Abstracts for presentation held at the fourth internal water seminar, Swedish University of Agricultural Sciences, 11-12 April 2024

Genomic Studies to Enhance the Reproductive Performance of the Swedish Arctic Charr (Salvelinus alpinus)

Khrystyna Kurta, Department of Animal Breeding and Genetics.

The consistent presence of substantial variability in male fertility within the Swedish Arctic charr poses a crucial challenge impacting its reproductive success. However, in-depth investigations into these fluctuations within a reproductive season and across multiple years are lacking. Additionally, there is limited information regarding the impact of genetic factors on sperm quality. Our research aimed to address these gaps by examining seasonal, age-related and genetic factors that could influence sperm quality in males raised under natural and delayed photoperiods. Over two consecutive years, animals were sampled three times, and their sperm quality was assessed using a computer-assisted sperm analysis (CASA) system. High-throughput sequencing technologies were then employed to pinpoint genomic regions associated with the changes in sperm quality throughout the breeding season.

What is the tolerable PFAA limit in drinking water to prevent significant health risks?

Carolina Vogs, Department of Biomedical Science and Veterinary Public Health.

Per- and polyfluoroalkyl substances (PFAS), also called “forever chemicals”, is a chemical class comprising around 10,000 PFAS-related structures. PFAS can be precursors to perfluoroalkyl acids (PFAA) and some PFAA exhibit high persistence, occur globally, accumulate in biological matrixes, and adversely affect human and animal health. A recent published “Forever Pollution Map” visualizes 17,000 contamination sites identified across Europe. Moreover, sources of human PFAA exposure are diverse and include exposures from food, drinking water, cosmetics, dust, textiles, consumer products and others. Notably, PFAA exposure through drinking water emerges as a major public health concern, specifically in hotspot locations where high PFAA contamination levels contribute to elevated serum concentrations above background exposure from other sources than local drinking water. New evidence also indicates that even low PFAA levels in drinking water can contribute to elevated serum concentrations in adolescents. Because of the cumulative exposure over the last decades as well as long half-lives over years, some PFAA are found in nearly every person as revealed by human biomonitoring data. As a response to this public health concern, the European Food Safety Agency (EFSA) recently revised the tolerable daily intake for the four most monitored PFAA (PFOA, PFNA, PFHxS, PFOS) from aggregated exposure based on decreased response to vaccination in 1 year-old toddler. The tolerable daily intake is assumed to be protective against other PFAA-associated health issues such as disrupted lipid metabolism, endocrine disruption, fertility problems, and decreased birth weight. However, we currently lack the understanding of the contribution of PFAA from drinking water to the total body burden and the associated health issues. Therefore, this research aims to derive urgently needed maximum PFAA limits in drinking water for different age groups and both genders. To this end, toxicokinetic models

will be developed and applied to translate PFAA in drinking water to PFAA in serum accumulated over lifetime. The maximum PFAA limits in drinking water will be aligned to the existing regulatory-assessed tolerable daily PFAA intake as well as newly scientific evidence from epidemiological and toxicological studies, thereby supporting risk assessors and mangers in their future risk mitigation decisions.

Patterns of reproduction in a social fish that shapes, and is shaped by, its own ecology

Aneesh H.P. Bose, Department of Wildlife, Fish and Environmental Studies

The local ecological environment, including the distributions of food, resources and predators, provides the backdrop against which animals interact and reproduce with one another. Particular ecological circumstances can constrain reproductive opportunities, but can sometimes also present new ones. For example, when group-living animals are faced with the complex decisions of how to partition within-group reproduction and how much to seek extra-group reproduction, it is their local environment that provides the arena in which these alternatives get weighed against one another. A central goal of mating systems evolution is to be able to predict the reproductive strategies that get employed under a particular set of ecological conditions, but this can be challenging, particularly in the wild where many factors can vary at the same time. I will present mating systems data from Neolamprologus multifasciatus, a group-living cichlid fish from Lake Tanganyika in East Africa that experiences an extraordinarily unique set of ecological conditions. This species lives on "shell beds", regions of the lake floor covered in empty snail shells that they excavate from the sand and use as shelters and brood chambers. N. multifasciatus live at extreme densities and under constant threat of predators, but they also have the ability to remodel the physical landscape around them and influence their own ecological circumstances (i.e., ecological niche construction). I will show how reproductive skew differs between the sexes under the species' 'typical' ecological conditions, and how patterns of reproduction depend on whether the fish can or cannot engage in niche construction.

Microbiome monitoring for risk assessment in Recirculating Aquaculture Systems

Fernando Puente Sanchez, Department of Aquatic Sciences and Assessment

Aquaculture is a key technology for achieving food security, as it is a source of high-quality protein that can be produced locally with a reduced environmental impact. Recirculating Aquaculture Systems (RAS) are a promising development for achieving sustainable production, but experience high densities of fish and organic matter, which can favor the growth of opportunistic harmful bacteria. Traditional pathogen control methods, such as disinfection or the use of antibiotics, are costly and can pose environmental risks, resulting in a less sustainable operation. Instead, monitoring the microbiome associated to aquaculture facilities can help us develop strategies to prevent disease and promote beneficial bacteria. However, our knowledge of microbial dynamics in aquaculture systems is still limited.
In this project, we will use genome-resolved metagenomics to identify microbial species from a pilot RAS facility and classify them into different threat levels based on their genomic features. We use amplicon sequencing to track their dynamics when subjected to different amounts and qualities of organic matter. Microbiological and chemical data will be

integrated with machine learning in order to identify risk factors leading to the overgrowth of potentially harmful bacteria. We will finally translate this approach to commercial partners by collaborating with a Swedish company, using our newly developed method to assess the role of microorganisms in their daily operations.

Older is always better – making age structure a focal point for sustainable fisheries management

Christopher Griffiths, Department of Aquatic Resources

Abstract. Big, old, fat, fecund females (BOFFFs) play a critical role in marine fish populations. Older and larger fish contribute disproportionately to spawning success, are more resilient to stressors, and play important roles in collective space use. Despite this, fisheries management is currently stuck in a paradigm of maximised yield where catches are set without consideration of whether a population has the size or age structure it needs to be sustainable. Part of the problem is a lack of tools (indicators and reference points) capable of translating the importance of size and age from scientific paper to policy. Here, I will briefly present a new age-based indicator (developed by us here at SLU - https://doi.org/10.1111/faf.12789) that addresses this need directly. Further, I will discuss its application in the Northeast Atlantic and our plans to turn it into an operational tool for global fisheries management.

Decision Support Tools of Sustainability Assessment for Urban Stormwater Management – a review of their roles in governance and management

Zhengdong Sun, Department of Landscape Architecture, Planning and Management

Urban areas face growing sustainable challenges arising from stormwater issues, necessitating the evolution of stormwater management (SWM) concept and practice. This transformation not only entails the adoption of a multifunctional, holistic, and sustainable approach but also involves the integration of water quality and quantity considerations with governance and management aspects. A means to do so is via decision support tools (DSTs). However, whilst existing studies using the tools by employing sustainability assessment principles or as indicators to plan stormwater control measures and strategies, uncertainties remain regarding how DSTs encompass governance and management dimensions. The aim of this study is to provide much-needed clarity on this aspect, to achieve this, a systematic review of DSTs used in sustainability assessment within the SWM context is conducted, focusing on their abilities to include governance and management. Findings encompass governance aspects, such as actors, discourses, rules, and resources considered, and explore how these relate to long-term management. The potential of DSTs in facilitating governance and management within sustainable SWM is recognized, however, further efforts need to be allocated in: (i) exploring practical challenges in integrating all sustainability assessment pillars with consistent criteria into DSTs. This is crucial to determine the optimal use of all criteria in fostering open and informed stormwater governance and management; (ii) understanding how to engage diverse stormwater actors with future DSTs, to secure ownership and relevance; (iii) use of retrospective (ex-post) sustainability assessments are

needed to provide more tangible knowledge and to support long-term management. This is particularly related to nature or natural aspects in sustainable SWM.

Drivers, resilience and measures in an ongoing ecosystem regime shift along the Baltic Sea coast

Agnes Olin, Department of Aquatic Resources

I will present the results from a recently finished project where we studied an ongoing, spatially propagating shift in dominance from predatory fish to the opportunistic three-spined stickleback along the Baltic Sea coast, a regime shift that is having cascading effects throughout the food web. As ecosystem regime shifts can have severe ecological and economic consequences, it is a top priority to understand how to make systems more resilient. Here, we used >7000 fish samplings from the Baltic Sea coast to explore which factors make an area more or less resilient to the shift. After controlling for the influence of other drivers (including increasing stickleback densities), we find that predatory fish habitat connectivity increases resilience to the shift, but only when densities of fish-eating top predators (grey seals, great cormorants) are low. Resilience also increases with temperature, likely through boosted predatory fish growth and recruitment.

I will also briefly introduce some recently started projects where we dig deeper into the role played by seals and cormorants, and investigate which measures are likely to be most effective for protecting and restoring coastal predatory fish populations.

Fatty-acid changes in northern freshwater food webs in response to environmental change

Fernando Chaguaceda, Department of Aquatic Sciences and Assessment

Northern regions are warming more than twice as fast as the global average which has important impacts in northern freshwater ecosystems through warming, browning (caused by the mobilization of terrestrial carbon) and changes in nutrient levels. These rapid environmental changes can have important consequences in freshwater food webs, particularly in the production and transfer of physiologically-important biomolecules such as long-chained polyunsaturated fatty acids (LC-PUFAs) that are key for consumer growth and fitness as well as for human nutrition. In this presentation I will show the results from two space-for-time studies focusing on the fatty acid responses of benthic and pelagic food webs across broad spatial and environmental gradients. These results help understand which are the main drivers of fatty acid composition and what are the main impacts of global change in different food-web pathways and different taxa.