multivariate autoregressive state-space models, a framework which Louise has learned to handle during the autumn. She has chosen the species to be analysed and compiled most of the data needed for analyses of phytoplankton dynamics. During the summer Louise sampled zooplankton at the Tvärminne Zoological Station, in order to find out the magnitude of sampling variation associated with the method, and how environmental variables affect the sampling result. Louise's project is run together with Aronia's plankton group, co-supervised by Dr. Jonna Engström-Öst and prof. Kai Lindström.

Sara Fraixedas has now published the second chapter of her PhD thesis in Ornis Fennica. The paper is about population trends of common bird species living in forest habitats. The main conclusion is that species preferring mature forests have declined considerably during the last three decades. Also northern species, preferring nutrient poor habitat types are declining. On average, for all species considered, the pattern of decline is accelerating, so that the trend has turned more negative during the latter half (1999–2013) of the study period. The species of

Louise Lindroos samples zooplankton in Hanko archipelago, near Tvärminne Zoological Station. The aim of her fieldwork is to get a better view of the magnitude of sampling error associated with this method. Photo: Andreas Lindén



## Statistisk populationsekologi

Projektet fokuserar på tillämpning och utveckling av effektiva statistiska metoder för tillförlitlig estimering av ekologiskt intressanta parametrar. Forskningsintressen omfattar populationsdynamik, demografi, uppföljning, fenologi, fåglars flyttning och bioakustik. Året har varit både mångsidigt och produktivt, med studier av både fågel- och planktonpopulationer. Vi publicerade även en tvärvetenskaplig studie där vi relaterade attityder till vindkraft (generellt och nära eget hem) till socioekonomiska variabler.

Två nya medlemmar har påbörjat sin forskning inom projektet under 2015. Louise Lindroos började under sommaren jobba på sin doktorsavhandling och på hösten skrev hon sig in som fortsättningsstuderande vid Åbo Akademi. Med hjälp av tidsserieanalys studerar hon hur olika miljövariabler påverkar växlingar i våra kusters växt- och djurplanktonpopulationer. Patrik Korn har påbörjat sin pro gradu -avhandling vid Åbo Akademi om kattugglehanens spelläte och territoriella respons hos individer av den röda och gråa färgmorfen.

Projektet handleder även två personer vid andra institutioner. Sara Fraixedas är doktorand vid Helsingfors universitet och jobbar med trender i fågelpopulationer. I sin avhandling granskar hon hur markanvändning och klimatförändringar påverkat olika fågelgruppers populationer. Hon publicerade nyligen sin andra vetenskapliga artikel, som påvisade att många vanliga fågelarter som trivs i äldre skog uppvisar minskande bestånd. Magisterstudent Andreas Otterbeck vid Universitetet i Oslo gör sin avhandling om partiell migration hos fåglar i Sverige.

largest concern are Rustic Bunting (*Emberiza rustica*), Brambling (*Fringilla montifringilla*), Willow Tit (*Poecile montanus*) and Wood Warbler (*Phylloscopus sibilatrix*).

Patrik Korn started his MSc thesis at Åbo Akademi University by doing the research plan. He will study possible differences in the vocalization and territorial response of red and grey morph Tawny Owl males. In particular, he will study whether one can construct an indicator of aggressivity from multiple variables in the call, and whether the pattern of aggressive response differs between the two colour morphs. In spring 2016 Patrik will participate the field work in western Uusimaa, doing playback experiments and sound recording of the owls.

Andreas Otterbeck does his MSc thesis at the University of Oslo about annual variation in the partial migration prevalence of birds in Sweden. The study is based on Swedish national monitoring data and migration data from Falsterbo bird observatory. In August, A. Lindén presented a poster about the statistical methodology developed for the work at the European Ornithologists' Union 2015 conference in Badajoz, Spain. In addition to his MSc project, Otterbeck studies the breeding ecology of Sparrowhawks. During 2015 we published a paper in *Oecologia* studying the patterns of prey size used, how it varies between Fennoscandian populations and how it related to fitness. Another manuscript is in progress, investigating whether reusing old nests implies a higher risk of nest predation in the Sparrowhawk.

### Current collaborators

- Alekski Lehtikoinen, Kalle Meller & Kaisa Välimäki, University of Helsinki, Finland
- Heidi Petterson, Finnish Meteorological Institute, Finland
- Jacob Johansson & Johan Ekroos, Lund University, Sweden
- Jonas Knape, Swedish University of Agricultural Sciences, Sweden
- Jonna Engström-Öst, Patrik Karell, Mikael Kilpi & Lauri Rapeli, ARONIA, Finland
- Juha Tiainen & Jukka Rintala, Natural Resources Institute Finland, Finland
- Markus Öst, Åbo Akademi University, Finland
- Mike S. Fowler, Swansea University, U.K.
- Satu Ramula, University of Turku, Finland
- Sirpa Lehtinen, Maiju Lehtiniemi, Finnish Environment Institute, Finland
- Torbjørn Ergon, Endre Knudsen, Karl Inne Ugland, University of Oslo, Norway

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- Fraixedas, S., Lindén, A. & Lehtikoinen, A. (2015): Population trends of common breeding forest birds in southern Finland are consistent with trends in forest management and climate change. *Ornis Fennica*, 92: 187–203.
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Field work at night is both demanding and rewarding. If you study owl calls *in situ*, there is not much of a choice. Photo: Andreas Otterbeck



# HAVSMANUALEN

Matthias Scheinin

Havsmanualen (The Marine Guide) is an applied research project. Its main aim is to provide guidance in the sustainable management of coastal waters in the city of Raseborg. The concrete outcome, the marine guide, is a geographic information systems (GIS) interface. It displays various sorts of environmental information on an interactive map with several layers on top of each other. In other words, the map connects various sorts of information about the environment with its geographic location.



Field worker Amelie Lignell in a boat surrounded by mermaid's tresses (floating filaments of the green algae *Spirogyra* sp.) in Gunnarsviken. Photo: Catherine Munsterhjelm

The layers of the map form a hierarchical tree structure. Each layer synthesizes the information from its subordinate layers. On top of the hierarchy, there are two parallel layers. They display the risks and benefits associated with negative (e.g. dredgings) and positive (e.g. building of sedimentation basins) environmental actions, respectively. Since the map consists of multiple layers, it can also show how the pieces of information are analyzed and thus contribute to the main conclusions.

The risk analysis takes account of two main components – the magnitude of the potential loss, and the probability that the loss will occur. By the same token, the benefit analysis is based on the magnitude of the potential benefit, and the likelihood that a beneficial effect will take place. All the components are based on spatially detailed but extensive assessments of ecological status, ecosystem services, human pressures and potential threats. The elaborate identification and itemization of risks and benefits forms a solid basis for an explicit management strategy with targeted conservation and restoration measures.

As stipulated in the European Union Water Framework Directive (WFD), evaluation of ecological status takes account of biological, physicochemical and hydromorphological quality elements. This approach is essentially important. The variety of elements enables a comprehensive evaluation. Each feature contributes to the assessment in its own right. Further, the different elements are interdependent. On ecological time scales, the physicochemical and biological qualities of the environment are condition-

al on the underlying hydromorphological qualities. That is, the biological and physicochemical qualities need to be interpreted in such a way that the hydromorphological features of the environment are taken into account. Further, the hydromorphological quality elements, especially the size and degree of isolation of water basins and their respective drainage areas, form the basis for assessing how sensitive/receptive different water basins are for local (positive and negative) environmental actions. The ecological status of the environment also determines its natural, recreational and economic values, i.e. ecosystem services. Finally, human pressures are quantified by using available information on anthropogenic land and water usage.

The information for the analyses is derived from field studies carried out during the growing seasons 2014 and 2015 as well as from existing empirical data and models from external sources. The main focus in the field studies has been on using macrophyte assemblages as bioindicators. The external empirical data consists of a compilation of old field studies in the research area. The models deal mainly with the distribution of different fish species as well as physicochemical water features.

In addition to environmental authorities, Havsmanualen is intended for the general public. The Environmental Office of Raseborg is the project owner and Novia University of Applied Sciences implements this two-year-project. Havsmanualen is financed by Bergsrådinnan Sofie von Julins stiftelse, Novia University of Applied Sciences and The Centre for Economic Development, Transport and the Environment in Uusimaa.



## Havsmanualen

Havsmanualen var ett tillämpat forskningsprojekt som utfödes 2015-2016, initeirat av Miljöbyrån i Raseborg och utfört i samarbete med Novia.

Under projektets gång kartlades mer än 400 undervattensobjekt, och vid projektets slut hade en kartportal med information om grunda havsområden (< 6 m) skapats. Den information som finns att tillgå om undervattensnatur som nu finns från skärgården i Raseborg är landsunik, och ger en faktagrund att stå på för planering av strandnära verksamhet.

The main focus of the project is set on assessing shallow waters (depth < 6 m) and coastal habitats along the coast of Raseborg. A total of eight people undertook field work during the first field season. During the following field season, 13.7.-30.9.2015, four people continued the work. The field work has been concentrated to the eastern part of the Ekenäs archipelago and to Bromarv, as there is considerably less existing ecological information from these parts of the municipality as compared to the southern part of the Ekenäs archipelago. About a sixth of the efforts were undertaken as part of the national Velmu programme (the Finnish Inventory Programme for the Underwater Marine Environment) on behalf of The Centre for Economic Development, Transport and the Environment in Uusimaa.

During field studies underwater aquatic plants and macroalgae were monitored, the coastal habitat type (e.g. shallow bay, flad, juvenile flad, exposed beach) was characterized; Secchi-depth and other physicochemical environmental factors were measured. Additionally, signs of human induced pressures were recorded. For the underwater monitoring two different methods were applied. A minor part of the areas were studied using the drop-video method (underwater video filming) producing about 2,000 videos, which have been analyzed for percentage coverage of macrophytes, type of bottom substrate and presence of fish, benthic organism and filamentous algae. The majority of the sites were monitored with dredges and aquatic binoculars, and the abundance of aquatic plants, macroscopic algae and filamentous algae were determined on a 4-degree abundance scale.

Overall, information from about 400 water basins was collected during the two field seasons. The field work was completed in the fall of 2015.

The information from the field studies as well as existing environmental information has been summarized and analyzed with GIS (geographical information system) software. By now, most interactive maps pinning ecological information to its spatial position have been produced. At the moment the work is focused on producing recommendations on the use, conservation and possible restoration of particular types of coastal habitats. All

the produced maps will be incorporated into an existing map service during February-March 2016. The map service and the map layers can then be used by owners of water- and land areas (such as, for example, recreational homeowners and farmers), by conservation organization, by both local and regional environmental authorities as well as by any other interested parties.

Furthermore, a short educational film for the public will be produced during the project. The film will show people what nature looks like underneath the water. It will also highlight the connection between how we use our land- and water areas and how that affects the underwater habitats. Understanding the ecology of a particular water area and how it may respond to pressures and conservation measures is the first step towards more sustainable use and management of our coastal water resources.

### Workshops & meetings

The steering committee of Havsmanualen held its latest meeting on the 23rd of September 2015. The steering committee consist of representatives from the Environmental Office of Raseborg, the Employment and Economic Development Centre of Uusimaa, Metsähallitus – Natural Resources, Tvärminne zoological station, Bergsrådinnan Sofie von Julins stiftelse and UAS Novia.

The Luther rake is one of the most essential field tools within the project Havsmanualen. Photo: Pia Geyskens



Mass occurrences of the hornwort *Ceratophyllum demersum* are characteristic for shallow, eutrophied waters. Photo: Catherine Munsterhjelm

# Aronia Personnel

## Researchers

Jonna Engström-Öst  
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Andreas Lindén  
Satu Ramula  
Patrik Karell  
Kim Jaatinen

## Project personnel

Marianne Fred (R&D Unit, research manager)  
Ann-Louise Erlund  
Anna Sannholm  
Matthias Scheinin

## Other personnel

Wilhelm Fortelius (vice-president, head of Aronia)  
Mikael Kilpi (Aronia research manager)  
Ulrika Isaksson (R&D Unit secretary)

## Aronia Board

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Kjell Andersson (Åbo Akademi University)  
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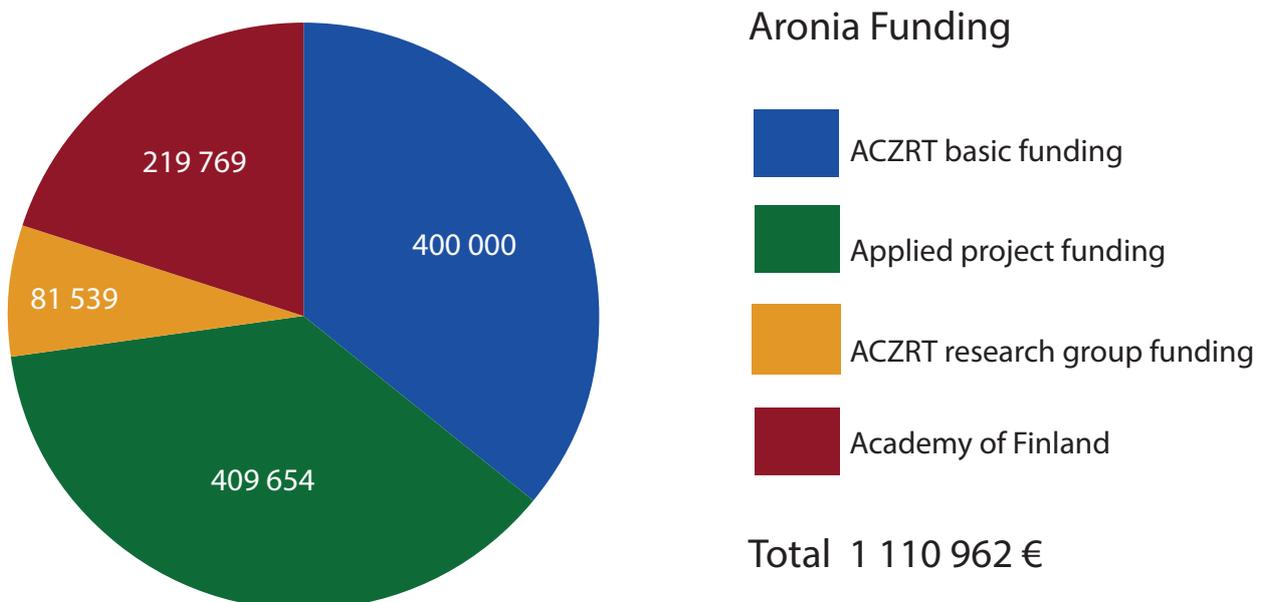
# Aronia Funding

## **Aronia** Basic Funding

Novia University of Applied Sciences

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