Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

NJ-fakulteten
SLU Vattenforum

2021-07-01

Anteckningar möte med WaterCOG 2021-06-01

Tid: 10.00-12.00, via Zoom

Deltagare: Anna Gårdmark, Richard Johnson, Helena Aronsson, Jennie Baron, Jennifer Mcconville, Anders Kiessling, Karin Wiberg, Kevin Bishop, Tomas Brodin, Lutz Ahrens, Sara Bergek, Staffan Waldo, Stefan Bertilsson, Hjalmar Laudon, Stina Drakare, Ulf Bjelke, Staffan Lund, Lisa Beste and Jens Olsson.

Agenda:

1. Att diskutera hur vi tar sammanställningen av kunskapsbehoven om vatten på SLU vidare.

2. Diskussion om framtida och kommande gemensamma forskningsansökningar.

3. Övriga frågor

1 Sammanställning kunskapsbehov om vatten på SLU

I bilaga 1 och 2t finns en sammanställning av de kunskapsbehov som WaterCOG lämnat in under 2020 och 2021, samt ett förslag på gruppering av kunskapsbehoven (av Jens Olsson) i olika ämnesområden (”Thematic areas”).

Mötet diskuterade de inkomna kunskapsbehoven och förslaget på gruppering i olika ämnesområden, och hur denna sammanställning kan/ska tas vidare. Följande slutsatser drogs:

- Detta kan förslagsvis tas vidare genom att skriva review-papper, policy-briefs, hålla interna seminarier, hålla externa seminarier med avnämare och finansiärer, skriva debattartiklar, samt att formera grupper för gemensamma forskningsansökningar utifrån gemensamma forskingsbehov och intressen.
- Bra om VattenNAVet på SLU spelar in sina kunskapsbehov. Staffan Lund ombesörjer detta.
- Svårt med avgränsningar kring kunskapsbehoven då de ibland innefattar bara vattenfrågor, ibland hela system där vatten utgör en del.

- Sammanställningen är fortfarande spretig och det är lite oklart vad syftet med den är. Vem vänder vi oss till? Skulle vara bra att kondensera ner sammanställningen till ett färre antal punkter som är mer fokuserade.
- Vi skulle samtidigt behöva verka mer för att kommunicera våra starka ämnesområden på SLU och även externt.

Mötet landade i att vi i detta skede bäst tar sammanställningen och kunskapsbehoven vidare genom att anordna en öppen digital och populärvetenskaplig seminarieserie med start under hösten 2021 där vi betar av de tematiska ämnesområdena ett efter ett, samt att framgent även tydligare synliggör vår expertis om vatten på SLU via webben. Efter sommaren träffas därför de som har intresse av att bidra och medverka till seminarieserien för att ta idéerna vidare till konkret handling (format, frekvens och ämnen att fokusera på). Jens Olsson skickar ut en intresseförfrågan om ett sådant möte till WaterCOG efter sommaren.

2 Diskussion om framtida gemensamma forskningsansökningar

Det finns flera för SLU Vattenforum intressanta utlysningar/program på gång. Till exempel Formas nationella forskningsprogram för hav och vatten (utlysning om ”Blue innovation” stänger i höst), Horizon Europe, Naturvårdsverkets utlysning om multifunktionella landskap (45 miljoner, stänger i oktober), samt Mistras forskningsprogram om hav och marina ekosystem (öppnas förhoppningsvis under hösten 2021).

Under mötet diskuterade vi främst Naturvårdsverkets utlysning om multifunktionella landskap, med utgångspunkten i att SLU bör gå in med åtminstone en ansökan kopplat till landskap och vatten och där intresserade inom WaterCOG vill medverka. Flera personer i WaterCOG har blivit kontaktade av externa parter om intresse för att formera konsortier för utlysningen. När den kompletta utlysningstexten publicerades kort efter detta möte är det tydligt att utlysningen fokuserar på biologisk mångfald, tvärvetenskap och att ansökan ska ha en tydlig (styrande?) samhällsvetenskaplig inriktning. Senare gav dekan Torleif Härd (NJ-fakulteten) Mark Marissink (chef vid SLU Artdatabanken) uppdraget att leda arbetet med en tvärvetenskaplig och gemensam ansökan från SLU. Jens Olsson utpekades att bistå Mark inom vattenområdet. Grants Office på SLU är villiga att bidra i arbetet med en gemensam ansökan. Just nu pågår diskussioner mellan Ekologen, Stad och land, Ekonomi och personer från WaterCOG om en eventuell gemensam ansökan och vem som ska ta ansvar som huvudsökande. Parallellt pågår flera initiativ på SLU för att ta fram underlag för gemensamma ansökningar.

3 Övriga frågor

Finansieringen för SLU Vattenforum upphör som det ser ut i dagsläget vid utgången av 2021. Det finns en plan och budget för det fortsatta arbetet inom SLU Vattenforum under 2021 och 2022, och Jens Olsson har fått signaler från dekan

Torleif Härd om att de finns en vilja från centralt håll att delvis finansiera SLU Vattenforums verksamhet. För att ytterligare förtydliga behovet och nyttan med att SLU Vattenforum får fortsatt finansiering tar Kevin Bishop fram ett förslag till ett brev från prefekterna vid ”vattentunga” institutioner att skicka till SLU:S ledning.

Nästa ordinarie möte med WaterCOG hålls under sen höst 2021, med möjligt fokus på fortsatta gemensamma ansökningar, samt vattenutbildningar på SLU.

Anteckningar av Lisa Beste och Jens Olsson.

Bilaga 1

Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

NJ-faculty
SLU Water Forum
Jens Olsson

2021-05-26

Summary knowledge needs SLU Water Forum 2020-2021

Background

To strengthen transdisciplinary collaboration on water at SLU, it was suggested during the spring 2020 meeting of WaterCOG (coordination group for water at SLU) to map future knowledge needs on water issues in light of current and future environmental- and societal challenges. Following this mapping activity, the suggested knowledge needs could be further grouped into thematic areas (e.g. Water and food, Water and forests, Water and agriculture….) with identification of key persons/groups and potential interdisciplinary connections and cooperation. Emerging and evident synergies are expected to follow. A next step could then later be to organize a seminar day/workshop with stakeholders and funding bodies focusing on a dialogue on future knowledge needs from the perspectives of all participants and also including presentations from SLU describing our expertise and key focal areas with respect to water. The ultimate aim of the seminar should be to inform and influence funding bodies on the needs for future calls focused on water. Another parallel step could be to summarize the mapping activity in one or several scientific review paper/papers.

Below are the contributions to the mapping of knowledge needs so far, including the identity of the sender.

Kevin Bishop (IVM)

1. Knowing the **underlying hydrological processes that move water through catchments**. This has bearing on the following “miljömål” Giftfri Miljö, Övergödning, Försurning, Klimat

2. Several key unknowns:

    a. **Wetlands** as green infrastructure **to moderate hydroclimatological extremes**

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b. The **differences in runoff amount and timing from forests, agriculture and wetlands**. This has a major bearing on all efforts at pollution source apportionment, as well as "green infrastructure"

c. **Mercury cycling in relation to the UN Minamata Convention**

d. **Carbon cycling** – both inorganic and organic forms.

e. The use of **tracers of water to overcome equifinality in hydrological modeling**

f. **Water and Forests in Ethiopia**

g. **Managing water resources** (interdisciplinary)

h. **Monitoring water amount, quality and biology** (FOMA)

Stefan Bertilsson (IVM)

-**The GHG balance** (CO_2, CH_4, N_2O) **of different types of freshwaters**, now and in a future climate change scenario.

-Strategies to **mitigate eutrophication and algal blooms for sustainable use of freshwater resources**.

-**Microbiologically safe freshwaters**

-**Aquatic ecosystem responses to changing ice cover** predicted for the future (both freshwater and marine).

-**Invasive species and their biological controls**.

-**Bioindustrial use of freshwater resources** (aquaculture, paludiculture)

Karin Wiberg and Lutz Ahrens (IVM), and Johan Lundqvist, Stefan Örn, Gunnar Carlsson och Anders Glynn (BVF)

Future knowledge needs on water issues

- **Clean water** for everyone
- **Safe reuse** of water
- Identification of **chemical and microbial hazards in raw and drinking water**
- Early **warning methodology for water contamination**

- **Treatment technology for contaminated water**
- **Safe use of water in primary food production and in the food industry**
- **Waste water treatment plants (WWTPs) as sources of chemical and microbial hazards**
- **Urban run-off / Storm water as sources of chemical and microbial hazards**
- **Consequences of chemical and microbial contamination of aquatic systems for food safety**
- **Consequences of chemical and microbial contamination of aquatic systems for aquatic organism health**

Drinking water supplies

IVM (Karin Wiberg, Stephan Köhler, Lutz Ahrens) and BVF (Anders Glynn, Johan Lundqvist, Stefan Örn)

Water and Food

IVM (Karin Wiberg, Stephan Köhler, Lutz Ahrens) and BVF (Anders Glynn, Johan Lundqvist, Stefan Örn, Gunnar Carlsson), BT (Malin Hultberg), Animal husbandry (Animal Environment and Health, Animal Nutrition and Management, NN ????), Crop production (Crop Production Ecology, NN ????)

Aquatic system contamination and food safety/aquatic organisms health

IVM (Karin Wiberg, Stephan Köhler Lutz Ahrens), BVF (Anders Glynn, Johan Lundqvist, Stefan Örn, Gunnar Carlsson), SLU Aqua (????), fler???

Richard Johnson (IVM)

- Effects of land use on riparian and aquatic biodiversity and function, in particular with special focus on the importance of cross-habitat connectivity for ecosystem resilience
- Better estimates of reference conditions of lowland streams and lakes
- Restoration - understanding what works and what doesn’t
- More focus on modelling, e.g. diagnostic models

SLU Aqua (via Anna Gårdmark and Sara Bergek)

- **Effects on connectivity** among freshwater, coastal and offshore systems **from future climate change** and **other anthropogenic disturbances** including development and fishing?

- **Do Baltic Sea top predators suffer from thiamine deficiency** and is there a connection to the imbalance of the Baltic Sea ecosystem (climate change, eutrophication and contaminants)?

- How to provide solutions across relevant scales (spatial and temporal scales) that address the **trade-offs between blue economy, sustainability, conservation measures, policy objectives and actions to meet aquatic biodiversity and climate change targets?**

- How to provide an **integrated transdisciplinary approach for linking aquatic biodiversity to ecosystem services and Nature's Contributions to People** (NCP) from local to the global scales to allow transformative changes that will **embrace the human dimensions of coastal and marine ecosystems?**

- How to provide **e-infrastructure and Open Access Science** for sharing information and building trust **between multi-sectors stakeholders and users**?

- What's the **impact of forestry practices on (Baltic Sea) coastal ecosystems**?

- How will **adaptation of the blue food sector to climate change affect aquatic food webs?**

- **Environmental adaption of hydroelectric power plants**. In relation to the establishment of a national competence center for the re-examination of all existing hydroelectric power plants in Sweden.

- How to plan for the future? **Multifunctional measures for ecosystem-based climate adaptation**, development of **green infrastructures** and **safe guarding biodiversity**.

Vilt, fisk och miljö (Tomas Brodin, Erin McCallum, Michel Bertram, Daniel Cerveny - VFM)

- Ecological and evolutionary effects of chemicals and chemical mixtures

- Interactive ecological and evolutionary effects of multiple anthropogenic stressors in a changing climate
- Effects of pharmaceuticals in aquatic environments
- Estimating pharmaceutical transfer between aquatic and terrestrial ecosystems
- WWTP as ecological traps – prioritizations and mitigations
- Ecological and biodiversity effects of tertiary cleaning
- Increased connectivity and improved restoration of rivers and streams
- Environmental adaption of hydroelectric power plants. In relation to the establishment of a national competence center for the re-examination of all existing hydroelectric power plants in Sweden (with Aqua).
- Apex predators – the role of large predators for ecosystem health, stability and functioning.

Ulf Bjelke (SLU Artdatabanken)

- **Identifying and developing time series for species susceptible to climate change.**

- **Status and trends for alpine** freshwater invertebrates.

- **Ecosystem effects of invasive alien species in lakes and streams**.

- **Ecosystem effects of riparian invasive alien species** (Himalayan balsam (jättebalsamin), yellow skunk cabbage (skunkkalla)) et c.

- Survey of eradication methods abroad regarding invasive alien species in freshwaters and riparian zones.

- Sweden has 100 000 lakes, but in addition to this, **≈300 000 standing waters smaller than 1 ha** (with a combined area comparable to the one of lake Mälaren); **what biodiversity** is inhabiting these understudied waters and **what ecosystem functions** are carried out.

- Sweden has **800 000 km of ditches** crisscrossing the landscape, **what biodiversity** is inhabiting these waters and **what ecosystem functions** are carried out.

- **The Swedish Environmental Objectives** (Miljömålen) states that all native species should be able to survive in long-term viable populations with sufficient genetic variation. Still, for a large number of freshwater species the knowledge is very scarce. A number of species have no

recordings during the past decade. SLU has a number of taxonomic experts that could participate in future surveys of understudied species (and understudied habitats).

Josefin Sagerman (SLU Artdatabanken)

- Developing **indicators and monitoring methods for aquatic plant communities.** Current focus is on submerged aquatic vegetation on shallow sediment bottoms of the Baltic Sea. To accomplish monitoring with good precision, of variables that are sensitive to anthropogenic disturbance.

Sebastian Sundberg (SLU Artdatabanken)

- eDNA techniques need to be developed and tested to detect and monitor macrophytes in lakes and streams. This is urgent since field surveys are demanding, expensive and imprecise. Results from eDNA sampling can direct physical sampling (search for and quantification of populations) to sites with a positive indication. Relevant species and groups include the EU Habitats directive species *Najas flexilis* (also *N. tenuissima*), species of national action plans among pondweeds *Potamogeton* and stoneworts/charophytes (order Charales), and invasive alien species such as *Elodea nuttallii* (and other potentially threatening aquatic plants). There is a growing body of international experience and DNA libraries published for these groups to develop further.

Christina Halling (SLU Artdatabanken)

I. To meet the objectives of the new EU: s biodiversity strategy for 2030 there is an urgent need for effective monitoring ecological status of diversity and functions aquatic habitats both freshwater and marine. There is also an urgent need for identifying, implement, assess and evaluate effective measurable measures wherever needed for the improvement of ecological status in aquatic environments. Comparing to terrestrial the aquatic and marine environments are far behind due to practical challenges and knowledge gaps. However, the rapid technical and method development provides new possibilities for example for species detection using barcoding and eDNA. The expertise found within SLU is highly relevant for dissolving this matter. Some examples/ideas:
    - Development of molecular monitoring/detecting methods (eDNA) for detecting key/rare/invasive marine/aquatic species.
    - Development of molecular monitoring methods (eDNA) for detecting marine evertebrates

- Development of molecular monitoring methods (eDNA) for detecting marine macrophytes (see also Sebastian Sundberg's proposal about freshwater macrophytes).

II With the technical development within remote sensing /drones and better access to satellite data and acoustic measures there are today great opportunities to do different kinds of investigations in aquatic environments. Like mapping seasonal variations on "biodiversity hotspots" etc.

III Management of shores: The management of the shores both in marine and in freshwater are of high importance for biodiversity. Areas being periodically/seasonally submerged as well as areas with partly submerged vegetation constitutes highly important ecological value. Even if their ecological importance are recognized, their duality seems to be overlooked in management - an area is aquatic OR terrestrial. Highly up to date also due to Strandskyddsutredningen, that in some (unexploited) areas will make shores more available for exploitation despite their importance for biodiversity. What will the consequences be? What level of exploitation is sustainable?

IV Petersen, Jägerskiöld, Waern and others. Look into the history of documented marine biodiversity and revisit a number of these places/sites in order to investigate the status and biodiversity today.

V Baselines; reference values; strict protection and pristine aras. When assessing status there is a need for a reference value. What is good ecological status? Especially aquatic environments management is suffering from a sort of literacy – we actually do not know how the aquatic environments looked like before anthropogenic pressures started to change its conditions/composition. This is especially true for freshwaters (landuse, dams etc) but also coastal areas where humans have interfered through hunting and fishing (eagels/diving ducks; seals/cormorants etc). We need a better understanding of how biodiversity and ecological functions and services has changed over time in aquatic habitats for management decisions. How can we reach that understanding and how shall we use this information?

Food and feed from water

Anders Kiessling

I'm not pointing to any specific department, as we have a cross faculty center in SLU Aquaculture gathering the SLU competence in parallel with SLU Water.

At this point I therefore like to mention some general areas to be detailed at interest/activity.

- All farming of aquatic organism has an impact on the surrounding water environment. This includes both fed and extractive aquaculture, independent if conducted in open or more closed system. This interaction will be different pending type of activity and can be both of negative and positive nature, in relation to the surrounding eco- and societal system. In all, we need to understand this interaction better in order to develop aquaculture as a part of our future food system and as a part of ecosystem management. This is especially interesting concerning extractive aquaculture, or blue catch crops, ranging from bivalves to reeds, but also open finfish aquaculture is discussed as a possible part of ecosystem management in hydropower dams of Northern Sweden.

In this respect, I like to mention three very relevant ongoing/starting activities of relevance to include under the present initiative:

1. **Rich water (Rikare vatten)**, that includes reed as feed and feed mussel farming in the Baltic proper as blue/green catch crop).
2. **Blue food**, is one of the future food centers financed by Formas for food from water. SLU is responsible for the area, circular production with special focus on the fait/use of fish manure.
3. **Hydro power dams a future hub in a circular food production with environmental benefits?** This is a cross faculty group, including representatives from ecology, water chemistry, social sciences and aquaculture from all four SLU faculties and Umeå Univ. (fish population dynamics). The aim is to understand how the by man and environmental factors, as climate change, imposed changes in this once natural river lakes, and how their historic social importance may be enhanced as a part of an ecosystem based management plane. The group has received a startup support from SLU Aquaculture and is headed from IVL (Martyn Futter) in close collaboration with HUV (me) and a number of researchers all over SLU.

Jens Fölster (IVM och FoMa Övergödning)

1. Predicting hotspots for nutrient leaching in the agricultural landscape

2. Credible estimations of cost efficiency for measures against nutrient leaching from agricultural soils.

3. Multifuncionality of rivers and river banks including control of nutrient leaching and floods as well as terrestrial and aquatic biodiversity

Kretsloppsteknik (via Jennifer McConville & Björn Vinnerås)

- More research is needed on the **fate of pharmaceuticals, microplastics and organic pollutants** during the collection, treatment and reuse of wastewater fractions
- **Climate impacts** of wastewater treatment, including nitrous oxides and other greenhouse gases. Investigations should also look at potential remediation options and alternative system formations that would reduce climate impacts.
- **Innovation studies assessing drivers and barriers** for innovative system changes that would allow for greater resource recovery and reducing in negative impacts on climate and eutrophication. Including issues of acceptance, policy, public procurement and technological development
- **Potentials for antibiotic resistance** in recovered resources from wastewater

Jennie Barron, Helena Aronsson and Magdalena Bieroza (Mark och miljö)

1. Landscape understanding of pollutant transport from sources to recipients

- Evaluating multiple stressors in agricultural landscapes rather than single pollutants
- targeting critical sources and delivery pathways-both in space and time in agricultural landscapes
- High-resolution spatial and temporal data and models linking hydrology, biogeochemistry and ecology
- Evaluating and prioritizing multiple pressures in agricultural landscapes e.g. eutrophication, greenhouse gas emissions, water shortages

2 **. Mitigation measures to reduce pollutant losses from agricultural land to waters**

- improved choice (what measures are appropriate for a given pressure) and targeting of measures in the landscape for the highest improvements in water quality

- evaluating the long-term effects on water quantity and quality

- multifunctionality of the mitigation measures to fulfill several ecosystem services and addressing trade-offs in pollution

- adaptions to climate change and extreme weather events

- big data and new approaches (technology /modelling/ measuring) for monitoring and management water –food production systems-environment: how to have efficient and representative and cost efficient monitoring to inform management and policy ?

- improve understanding BMP /NBS and engineered solutions (and mix thereof) and assessing cost benefits through spatial-temporal scales

3**. Improved nutrient recycling in agriculture and food chain for increased bioeconomy/circular economy and reduced eutrophication**

- test/pilot – develop technologies (BMP /NBS and engineered solutions (and mix thereof)) for recirculation of nutrients in the system, and of those lost to waters

4. **Allocation and tradeoffs of water for productive food systems and nutrition security in agricultural landscapes**

Future climate and water resources variability will affect water demand into food production at local and global scales. Food and nutrition (crop, livestock, other) will rely more on managed rainfed systems, to reduce water quantity outtake (i.e. contribute to SDG 6.4). It will mean to develop both irrigation and drainage technologies for productive use, understand implication on local landscapes, and tradeoffs, whilst supporting food and nutrition security

- Understand the relevance of soil management and natural vs anthropogenic water infrastructure (incl ditches , drainage and wetlands , reservoirs) for agricultural landscapes (Sweden, international)

- In the specific case Sweden: the role, need and potential impact (benefits/tradeoffs) for drainage and irrigation solutions to meet food and nutrition security and production demands

- In international context: develop understanding on potential solutions and tradeoffs between rainfed, irrigated and pasture production systems from water and land/soil perspective

5 Understand water, agriculture and GHG interlinkages for risk assessment and mitigation measures under changing climate, and agricultural current and future production systems

- Contribute to metrics and data to Swedish Climate reporting, and solutions on land/soil and water management related to GHG emissions in crop systems on both mineral and organic soils

6 Water and urban green areas

we do have a responsibility, but currently do very little? to consider both issues and solutions related to urban green environments , and the interplay with water resources. For example, in Sweden we have no systematic data on soil/growth medium physical characteristics available, which in turn means little comprehensive understanding on infiltration rates or means to improve these under current or

future climate. It can affect on both water quality and quantity, and support improved practical solutions.

Hjalmar Laudon (FEM – Forest Ecology and Management)

a) **Hydrological and biogeochemical effects of contemporary and future intensive forest management in a changing climate**
   i) Local, landscape and regional consequences
   ii) Effects of various management strategies

b) **Riparian buffer management to reduce water quality and ecological effects on surface waters**
   i) Improving the spatial configuration of buffer zones
   ii) Adaptive management around streams

c) **Forest management of wet soils**
   i) Consequences and benefits of ditch-cleaning
   ii) Alternative management strategies to conventional ditch maintenance

d) **Wetland restoration to restore legacy effects of forestry**
   i) A tool to reduce flooding and drought in a changing climate
   ii) Water quality effects

Department of Economics (Staffan Waldo)

Ecosystem based management – economy and the human dimension is a crucial part of ecosystem based management.

Trade-offs in marine management – how is the fishery and its different fleet segments affected by management measures targeting e.g. conservation, climate change, biodiversity, etc.?

Economic analysis of marine spatial planning – e.g. effects of Natura2000 areas, wind power farms, etc.

Aquaculture economics – aquaculture is a growing sector that is not well analyzed from an economic perspective in Sweden

Fish value chains – the value chains after landing by Swedish fisheries (and aquaculture production) is not well understood.

Bilaga 2

Summary of the knowledge needs on water SLU

Jens Olsson, 2021-05-31

Potential "thematic areas"

1. Wetlands

- The underlying hydrological processes that move water through catchments,
- Wetlands as green infrastructure to moderate hydroclimatological extremes,
- The differences in runoff amount and timing from forests,
- Agriculture and wetlands,
- Wetland restoration to restore legacy effects of forestry

Persons: Kevin Bishop and Hjalmar Laudon.

2. GHG balance of water and climate change

- The GHG balance (CO_2, CH_4, N_2O) of different types of freshwaters,
- Carbon cycling – both inorganic and organic forms,
- Aquatic ecosystem responses to changing ice cover predicted for the future,
- Effects on connectivity among freshwater, coastal and offshore systems from future climate change and other anthropogenic disturbances including development and fishing,
- How will adaptation of the blue food sector to climate change affect aquatic food webs?,
- Interactive ecological and evolutionary effects of multiple anthropogenic stressors in a changing climate,
- Identifying and developing time series for species susceptible to climate change,
- Climate impacts of wastewater treatment, including nitrous oxides and other greenhouse gases,
- Adaptions to climate change and extreme weather events,
- Understand water, agriculture and GHG interlinkages for risk assessment and mitigation measures under changing climate, and agricultural current and future production systems,
- Societal consequences of a changed climate (draught, flooding) and coupled stressors.

Persons: Stefan Bertilsson, Kevin Bishop, SLU Aqua (via Anna Gårdmark and Sara Bergek), VFM (Tomas Brodin, Erin McCallum, Michel Bertram, Daniel Cerveny), Ulf Bjelke, Jennifer Mcconville, Björn Vinnerås, Anna-Karin Dahlberg, Jennie Barron, Helena Aronsson and Magdalena Bieroza.

3. Eutrophication

- Strategies to mitigate eutrophication and algal blooms for sustainable use of freshwater resources,
- Predicting hotspots for nutrient leaching in the agricultural landscape,
- Credible estimations of cost efficiency for measures against nutrient leaching from agricultural soil.

Persons: Stefan Bertilsson and Jens Fölster.

4. Hazardous substances and water quality

- Mercury cycling in relation to the UN Minamata Convention,
- Microbiologically safe freshwaters,
- Identification of chemical and microbial hazards in raw and drinking water,
- Early warning methodology for water contamination,
- Waste water treatment plants (WWTPs) as sources of chemical and microbial hazards,
- Urban run-off / Storm water as sources of chemical and microbial hazards,
- Ecological and evolutionary effects of chemicals and chemical mixtures,
- Effects of pharmaceuticals in aquatic environments,
- Estimating pharmaceutical transfer between aquatic and terrestrial ecosystems,
- Landscape understanding of pollutant transport from sources to recipients,
- Mitigation measures to reduce pollutant losses from agricultural land to waters
- Consequences of chemical and microbial contamination of aquatic systems for aquatic organism health.

Persons: Kevin Bishop, Stefan Bertilsson, Karin Wiberg, Lutz Ahrens Johan Lundqvist, Stefan Örn, Gunnar Carlsson, Anders Glynn, Foon Yin Lai, Oksana Golovko, Mikaela Gönczi, Anna-Karin Dahlberg, VFM (Tomas Brodin, Erin McCallum, Michel Bertram, Daniel Cerveny), Jennie Barron, Helena Aronsson and Magdalena Bieroza.

5. Recycling and re-use of water

- Safe reuse of water,
- Treatment technology for contaminated water,
- Ecological and biodiversity effects of tertiary cleaning,
- WWTP as ecological traps – prioritizations and mitigations,
- The fate of pharmaceuticals, microplastics and organic pollutants during the collection, treatment and reuse of wastewater fractions,
- Potentials for antibiotic resistance in recovered resources from wastewater,
- Innovation studies assessing drivers and barriers for innovative system changes that would allow for greater resource recovery and reducing in negative impacts on climate and eutrophication.

Persons: Kevin Bishop, Stefan Bertilsson, Karin Wiberg, Lutz Ahrens Johan Lundqvist, Stefan Örn, Gunnar Carlsson, Anders Glynn, Foon Yin Lai, Oksana Golovko, VFM (Tomas Brodin, Erin McCallum, Michel Bertram, Daniel Cerveny), Jennifer Mcconville and Björn Vinnerås.

6. Invasive species

- Invasive species and their biological controls,
- Ecosystem effects of invasive alien species in lakes and streams,
- Ecosystem effects of riparian invasive alien species (Himalayan balsam (jättebalsamin), yellow skunk cabbage (skunkkalla)) et c.,
- Survey of eradication methods abroad regarding invasive alien species in freshwaters and riparian zones.

Persons: Stefan Bertilsson, Sebastian Sundberg and Ulf Bjelke.

7. Water and food production

- Bioindustrial use of freshwater resources (aquaculture, paludiculture),
- Safe use of water in primary food production and in the food industry,
- Consequences of chemical and microbial contamination of aquatic systems for food safety,
- Impact on the surrounding water environment from aquaculture,
- Rich waters (Rikare vatten) that includes reed as feed and feed mussel farming in the Baltic proper as blue/green catch crop),
- Blue food, is one of the future food centers financed by Formas for food from water,
- SLU is responsible for the area, circular production with special focus on the fait/use of fish manure,
- Hydro power dams a future hub in a circular food production with environmental benefits?,
- Improved nutrient recycling in agriculture and food chain for increased bioeconomy/circular economy and reduced eutrophication,
- Allocation and tradeoffs of water for productive food systems and nutrition security in agricultural landscapes.

Persons: Stefan Bertilsson, Karin Wiberg, Lutz Ahrens Johan Lundqvist, Stefan Örn, Foon Yin Lai, Oksana Golovko, Gunnar Carlsson, Anders Glynn, Anders Kiessling, Jennie Barron, Helena Aronsson and Magdalena Bieroza.

8. Aquatic ecology and biodiversity

- Effects of land use on riparian and aquatic biodiversity and function,
- Do Baltic Sea top predators suffer from thiamine deficiency,
- Apex predators – the role of large predators for ecosystem health, stability and functioning,
- Status and trends for alpine freshwater invertebrates,
- biodiversity and ecosystem function of small (less than 1 ha) water bodies and ditches,
- increased knowledge of aquatic biodiversity,
- Look into the history of documented marine biodiversity and revisit a number of these places/sites in order to investigate the status and biodiversity today.

Persons: Karin Wiberg, Lutz Ahrens Johan Lundqvist, Stefan Örn, Gunnar Carlsson, Anders Glynn, Richard Johnson, SLU Aqua (via Anna Gårdmark and Sara Bergek), Josefin Sagerman, Ulf Bjelke and Christina Halling.

9. Management of aquatic ecosystem

- Better estimates of reference conditions of lowland streams and lakes,
- Restoration - understanding what works and what doesn't,
- More focus on modelling, e.g. diagnostic models,
- Developing indicators and monitoring methods for aquatic plant communities,
- Management of shores,

- Baselines; reference values; strict protection and pristine areas.
- When assessing status there is a need for a reference value. What is good ecological status?,
- Water and urban green areas,
- Hydrological and biogeochemical effects of contemporary and future intensive forest management in a changing climate,
- Forest management of wet soils,
- Ecosystem based management,
- Trade-offs in marine management,
- Managing water resources (interdisciplinary).

Persons: Kevin Bishop, Richard Johnson, SLU Aqua (via Anna Gårdmark and Sara Bergek), Josefin Sagerman, Christina Halling, Anna-Karin Dahlberg, Jennie Barron, Helena Aronsson and Magdalena Bieroza, Hjalmar Laudon and Staffan Waldo.

10. Human and societal dimensions of water and use

- How to provide solutions across relevant scales (spatial and temporal scales) that address the trade-offs between blue economy, sustainability, conservation measures, policy objectives and actions to meet aquatic biodiversity and climate change targets?,
- How to provide an integrated transdisciplinary approach for linking aquatic biodiversity to ecosystem services and Nature's Contributions to People (NCP) from local to the global scales to allow transformative changes that will embrace the human dimensions of coastal and marine ecosystems?,
- How to provide e-infrastructure and
- Open Access Science for sharing information and building trust between multi-sectors stakeholders and users?,
- Economic analysis of marine spatial planning,
- Aquaculture economics,
- Fish value chains,
- Societal analyses on the drivers of degradation of marine ecosystems,
- The human dimension of current and future water use.

Persons: SLU Aqua (via Anna Gårdmark and Sara Bergek) and Staffan Waldo.

11. Modified water bodies

- Environmental adaption of hydroelectric power plants. In relation to the establishment of a national competence center for the re-examination of all existing hydroelectric power plants in Sweden,
- Increased connectivity and improved restoration of rivers and streams,
- Improve understanding BMP /NBS and engineered solutions (and mix thereof) and assessing cost benefits through spatial-temporal scales.

Persons: SLU Aqua (via Anna Gårdmark and Sara Bergek), Jennie Barron, Helena Aronsson and Magdalena Bieroza.

12. Multifunctional landscapes and measures

- How to plan for the future? Multifunctional measures for ecosystem-based climate adaptation, development of green infrastructures and safe guarding biodiversity.
- multifunctionality of the mitigation measures to fulfill several ecosystem services and addressing trade-offs in pollution.

Persons: SLU Aqua (via Anna Gårdmark and Sara Bergek), Jennie Barron, Helena Aronsson and Magdalena Bieroza.

13. Cross-ecosystem effects

- What's the impact of forestry practices on (Baltic Sea) coastal ecosystems?,
- Riparian buffer management to reduce water quality and ecological effects on surface waters,
- Bio-geochemical processes across ecosystems systems,
- Cross-system effects (land-water, land-sea, blue-green infrastructure in urban environments – the vaule of water in urban environments.

Persons: SLU Aqua (via Anna Gårdmark and Sara Bergek), Hjalmar Laudon and Stefan Bertilsson.

14. Development of new techniques to collect data

- e-DNA,
- Better access to satellite data and acoustic measures there are today great opportunities to do different kinds of investigations in aquatic environments,
- Big data and new approaches (technology /modelling/ measuring) for monitoring and management water –food production systems-environment: how to have efficient and representative and cost efficient monitoring to inform management and policy?

Persons: Sebastian Sundberg, Christina Halling, Jennie Barron, Helena Aronsson and Magdalena Bieroza.