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Keynote Presentation: Frances Lucy

295 - Casting a glance in the rear-view mirror - how the ICAIS Series captures the ongoing development of aquatic invasive species research and management

Frances Lucy[1]

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E1 - Crayfish on the March: Decoding the Mechanics of Invasion

49 - Understanding the invasive success of alien crayfish species using an ecomorphological approach

Leo Nagelkerke[1], Pim Lemmers[2]

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Alien crayfish species have become widespread in Europe. Presently, at least seven species have been reported from the Netherlands, while the only native species, *Astacus astacus* is almost extinct. A number of crayfish species is already widespread, while others are expanding or potentially establishing, due to releases from the aquarium trade. Success in establishment, spread, and invasiveness of alien crayfish has been explained by differences in functional traits, mostly related to reproductive capacity, migration abilities, and climatic resistance. Crayfish can cause large-scale ecological and socio-economic damage through predation on native fauna, destruction of aquatic vegetation, and through burrowing activities, which may cause bank instability, potentially leading to flooding risks. In this study we analysed morphological traits, associated with feeding and locomotion, of seven alien and one native crayfish species. The aim was to gain mechanistic insights in how alien crayfish cause damage, how species differ

from each other, and whether these differences can be related to their invasive success. Thirty-five internal and external morphological traits were measured on 5-15 specimens of female and male specimens of *A. astacus*, *Faxonius limosus*, *F. virilis*, *Pacifastacus leniusculus*, *Pontastacus leptodactylus*, *Procambarus acutus*, *P. clarkii*, and *P. virginalis*. These traits were linked to locomotion, prey search, prey capture, and masticatory functions of each of the species. All species showed consistent morphological differences in most traits associated with these functions, clearly indicating niche segregation. Notwithstanding the absence of a clear relationship with invasiveness, such niche differentiation could indicate the long-term potential of species to become established in a 'vacant niche'. As such, this ecomorphological approach could be used as an additional tool for assessing risks of the imminent introduction of additional crayfish species.

26 - Where I Was and Where I Am: Long-Term Assessment of a Near-Global Freshwater Invader

SIMONE GUARESCHI[1], TOMMASO CANCELLARIO[2], FRANCISCO OFICIALDEGUI[3], ALEX LAINI[4], MIGUEL CLAVERO[3]

[1]Rey Juan Carlos University, [2]Universitat de les Illes Baleares, [3]Estación Biológica de Doñana, EBD -CSIC, [4]University of Turin

Freshwater ecosystems are invaded by a non-random selection of taxa, among which crayfish stand out with successful examples worldwide. However, long-term studies depicting the multicontinental invasion trajectories of species are often constrained by the scarcity of documented records. The red swamp crayfish, *Procambarus clarkii* (Decapoda: Cambaridae), stands out as an uncommon example of hyper successful invasive species with a well-known invasion history at both regional and global levels. This allows for the use of its records to track distribution dynamics and bioclimatic preferences over time. Through multiple temporal comparisons, the global bioclimatic tendencies of the species have been explored over a period exceeding a century (1854-2023). This specific setup provides a rare focus on biological invasions at both broad temporal and spatial scales. The results highlight climatic trends in the invasion process of the species, including decreases in the values of bioclimatic variables associated with temperature and precipitation. This trend encompasses not only mean values but also both extreme (minimum and maximum) and is coupled with increases in elevation and aridity values in the areas with the presence of the species. In a scenario of global change, these shifts could lead to previously unexplored ecological interactions within ecosystems and local or introduced species as well as impacts on range-restricted species located in climatic refuges once considered protected (e.g., mountainous areas). These findings help anticipate changes in the species' invasion trajectory, suggesting possible expansions into colder, less humid climates and higher altitudes. This approach aids in better understanding the species' spread and enables more accurate predictions of future distribution shifts, thereby informing targeted management strategies and conservation efforts. The raw data that support the findings of this study are openly available in the platform Open Science Framework (OSF).

52 - CRAFTing the profile of a perfect invader: a global database of crayfish traits within and beyond their native range.

Danai Kontou[1], Miguel Clavero[2], Josie South[1]

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There are currently 788 described species of freshwater crayfish, yet despite their global distribution, incredible trait diversity and extensive research, there is - to date - no standardised trait database. This limits the possibilities of meaningful comparisons between species or sites and restricts generalisations of hypotheses and predictions that can prove crucial for conservation and management in a rapidly changing climate. The same functional traits that make crayfish valuable ecosystem engineers, bioindicators and a key link of aquatic food webs can also make crayfish very successful invaders, with devastating impacts when they are introduced in ecosystems out of their range. We have established an initial global network of data contributors and created the first CRAyfish Functional Trait (CRAFT) database compiling morphological and reproductive traits data on the individual, population and species level along with sampling metadata and environmental parameters that will ultimately be linked to existing geospatial information. We present an outline of our database to date as proof-of -concept and invite further collaboration and contributions. Our aim is to construct a valuable community resource, that will allow effortless data-sharing and help answer high-level questions relating to invasion science and conservation planning using crayfish as a model organism.

312 - Trophic ecology of the invasive marbled crayfish in ephemeral streams of semi-arid environments

Rotem Mor[1], Oren Kolodny[1], Tamar Guy-Haim[2]

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The marbled crayfish (*Procambarus virginalis*) is a freshwater decapod that has invaded and established populations in hundreds of sites across Europe, North America, Africa, Asia, and recently, several locations in Israel - raising concerns about its impact on fragile aquatic ecosystems. This study examines the impact of marbled crayfish on food webs in ephemeral Israeli streams, which differ from previously studied habitats in being seasonal, warmer, partially human-altered, and lacking both native crayfish and fish predators.

We combined stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$) of crayfish and potential food sources from three invaded Israeli sites with controlled laboratory diet regime experiments. Stable isotope data were used to estimate trophic position, isotopic niche breadth, seasonal variation, ontogenetic shifts, and dietary composition using Bayesian mixing models. Diet regime

experiments evaluated survival, growth, and cannibalism under herbivorous and omnivorous diets.

Results show that the crayfish occupied an intermediate trophic position (2.3-2.9) across all sites. However, diet composition varied among sites. Trophic position increased during summer, and adults generally occupied higher trophic positions than juveniles. Laboratory experiments revealed high survival for juveniles in the absence of adults, under all diet regimes. In contrast, juvenile survival in the presence of adults was consistently low, pointing to substantial predation pressure. Survival of adults was not significantly affected by diet.

Our findings show that the crayfish are omnivorous, with varying main food sources. The different trophic behaviors among sites suggest local adaptation to the available resources and ecological conditions in each habitat. This suggests this species can adapt to diverse food sources, posing a threat to native food webs.

This study has been accepted by NeoBiota and a preprint available at ARPHA Preprints, e183353. https://doi.org/10.3897/arphapreprints.e183353.

C1 - Special Session: Cross-System Comparisons and Knowledge Sharing for the Management of Invasive Salmonids I

80 - The forgotten pink salmon in the Laurentian Great Lakes: an unexpected invasion with insights for three oceans

Joseph Langan[1], Peter Alsip[1], Hazem Abdelhady[2, 3], Charles Bronte[4], Cory Goldsworthy[5], Matthew Kornis[4], Krista Oke[6, 7], Eva Thorstad[8], Benjamin Turschak[9]

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Introductions of species outside their native range, such as pink salmon (*Oncorhynchus gorbuscha*) in the Laurentian Great Lakes, can serve as unplanned experiments that provide new insights into ecological plasticity and adaptation. We synthesize information on the understudied Great Lakes pink salmon invasion, use information from marine systems to help bridge knowledge gaps, and highlight how this case can inform research and management related to expansions and invasions of this species in the Pacific, Arctic, and North Atlantic Oceans. Accidentally introduced to Lake Superior in 1956, pink salmon quickly spread to all five

Great Lakes, displaying unexpected life history changes and behaviors. This invasion history demonstrates a remarkable ability of pink salmon to establish from a small founder population, colonize large areas, produce explosive year classes to rapidly increase in abundance, and complete a full life cycle entirely in freshwater. One of the most striking changes is a shift from the rigid two-year life cycle exhibited in the native Pacific range to a variable maturation age ranging from one to four years, likely influenced by prey availability as well as temperature and other environmental factors. We discuss these observations and their implications for expansions and invasions elsewhere, as well as outline high-priority research themes necessary for understanding pink salmon dynamics in the Great Lakes and with broader relevance for the native and non-native ranges. Developing a better understanding of what factors influence establishment potential and rapid changes in abundance, how novel abiotic conditions and habitat features regulate distribution and productivity, and how variability in maturation age arose and altered population dynamics would provide invaluable insights for managing the species everywhere it occurs.

99 - Pink Salmon in Nordic Waters - Patterns of Spread, Ecological Concerns, and Regional Cooperation

Thomas Staveley[1], Ida Ahlbeck Bergendahl[1], Eva Thorstad[2]

[1]Swedish University of Agricultural Sciences, [2]Norwegian Institute for Nature Research

Over the past decade, the non-native pink salmon (*Oncorhynchus gorbuscha*) has been recorded in unprecedented numbers across the North Atlantic. In the Nordic region -particularly in northern Norway - this species has reached notably high abundances, often exceeding those of native salmonid species in many river systems.

This contribution outlines the current status of pink salmon across the Nordic countries, detailing its spatial distribution, patterns of spread, recent research findings, and the implementation of monitoring, management, and communication strategies. Despite increasing observations, there remains a significant lack of evidence-based understanding regarding the ecological impacts of pink salmon in both marine and freshwater environments within this region. This underscores the urgent need for coordinated research initiatives.

A specific focus is given to the west coast of Sweden, where pink salmon populations remain low relative to Norway. However, this early stage of invasion presents a critical window for proactive detection and management before large-scale establishment occurs. Here, we present results from environmental DNA (eDNA) methodologies to detect both juvenile and adult individuals in river systems. These approaches have revealed previously undocumented occurrences and likely establishment, suggesting that pink salmon are approaching the threshold of colonising the Baltic Sea. Although no verified records exist from the Baltic Sea over the past four decades, we discuss potential ecological implications based on ecosystem modelling and ongoing surveillance efforts.

Finally, we highlight the importance of international collaboration in facilitating data sharing, harmonising monitoring protocols, and advancing cross-border management responses to this emerging biological invasion.

218 - The Pink salmon invasion in Norway: Monitoring, invasion dynamics and coordinated responses

Henrik Hårdensson Berntsen[1]

[1]NINA

Pink salmon (*Oncorhynchus gorbuscha*) have been reported in Norwegian rivers since the late 1950s, following introductions to North-Western Russia. While initial occurrences in Norway were sporadic, the establishment of self-sustaining stocks in Russia from 1985 onwards set the stage for a gradual westward spread. For decades, Norwegian rivers held low and relatively stable numbers of Pink salmon. This changed dramatically in 2017, when a sudden and unprecedented increase in abundance was observed across the country. Since then, Pink salmon numbers have continued to rise, and in many rivers today they outnumber returning Atlantic salmon (*Salmo salar*).

Pink salmon are now observed to successfully reproduce in several regions of Norway and they are expanding their geographical distribution in both Norway and in the North Atlantic. The ecological implications of this invasion remain uncertain but include competition with native salmonids, disruption of food webs, and potential effects on biodiversity and ecosystem functioning.

Here we present an overview of the invasion history of Pink salmon in Norway and the shifting public opinions, monitoring and mitigation efforts through time.

The rapid escalation of this invasion has triggered both public concern and a strong governmental response. The Norwegian Environment Agency has coordinated large-scale management efforts, most notably through the deployment of river traps designed to selectively remove Pink salmon while allowing native species to pass. These efforts are resource-intensive, logistically challenging, and not feasible in all rivers. Alongside physical removal, there is a need for a concerted effort to coordinate monitoring, improve public awareness, and facilitate knowledge exchange between scientists, managers, and stakeholders.

The Norwegian experience illustrates how a relatively overlooked non-native species can, within a few years, develop into a widespread invader with major ecological and management implications.

45 - Waiting for the storm - identifying risks and finding solutions for invading pink salmon in the UK

Colin Bean[1]

[1]NatureScot

Pink salmon were first recorded in the UK in 1960, and in the 56 years which followed that initial capture, only 16 more were ever recorded. In 2017, due to unknown factors but probably linked to climate change, Pink salmon, originating from newly established Russian populations, showed an unprecedented rise in numbers and distribution across western Europe. This initially led to fears that Pink salmon will continue to arrive in UK rivers in significant numbers but, whilst numbers have remained comparatively high, they have not yet reached the very high levels observed in those Scandinavian countries which border Russia. New evidence that Pink salmon can successfully recruit within UK rivers suggest that it is only a matter of time before this is the case. This talk aims to explore the reasons for this sudden increase in Pink salmon, describe the risks and provide some insight as to how Government and other stakeholders have developed an effective partnership to deal with this issue, and highlight some of the key scientific and management obstacles that may affect success.

A1 - Shifting Environments: Thriving in a Changing World

89 - Invasion risk, impacts, and rapid change: lessons from the Great Lakes-St Lawrence River system

Anthony Ricciardi[1]

[1]McGill University

No other freshwater system contains as many non-native species or has been invaded as frequently as the Great Lakes-St. Lawrence River basin. Its documented history of invasion spans two centuries and implicates multiple vectors, resulting in the establishment of nearly 190 non-native species to date. Collectively, these invasions have profoundly altered biodiversity, productivity, water quality, contaminant cycling, and ecosystem services. They also offer a wealth of information to inform invasion science and management. Here, I highlight five general lessons that I propose can be learned from this well documented history. First, the pattern and risk of invasion in a large system vary with changing vector activity and pathways, such that the identity—but not necessarily the timing—of some invasions can be forecasted. Second, interactions among non-native species can create unpredictable ecological impacts. Third, spatial variation in impacts are mediated by habitat heterogeneity, creating refugia for native species; but such refugia can be disrupted by other environmental stressors. Fourth, invasions act as disturbances that threaten ecosystem sustainability, such that even desirable non-native species are threatened by subsequent invasions. Finally, ballast water management has proven that evidence-based policy targeting a key vector can substantially reduce invasion rates in large heterogeneous systems.

10 - Anthropogenically Induced Adaptation to Invade (AIAI) - Assessing the stress resistance of populations from anthropogenically impacted versus pristine habitat

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Due to globalization and an increase in trade and travel number of non-native species is increasing globally. The invasion process is complex and many invasion events ultimately end unsuccessfully. Therefore, many scientists ask the question why some species become non-native, while others do not. Recently Hufbauer et al. (2011) proposed that adaptation to human-altered habitats within the native range of species may pre-adapt populations to anthropogenic stressors, and named the term “Anthropogenically Induced Adaption to Invade” (AIAI). In this study, we experimentally tested the first part of the Hufbauer et al. (2011)’ hypothesis to determine if populations from urban and anthropogenically altered habitats are more resistant to diverse stressors. We have conducted comparative assessment of stress resistance of populations of two amphipod *Gammarus salinus* and *G. locusta*, one mussel *Mytilus edulis*, and one seaweed species *Fucus vesiculosus* sampled from anthropogenically impacted and pristine sites in Schleswig-Holstein. Three combinations of stressors were applied during the experiments: i) increased temperature and salinity; ii) increased temperature and pCO_2 levels; and iii) increased temperature and copper concentrations. Our experiments revealed that populations of all four species collected from the pristine habitats were less resistant to induced stress than the populations from the anthropogenically impacted habitat, which indicates that the latter populations might be pre-adapted to anthropogenic stressors. Given these findings, we conclude that “anthropogenically induced adaption to invade” took place in the cases of populations of these four species from anthropogenically impacted habitat in Schleswig-Holstein of the Baltic Sea.

101 - From pollution to proliferation: Understanding invasive success in degraded waters

Mhairi Alexander[1], Connor Wood[1], Iain McLellan[1], Katherine Sloman[1], Jennifer Dodd[2]

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Biodiversity is under increasing pressure from global change, with freshwater ecosystems particularly vulnerable. Declining water quality and biological invasions are two major drivers of biodiversity loss, yet understanding their interactions remains limited. Aquatic contamination, especially from contextually understudied trace elements and heavy metals (Potentially Toxic Elements; PTEs), degrades habitats by reducing native species richness while favouring environmentally-tolerant taxa, which proves advantageous to non-native species. Evidence suggests contamination enhances invasion success, but the underlying physiological,

metabolic, and behavioural mechanisms are largely unexplored. Crustaceans, Gammaridae in particular, represent some of the most successful aquatic invaders. In the UK, established Gammaridae species span the native, naturalised, and invasive status continuum, across diverse habitats from streams to estuaries. Gammaridae therefore offer a valuable model group for exploring the role contamination plays in invasion dynamics. Despite their widespread use in ecotoxicology, there is limited work exploring whether invasion status mediates responses to PTEs, or how this might alter impact. Here, we present results from experimental studies investigating the ecophysiological and functional behavioural responses of Gammaridae species with differing invasion statuses to PTE exposure. By comparing taxonomically similar species across an environmentally realistic contamination gradient, we provide new insights into the mechanisms that underpin invasive success in degraded freshwater environments. The consistent increase in species invasion coupled with advancing urbanisation makes disentangling the roles of environmental degradation a critical need for robust non-native species management and strategy. Our findings highlight the role of contaminants in shaping invasion outcomes and emphasise the importance of integrating pollution dynamics into freshwater management strategies.

D1 - Weeding Out the Problems: Insights from Invasive Plant Control in Aquatic Environments

4 - Lessons learned from the first 15 years of attempting to eradicate water primrose Ludwigia grandiflora from Great Britain

Trevor Renals[1]

[1]Environment Agency

Water primrose *Ludwigia grandiflora* is a South American aquatic plant that was traded as an ornamental pond plant in Europe prior to being listed in the EU Regulation on Invasive Alien Species (Regulation (EU) No 1143/2014). It has become established in the wild in Western Europe, North America and Japan, blocking watercourses, degrading navigation and amenity use and altering the ecology of waterbodies.

Water primrose was first recorded in the wild in Great Britain in 1998 at the Barn Elms wetland centre, London. It has subsequently been found at an additional 53 sites in England and a single site in Wales. Since 2009 the Environment Agency of England has been tasked with coordinating the eradication of water primrose. This is a summary of lessons learned to date.

To date, 26 of the sites are believed eradicated. A range of chemical, mechanical and manual controls have proven successful and work continues to refine methods and trial new products.

Chemical control had previously depended on glyphosate-based products approved for use in or near water but we have obtained a permit to use Blaster Pro, a triclopyr-based product for a period of three years against water primrose. Early results suggest that this product is highly effective.

Water primrose is proving to be a plant that can usually be easily reduced in biomass, but has proved tenacious to eradicate. Eradication remains a feasible objective, delivering considerable environmental and socio-economic benefits in terms of future degradation and costs avoided. In 2010, these costs were estimated at £242 million, equivalent to Euro 279 million (The Economic Cost of Invasive Non-Native Species on Great Britain, CABI, 2010).

181 - Japanese knotweed beyond Year Three: Riparian Treatment Sites from across New England

Michael Bald[1]

[1]Owner, Got Weeds?

Japanese knotweed, *Reynoutria japonica*, a high-impact species known to destructively monoculture sensitive riparian areas, can only be managed successfully, sustainably, and cost-effectively with chemical-based approaches. The literature (agencies, academia, and non-profits) drips with this shallow-rooted claim. The statement is however, quite false, and fails the everyday public it should instead serve.

Riparian zones are boundaries; they serve as the final transition from terrestrial worlds into the aquatic realm of streams and rivers. These boundaries, zones, or edges are pliable, shifty, and dynamic, but they are real and their functionality is vital. There is abundant truth to statements that knotweed is a challenging exotic species, one best prevented rather than ignored, and that removal or eradication is a time-consuming, perhaps tedious endeavor.

But so it is with resource stewardship. If local riparian zones and niche ecosystems are dynamic and evolving, would their stewardship not match those conditions in the enduring commitment and intensity? Why would we expect results in short timeframes, and why add toxin to sites already degraded and dysfunctional?

This presentation offers a look at non-chemical treatment sites managed to achieve eradication and long-term recovery in several New England states. We see what sites look like at 11 years, 14 years,15 years... in their transformation to the “desired future condition.” The work is often locally driven and funded, truly grassroots, a sector of invasive species management often separate but parallel to efforts by agencies and professionals, but with much to share regarding lessons learned, opportunities to exploit, and mistakes to avoid. Yet, few of these community level practitioners publish their results or share data. Transcending that gap would help greatly with broader efforts to control / manage Japanese knotweed; as it now stands, our lack of communication and the cooperation divide is a barrier limiting forward progress.

171 - Limiting the Spread of Alligator Weed through Stakeholder Engagement and Cross-Basin Collaboration

Madeleine FREUDENREICH[1]

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Alligator weed (*Alternanthera philoxeroides*), one of the world's most invasive aquatic plants, was first recorded in France in 1971 along the Garonne River, before progressively colonizing the Tarn basin and spreading widely across the watershed. In Mediterranean France, the species was first observed in 2013 at Sorgues on the Ouvèze River, only three kilometres upstream of the Rhône. A second site was soon detected on the Petit Rhône, 110 km downstream, signalling an active dispersal risk throughout the Rhône basin. Given that its distribution in France remains limited, there is still an opportunity to intervene and contain its spread, drawing on lessons from other management expériences.

Monitoring conducted by the Conservatoire Botanique National Méditerranéen (CBNMed) between 2015 and 2022 confirmed extensive colonization between Sorgues (Ouvèze) and Avignon (Rhône). This invasion mirrors patterns in other Mediterranean-climate regions, such as Australia, where the species thrives due to rapid vegetative growth, dispersal by fragments, and ability to colonize riverbanks and aquatic habitats.

Since 2016, several management techniques have been tested: (i) single annual uprooting, (ii) double annual uprooting, (iii) uprooting with opaque tarping, and (iv) hot-water weeding. Annual follow-up remains essential. Challenges persist in stone embankments, where roots are difficult to remove, and in habitats co-invaded by *Paspalum dilatatum* and *Ludwigia peploides*.

CBNMed provides site managers with updated monitoring data, technical guidance, and regular training sessions for river technicians. In parallel, awareness campaigns with fishing and kayaking federations have reinforced prevention through biosecurity measures and observation networks, improving mapping, prioritization of control efforts, and public awareness.

This integrated strategy, combining eradication trials, monitoring, and stakeholder engagement, represents a key step toward limiting the spread of alligator weed in Mediterranean France.

285 - Strategic Biomass Allocation for Invasive Water Hyacinth Management: An Integrative Analysis of Utilisation Pathways Using TOPSIS and Linear Programming

Sushmita Krishnan[1], Nica Claudia Caló Caló[1], Ingolf Kühn[2, 3, 4], Christine Fürst[1, 5]

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Water hyacinth (*Pontederia crassipes*, formerly *Eichhornia crassipes*) is an aquatic invasive species. It generates ecosystem disservices by forming a dense mat on the surface of water preventing the entry of sunlight, thereby increasing the biological oxygen demand, threatening aquatic biodiversity and ecosystem services associated with the water body. While mechanical removal is essential, failure to utilise the harvested biomass prevents the opportunity to offset the costs of removal and hinders productive reuse.

Utilisation of invasive species is a sustainable management strategy which incentivises regular removal in large masses. The most common methods of utilisation include crafts, handmade paper, biochar and biofuel production. By employing the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), we aim to rank the four utilisation pathways using systemic data collected from respective industries through interviews (from sector experts) and literature review for a sample size of 100 kilograms. Evaluation criteria constitute environmental, social and economic dimensions focussing net revenue generation, employment creation, carbon sequestration potential, infrastructure investment requirements, technical maturity and processing duration.

Following identification of the two most promising utilisation methods, linear programming optimisation will be applied to determine the optimal biomass allocation ratios, thereby maximising aggregate benefits across environmental, social and economic fronts. This is essential to ensure the efforts of maximum biomass utilisation complements environmental restoration.

The integrated analytical framework will subsequently be applied to an eight-year water hyacinth invasion dataset of Sanapur lake , Karnataka, India obtained through geospatial dataset from EU Copernicus to project field-scale returns under the proposed utilisation regime.

The analysis is expected to demonstrate that strategic biomass allocation can reconcile conservation objectives with livelihood generation, offering a replicable, context-adaptable model for water hyacinth management across diverse geographic and institutional settings valuing both provisioning services (income, materials) and regulating services (carbon sequestration, water quality restoration).

B1 - Risky Business: Preparing for Future Invaders

134 - AI-powered knowledge synthesis for invasive alien species risk assessment

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The increasing evidence on invasive alien species (IAS) impacts requires efficient risk assessment procedures. However, the vast literature poses a challenge. To address this, we explored the potential of artificial intelligence (AI) to support automatic literature reviews on IAS impacts, leveraging its state-of-the-art methods and tools to streamline manual tasks. Using AI, we analyzed information on 498 IAS from the European Alien Species Information Network, impacting 27 policy domains. Results were qualitatively and quantitatively analysed based on the domain impacted, type of impact (negative or positive) and strength of evidence (e.g. high, medium, low).

The “GPT Scheduler”, an integration between the GPT@JRC prototype and the Qlik Sense Business Intelligence service of the Joint Research Centre of the European Commission, was used to interact with the *LLama 3.3. 70b instruct language model.* This system retrieves structured information directly into a Qlik Sense model. The GPT Scheduler leveraged GPT@JRC within an automated framework for: i) iterate pre-configured prompts of species x domain matrix (498x27), ii) normalize model outputs, iii) generate a data model by fetching and storing questions, and iv) develop a dashboard for visualizing results. The AI model was trained on 1000 documents (totalling 40 MB) to ensure accurate retrieval of information on impacts of IAS. Over 25000 prompts were generated. Confusion matrices were used to evaluate performance, revealing fair to moderate agreement between experts’ assessments regarding impact domains, types of impact, and confidence levels.

Key takeaways include: i) the potential for (semi-)automation to enhance efficiency, ii) the critical role of subject matter expert involvement in validation and refinement, and ii) the value of AI models in extracting contextualized information and assessing the reliability of scientific publications. Finally, the benefits of leveraging ontologies for data harmonization and lookup services can support initial data collection, ultimately streamlining workflow steps.

56 - Mapping aquatic invasive species integrated introduction risks using machine learning and stakeholder insights

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Aquatic invasive species (AIS) threaten freshwater ecosystems, biodiversity, and economic activities across North America. Identifying the vectors and environmental conditions facilitating AIS introductions and mapping invasion risk are critical for effective prevention and management. In this study, we aimed to: (1) to identify and rank key factors contributing to AIS introductions, and (2) to map invasion risk across southern Québec (Canada). We applied a machine learning framework using the Boruta feature selection algorithm to identify significant

proxies influencing risks of invasion and used a random forest model to predict and map such risk based on documented occurrences of AIS on the landscape. We combined this approach with a stakeholder survey to inform a parallel risk model. Our Boruta analysis identified 28 significant proxies with hydrography coverage, air temperature, commercial fisheries zones, road intersections, and road density ranking highest. While results varied by taxa, hydrography was consistently important, followed by recreational area coverage and ballast water discharge volume. Stakeholders emphasized on a different set of factors, including boat launches, boat cleaning practices, marinas, and ballast water management. Both approaches pointed to the St. Lawrence River watershed and nearby urban centres as hotspots, but the stakeholder model also revealed additional secondary risks scattered across the province. By combining quantitative modelling with community knowledge, our work provides a practical framework for prioritizing AIS pathways and identifying high-risk areas.

244 - Hybrid modelling of an invasive seaweed: combining physiology and SDMs to predict the spread of Rugulopteryx okamurae in Europe

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Biological invasions, amplified by global warming, are reshaping marine ecosystems worldwide. Among invasive macroalgae, the brown seaweed *Rugulopteryx okamurae* has emerged as a significant threat in European waters, owing to its strong colonization capacity and severe impacts on native benthic communities. Predicting its future distribution is therefore crucial for developing effective management and mitigation strategies.

In this study, we combined controlled laboratory experiments with species distribution modelling (SDM) to forecast the potential range of *R. okamurae* under current and future environmental conditions. Laboratory assays were conducted to characterise the species' thermal response, revealing high growth performance (≥80% of maximum growth) between 21°C and 29°C. These physiological data were applied to a mean ocean temperature layer to estimate average monthly growth across both native and invaded regions. The resulting physiological layer was then integrated into a hybrid SDM to predict the potential spread of *R. okamurae* in Europe.

Our results indicate that regions already colonized by *R. okamurae* are highly suitable, and that the species is likely to expand further across European waters. Although growth performance and habitat suitability decline toward northern latitudes, projected climate change enhances suitability in these regions, with the magnitude depending on the scenario considered. These findings highlight the importance of proactive monitoring and targeted management strategies to limit further spread, and demonstrate the value of integrating physiological data with SDM approaches to improve forecasts of marine biological invasions.

E2 - Pinch Points: Real-World Approaches to Crayfish Management

260 - The use of microhabitat traps as a tool for sampling juvenile crayfish

Zoe Cole[1], Paul Stebbing[2], Rupert Houghton[2]

[1]lead author, [2]contributing author

Non-native crayfish are globally recognised as some of the most widely distributed and invasive aquatic species. Once established populations have high ecological impacts and can dominate invaded freshwater communities. Management of invasive crayfish populations involve using sampling methods not just to aid in mechanical removal of individuals but to monitor aspects of crayfish populations e.g. population density. There are numerous methods used for management of crayfish populations, most commonly baited funnel traps (BTs) are used, however these traps predominantly capture adults, while survey methods for juvenile signal are not well understood. Juvenile monitoring would allow for more targeted management of crayfish populations through understanding recruitment rates.

Unlike the standardised methodology of BTs, little is understood about a novel survey method, micro habitat traps, at trapping juvenile crayfish, along with aspects that increase their efficacy of trapping. Understanding efficacy of microhabitat traps of capturing and substrate preference of juvenile signal crayfish. Microhabitat traps were deployed in a UK reservoir with a known population of signal crayfish (*Pacifastacus leniusculus*). Microhabitat substrate type preference of juvenile crayfish was investigated. Microhabitats were shown to be an effective survey tool for juvenile crayfish (specifically young of year). Preferences of substrate materials were clear across the whole waterbody. This method allowed understanding of juvenile spread within a lentic waterbody and alongside the use of baited traps demonstrated differences in density of different life stages.

Understanding recruitment of juveniles in invasive crayfish populations can aid in population management as well as having a method to survey juvenile crayfish is a powerful tool in targeted population management for potential eradication, rapid response and early detection.

74 - A selective crayfish trap as approach to manage invasive freshwater crayfish

Fabian Helsloot[1], Joost Bergsma[2], Rob van de Haterd[2]

[1]research ecologist, [2]inventor and ecologist

Invasive crayfish threaten aquatic ecosystems world-wide. Invasive crayfish may severely impact local biodiversity by over-grazing of vegetation and through predation on native macroinvertebrates, fish and amphibians. Other than prevention, management options seem limited and without success. Small fyke nets, marketed as crayfish traps, are often a preferred catch method. While these fyke nets might prove effective in locally reducing invasive crayfish populations, these traps are harmful for native fish and amphibians, including native predatory fish. Moreover, invasive crayfish populations recover quickly when the catching stops. Therefore, we developed a new type of trap that is highly selective and exclusively targets crayfish: a SCT (Selective Crayfish Trap).

At first, crayfish enter a pyramid shaped trap, of which two designs exist. The refuge trap design attracts egg bearing females and young growing crayfish, as it serves as a shelter for moulting. The baited design attracts larger numbers, by attracting the crayfish with food.

Fish and amphibians can escape this trap by simply swimming out through the top, while the trapped crayfish can only enter a tube system that leads to a floating container. This floating container can be closed with a lid for research purposes or be left open. In the latter case it may serve as a ‘foraging opportunity’ for birds feeding on the exposed crayfish.

Since 2023, several pilot studies in the Netherlands have tested the effectivity of this method to manage the population of invasive crayfish, answering several research questions.

- Is it possible to reduce the invasive crayfish population with the SCT?
- Is the method safe for the local ecology?
- Do birds feed on the crayfish trapped in the SCT?

We present data of these studies and discuss the perspective this method offers for feasible management of invasive crayfish species.

125 - The winner-loser effect as a management strategy for invasive crayfish

Christopher Pennuto[1], Emily Klimczak[1]

[1]Buffalo State University

Interspecific dominance hierarchies exist within communities when high-ranking species outcompete lower ranking species, and thus tend to acquire more resources. Within species, pecking orders are somewhat analogous hierarchies but they result from repeated interactions with known individuals and the winner-loser effect, where winning or losing encounters influence future encounters and resource acquisition. Here we investigated whether intraspecific winner-loser effects crossed over to influence interspecific interactions between a native crayfish species (*Cambarus robustus*) and an invasive crayfish species (*Procambarus clarkii*). Native big water crayfish (BWC) were trained to be winners via repeated contests with smaller individuals. We then scored behavioral interactions between trained and untrained BWC versus invasive red

swamp crayfish (RSC). Trials were conducted both with and without food resources present. There was no difference in trial outcomes between trained and random BWC competing against red swamp crayfish. During non-food trials, BWC won most interactions with RSC, regardless of training profile state, suggesting this native species had a higher agnostic temperament. However, during food competition trials RSC dominated BWC, acquiring the food in nearly every trial. RSC movement within the test arena suggested they were inherently bolder than BWC and located food more quickly than BWC. These data suggest using the winner-loser effect was not a reliable management technique to enhance BWC competitive ability versus RSC, and that management efforts exploiting the food drive of RSC may be fruitful.

122 - First Detection of Invasive Red Swamp Crayfish (Procambarus clarkii) in Ontario, Canada

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In June and August 2025, a collaborative field survey was conducted in Tilbury, Ontario by the Ontario Federation of Anglers and Hunters and other government and non-governmental partners to assess the presence and establishment status of the invasive red swamp crayfish (*Procambarus clarkii*), a provincially prohibited species known for its ecological disruption in freshwater systems. Over 450 data points were collected across 40+ sites using a multi-method approach including baited trapping, burrow excavation, kick-and-sweep sampling, and visual inspections. The survey confirmed the presence of over 100 live specimens of *P. clarkii*, including all life stages and reproductive and ovigerous females, indicating a reproducing population. Burrow presence was strongly correlated with crayfish detection, providing a rapid assessment tool for future monitoring. Native crayfish species were also documented, but in lower densities, raising concerns about competition and displacement. The study area's proximity to the US border, combined with suitable habitat features, such as drainage ditches and slow-flowing channels, suggests a likely transboundary introduction, potentially via bait bucket release or food-related transport.

These findings represent one of the first confirmed established populations of *P. clarkii* in Canada and underscore the urgent need for coordinated early detection, public awareness, and containment strategies. This research supports national invasive species management priorities and provides a critical baseline for future surveillance and mitigation efforts in southwestern Ontario.

Keywords: Red swamp crayfish, first detection, invasive, surveillance

A2 - Invaders Among Us: Adapting to a Changing Planet

150 - Thermal stress and copper pollution shape early-life traits of an estuarine decapod: A framework for comparing native vs invasive plasticity in a global change context

Ángela Rodríguez-Ruiz[1], Gustavo Freire de Carvalho-Souza[1], Raúl Vallejo Sánchez-Movellán[1], Cristiano V.M. Araújo[1], Romain Coulaud[2], Enrique González-Ortegón[1]

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Global change imposes multiple stressors on aquatic ecosystems, including increased frequency of marine heatwaves (MHWs) and rising levels of trace metals (e.g., copper). Invasive species often exhibit greater plasticity under these stressors, potentially reshaping future population dynamics. We use the estuarine shrimp, *Palaemon longirostris,* native to the Atlantic coast but non-native in the Baltic and Black Seas, as a model to understand how early life stages might respond under combined thermal and pollution stress.

The present study aims to explore the combined effect of a simulated MHV and environmentally relevant copper concentrations on the development rate, survival, and juvenile dry weight (as a proxy for mass growth) of *P. longirostris* larvae, in order to compare these traits with those expected for invasive species like *Palaemon macrodactylus* in the studied area.

Newly hatched larvae from six ovigerous females of *P. longirostris* were exposed to two temperature regimes: control at 24ºC (mean of the Guadalquivir estuary), and a simulated MHW consisting of a daily ramp up from 24 to 28ºC (+1ºC per day), followed by a ramp down back to 24ºC (-1ºC per day), mimicking a transient heatwave. For each thermal regime, three copper treatments were applied: 0, 20 nM, and 200 nM. Larvae were reared individually until they reached the first juvenile stage (n=10 larvae per temperature regime, copper treatment, and female, 360 in total), and development rate analysis was measured as the intermolt duration between zoeal stages.

Preliminary results indicated that MHW simulations accelerated larval development compared to controls, consistent with thermal stress-induced metabolic enhancement. When combined with copper, developmental acceleration was further pronounced, particularly under high concentrations (200 nM), but at the cost of lower biomass accumulation. At low copper levels (20 nM), developmental timing was comparable to controls.

172 - Toxic Tug-of-War: Pesticides and Food Competition between Native and Invasive Amphipods

Darragh T Melaugh[1], James WE Dickey[2], Ellen J Dolan[1], Gareth Arnott[1], Jaimie TA Dick[1], Gary Hardiman[1]

[1]Queen's Univeristy Belfast, [2]Hun-Ren Centre for Ecological Research

Freshwater ecosystems are increasingly impacted by chemical contamination and biological invasions, yet how these stressors interact to influence species interactions remains poorly understood. We investigated how sublethal exposure to a binary pesticide mixture (2,4-D and mecoprop-P) influences competitive interactions between the native *Gammarus duebeni* and the invasive *Gammarus pulex* using controlled dyadic food contests following 47 h exposure.

Species identity was the primary determinant of behavioural variation and competitive performance. *G. pulex* acquired resources more rapidly than *G. duebeni*, despite lower overall activity, suggesting that differences in spatial behaviour and encounter-mediated resource acquisition underpinned this advantage. In contrast, pesticide exposure had no detectable effect on activity, spatial use, resource acquisition, contest performance, or final outcomes. However, importantly, exposure influenced contest dynamics in a context-dependent manner. Wrestling bout frequency increased relative to the control during interspecific contests, specifically, where *G. pulex* was the resource owner and *G. duebeni* the challenger. Whereas intraspecific contests showed a slight reduction under pesticide exposed conditions compared to the control group.

These results suggest that sublethal pesticide exposure can alter the behavioural dynamics of competitive interactions without modifying competitive outcomes. This indicates a decoupling between behavioural responses and ecological performance under chemical stress, with species-specific differences in spatial behaviour exerting a stronger influence on interaction outcomes than short-term exposure. More broadly, the results suggest that invasion-relevant competitive advantages may emerge from pre-contest processes such as resource encounters rather than contest escalation alone. This represents a potential mechanism that may contribute to the displacement of native species independently of direct interference competition. These findings emphasise the value of interaction-based approaches for predicting how environmental stressors shape species interactions and invasion dynamics in contaminated freshwater systems.

212 - Chemical risk cues impact fish behavior and thermal tolerance, but effects vary with predation experience

Veronica Groves[1], Erin Francispillai[1], Jessica Reemeyer[1], Lauren Chapman[1]

[1]McGill University

In response to predation risk in their microhabitat, prey can use chemical risk cues to modulate their antipredator behaviors. However, prey experience with predators may alter the response to predator odors. Using two experiments and lake-side assays, we asked whether inter- and intraspecific experience with an invasive predator affected behavior and thermal tolerance of prey fishes in Lake Nabugabo, Uganda, a lake that experienced the introduction of the predatory Nile perch (Lates niloticus) in the early 1960s. In doing so, we evaluated how warming and predation risk can interact to impact prey fishes as both stressors may impact metabolism and energy use. Furthermore, we determined, for the first time, the thermal tolerance of the cyprinid Rastrineobola argentea and the characin Brycinus sadleri. We predicted that thermal tolerance would decline in the presence of predator risk and that shoaling behavior would

increase with predator risk and conspecific disturbance cues. We first found that even 60 years post-invasion, three prey fishes in Lake Nabugabo failed to recognize Nile perch predator odors as risky and did not alter shoaling behaviors nor thermal tolerance. However, R. argentea, B. sadleri, and haplochromine cichlids increased shoaling behaviors in response to conspecific disturbance cues adding to the body of work demonstrating that disturbance cues can elicit antipredator behaviors in prey fishes. In contrast, in our second experiment, we compared the thermal tolerance of a population of the cichlid Pseudocrenilabrus multicolor that overlapped in the habitat with Nile perch to a population that had no habitat overlap with the predator. P. multicolor that co-occurred with Nile perch responded to Nile perch predator odors like predator odors from a native catfish predator, whereas predator-naïve cichlids failed to respond. Taken together, our experiments illustrate the importance of experience with a predator in the perception of predator odors.

30 - [PRESENTATION WITHDRAWN] Storm-driven disturbance in the age of pollution: A potential new pathway for biological invasions

Monica McCard[1]

[1]Liverpool John Moores University

Extreme storm events can rapidly redistribute marine debris, potentially increasing coastal pollution while also facilitating the dispersal of non-native species associated with floating material. Understanding these processes is increasingly important as changing storm regimes may alter the movement and accumulation of marine litter and associated organisms along coastlines. Post-storm surveys conducted following six named storms demonstrated that storm events substantially increased marine litter deposition and facilitated the transport of invasive species at one of two Merseyside beaches. Storm Amy, which reached a maximum wind speed of 67 mph, produced the greatest debris accumulation at both sites, while litter abundance increased significantly with storm intensity. Storm-deposited material was dominated by plastic and polystyrene, and storm events significantly altered overall pollution composition. Invasive species were recorded exclusively at West Kirby, where their occurrence increased significantly with storm intensity, indicating that higher-energy storms may enhance the dispersal of non-native organisms via floating debris. Together, these findings identify storm events as important mechanisms linking marine pollution with biological invasions and emphasise the value of incorporating post-storm monitoring into coastal management and biosecurity strategies.

C2 - Special Session: Cross-System Comparisons and Knowledge Sharing for the Management of Invasive Salmonids II

317 - PRESENTATION MOVED - EMPTY SLOT

N/A N/A[1]

[1]ICAIS

N/A

182 - Emerging evidence for ecological change in northern rivers due to pink salmon invasion

Kaisa-Leena Huttunen[1], Aino Erkinaro[1], Katariina Hakola[1], Iida Ojala[1], Jaakko Erkinaro[2], Wille-Pekka Lepo[1], Heikki Erkinaro[3], Timo Muotka[1]

[1]University of Oulu, [2]Natural Resources Institute Finland, [3]Envineer Oy

The numbers of non-native Pacific pink salmon (*Oncorhynchus gorbuscha*) in northernmost Europe have increased exponentially since 2017. Pink salmon has an anadromous-semelparous life cycle ending in mass deaths of full spawning cohorts. In its native distribution areas, salmon carcasses are a key resource for rivers and terrestrial surroundings. Ecosystems in the invaded area are inherently oligotrophic, their biota is scarce, and they have experienced only few invasions being thus particularly vulnerable to change. We studied the ecological effects of pink salmon invasion using two data sets from northern Norway and Finland: comparisons between i) downstream and upstream sites separated by migration barriers in pink salmon invaded rivers which had experienced two mass occurrences; and ii) an invaded river and rivers without pink salmon before and after four mass occurrences. The downstream and upstream sites did not differ in nutrient availability. However, the downstream river sites had higher algal growth than upstream sites indicating boosted primary productivity. Neither richness nor community composition of benthic invertebrates showed consistent differences between downstream and upstream sites. However, in downstream sites invertebrates showed higher signal of $\delta^{34}S$ ja $\delta^{15}N$ isotopes suggesting consumption of marine derived resources. When comparing macroinvertebrate community patterns in an invaded river before and after few mass occurrences we observed a temporal increase in invertebrate abundance and change in community composition. At the same time, invertebrate communities in control rivers remained more stable between the two sampling points. Together the outcomes of these studies suggest that pink salmon related resources may increase primary and secondary productivity in the invaded area and affect also benthic community composition. These changes are likely be patchy in the beginning and take time. More detailed research is needed to confirm the links

between pink salmon invasion and changes in biotic communities and ecological processes throughout time.

178 - Dinner is served: decomposition and release of nutrients from decaying pink salmon carcasses

Aino Erkinaro[1], Hannu Marttila[2], Sami Kivelä[1], Timo Muotka[3], Kaisa-Leena Huttunen[1, 4]

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Pink salmon (*Oncorhynchus gorbuscha*), an alien species in northern Europe, has over the past few years experienced dramatic growth in numbers and in distribution. The 2-year lifecycle of pink salmon ends in mass death of all spawning individuals. Nutrients and other resources provided by decaying pink salmon carcasses are expected to have various direct and indirect ecological effects in its non-native distribution area. So far little is known about the rate of carcass decomposition and consequent release, concentrations, and storage of nutrients, all partly affected by decomposer community compositions. In 2023 we monitored pink salmon carcass decomposition and nutrient release for 9 weeks in six Barents Sea catchment rivers in an experimental set-up mimicking hotspots of carcass accumulation sites. While pink salmon carcasses on shore disappeared in a few days, carcasses in stream were decomposed notably slowly, still present and releasing nutrients even after 9 weeks. Decomposing carcasses had no significant effects on water chemistry in free-flowing stream water compared to control areas. However, in hyporheic zone water, nutrients accumulated into the sediment in considerable amounts, and on average we observed 18 times higher nitrogen and 25 times higher phosphorous values in carcass compared to control areas, although there seemed to be high among- and within-sites variation. Biofilm bacterial community composition changed throughout the decomposition process from mostly aerobic to mostly anaerobic communities, indicating a formation of a local oxygen depletion around the carcasses. These results indicate that pink salmon carcasses have potential to affect nutrient availability and benthic communities in invaded areas, but the effects may be habitat specific.

255 - A selective fish barrier in the mighty Tana river: removing pinks, safeguarding natives.

Roar Sandodden[1], Pål Adolfsen[1], Rune Pedersen[1], Aksel Fiske[1], Mari Berger Skjøstad[1], Asle Moen[1]

[1]Norwegian Veterinary Institute

Pink salmon (*Oncorhynchus gorbuscha*), native to the Pacific, have established in Northern Norway after introductions by Russian authorities in the late 20th century. Invasion peaks in 2021 and 2023 showed how pink salmon can outnumber native Atlantic salmon and spread rapidly across European rivers, threatening biodiversity and increasing the risk of disease.

Pink salmon have become increasingly dominant in several rivers in Northern Norway, in some cases surpassing native anadromous Atlantic salmon. Their spread continues moving both westward and southward along the North Sea coast, reaching multiple European countries. Pink salmon pose a significant risk both to riverine biodiversity and as potential vectors of disease.

With its location, size, and anadromous stretch of approximately 1,200 km, the Tana River has considerable potential to produce large numbers of pink salmon. This makes it a key source for further spread, both locally and—over time—into many European Atlantic salmon rivers. However, the scale and complexity of the river system make it highly challenging to implement effective eradication measures against pink salmon while simultaneously avoiding bycatch or harm to the vulnerable spawning populations of Atlantic salmon.

To address this challenge, the Norwegian Veterinary Institute was commissioned by the Norwegian Environment Agency to lead a project on the establishment of guide fences and a fish trap in the Tana River. The first attempt in 2023 yielded limited success, but further development is ongoing in 2024, with a full-scale trial to stop pink salmon planned for 2025

In this talk, I will present the ongoing efforts to control pink salmon in the Tana River and share key lessons learned over the past four years.

B2 - eDNA Applications Unleashed: New Links, New Uses, New Frontiers

37 - eDNA-based methods: power, challenges, and integration in managing invasive species

Rein Brys[1], Teun Everts[1], Charlotte Van Driessche[1], Hanne Danneels[1], Sabrina Neyrinck[1], David Halfmaerten[1]

[1]Research Insititute for Nature and Forest (INBO)

Environmental DNA (eDNA) offers an ideal opportunity to enhance invasive species surveillance and management, particularly in aquatic ecosystems. By enabling sensitive detection, quantification, and ecological assessment, eDNA methods can greatly improve early warning systems and support eradication and conservation strategies. Yet, despite its technical maturity, the adoption by decision-makers and managers remains rather slowly and limited.

This contribution seeks to bridge that gap by addressing key topics relevant to both invasive species researchers, managers and policy makers. We will highlight: (i) eDNA monitoring strategies to improve the spatial and temporal resolution, as well as the robustness of eDNA detection; (ii) methods for refining estimates of abundance and population size using eDNA data

alone; and (iii) eDNA approaches and possibilities to assess the ecological impacts of invasive species on native communities. We will also explore how combining eDNA analyses with remote sensing and environmental datasets can increase sensitivity and strengthen habitat suitability modelling. Each of these aspects will be illustrated with innovative case studies from our eDNA research on invasive species in freshwater systems, including the American bullfrog, African clawed frog, Oriental weather loach, invasive crayfish, Muskrat and Racoon.

Our ultimate goal is to empower managers to make informed decisions about whether, when, and how to integrate eDNA into their surveillance and eradication programs. By understanding both the strengths and limitations of eDNA-based methods, invasive species managers can more effectively leverage these tools to protect native biodiversity and ecosystems.

21 - A multimarker ddPCR environmental DNA protocol for simultaneous detection of native and invasive weather loach species in European freshwaters

Jonathan Tibo[1], Teun Everts[1, 2], Jeroen Van Wichelen[2], Hans Jacquemyn[1], Rein Brys[2]

[1]KU Leuven, [2]Research Institute for Nature and Forest

Aquatic invasive species pose a major threat to biodiversity, particularly when closely related non-native taxa overlap with vulnerable native species. In Europe, the native European weather loach (*Misgurnus fossilis*) is increasingly at risk due to habitat loss and deterioration. The recent introductions of two Asian congeners, *M. bipartitus* and *M. anguillicaudatus*, are causing additional pressure through potential competition, hybridization, and disease transmission. Effective monitoring tools are therefore urgently needed to distinguish among these morphologically similar species, whose ranges increasingly overlap. We developed and validated a novel multimarker droplet digital PCR (ddPCR) assay for the simultaneous detection of *M. fossilis*, *M. bipartitus*, and *M. anguillicaudatus*. The assay was first evaluated *in silico* and *in vitro*. To validate its performance under natural conditions, eDNA samples were collected across a broad geographic range, including sites in Belgium, the Netherlands, Austria, Italy, and Spain, informed by GBIF occurrence data. Our results confirm the co-occurrence of *M. fossilis* and *M. bipartitus* in Belgium and the Netherlands, while *M. anguillicaudatus* was not detected despite earlier reports, suggesting potential misidentifications. In Italy and Spain, where *M. anguillicaudatus* is widely reported based on morphological identifications, our preliminary results indicate that some records may instead represent *M. bipartitus*. This finding parallels earlier misidentifications in other European countries and highlights the importance of molecular verification for closely related species. This new eDNA-based protocol provides a sensitive, reliable, and rapid tool to distinguish among *Misgurnus* species in Europe. Its application will enhance early detection of invasive congeners and support the conservation of the highly threatened native *M. fossilis*.

120 - Quantifying invasive marble crayfish impacts in an amphibian hotspot using quantitative eDNA barcoding

Jelger Erik Herder[1], Teun Everts[2], Rein Brys[2]

[1]RAVON, [2]INBO

Invasive crayfish species pose a growing threat to native amphibian populations. In 2021 a rapidly expanding population of marbled crayfish (*Procambarus virginalis*), a parthenogenetic invasive species, was discovered in the Overasseltse and Hatertse Vennen near Nijmegen (The Netherlands). This wetland area hosts a unique amphibian community of eleven species, including the endangered common spadefoot (*Pelobates fuscus*) and great crested newt (*Triturus cristatus*). To contain the invasion and limit the spread of crayfish toward key amphibian breeding sites in the southern part of the area, a 1.3-km long physical barrier (50 cm high) was installed in 2022. To maintain connectivity for amphibians while preventing crayfish from passing, innovative selective passages were designed, successfully tested, and integrated into the barrier.

To track the invasion front of the crayfish, 40 fens and ponds were surveyed in 2023 using environmental DNA (eDNA), revealing crayfish presence in 18 waters. The invasion front, combined with unaffected reference sites, provides a unique opportunity to study the ecology and impacts of this aquatic invasive species in Northwest Europe. We therefore set up long-term monitoring in 30 waters using an innovative approach with quantitative eDNA (ddPCR) to track the occurrence and densities of marbled crayfish and four native amphibian species. eDNA concentrations (copies/L) correlated well with trap-based crayfish densities and known amphibian distributions. In this presentation, we will highlight the use of quantitative eDNA as a cost-efficient, novel tool for assessing the empirical impacts of aquatic invasive species and present the results from the first three years of monitoring (2023-2025).

D2 - Weed the Waters: Advances in Invasive Plant Control Across Aquatic Environments

119 - Invasive Terrestrial Plants Along Riparian Zones: Exploring Alternative Control Methods on Japanese Knotweed (Reynoutria japonica)

Christopher Mellon[1], Jaimie Dick[1], Ross Cuthbert[1]

[1]Queen`s University Belfast

Invasive plants are known to displace natives, affect ecosystems, damage infrastructure and cause harm to human health, all whilst being particularly difficult to eradicate. Japanese

Knotweed (*Reynoutria japonica*) is the second most costly invasive species in the UK at £246.5 million annually. This invasive plant is known to establish along riparian zones, spreading through aquatic environments via clonal fragments which are carried to new locations. The plant reduces biodiversity by forming dense monocultures during the growing season, and then during winter its dieback causes riverbanks to become destabilised resulting in soil erosion and increased flooding risk. The most popular method of Knotweed control is widely regarded as glyphosate herbicide, a chemical which is currently under scrutiny for its toxic effects on non-target species and human health. Without available alternative methods of invasive plant control, an ecological disaster could be imminent if glyphosate bans were to be introduced at present. A laboratory-based study was carried out on knotweed to assess suitability of essential oils as alternative control methods. These applications were chosen based on their high allelopathic potential and thus their toxic effect on above and belowground plant material. A range of plant-based compounds, extracts and essential oils were trialled including, Thymol, Oregano oil, Pine oil, Eucalyptus oil, Lavendar oil, with glyphosate included as a 'gold standard' control. Success at inhibiting growth was observed through application of Oregano oil, where responses to application such as light utilisation, height and necrosis were comparable to glyphosate at >90%. These results suggest an inhibitory effect of Carvacrol and Thymol, which are allelopathic monoterpenes found in Oregano oil. Developing such methods for application in the field could lead to more sustainable and more environmentally friendly invasive plant control.

230 - Using Rhodamine WT Dye as Aquatic Herbicide Tracer to Quantify Site-Specific Water Exchange Rates In Hydrilla-Infested Tidal Areas of the Connecticut River

Amber Riner[1], Andrew Howell[2], Jonathan Glueckert[1], Michael Durham[3], Benjamin Sperry[4]

[1]University of Florida, [2]North Carolina State University, [3]United States Army Corps of Engineers, [4]US Army Corps of Engineers

The Connecticut River Watershed, the longest river system in New England, spans 11,260 square miles across parts of Quebec and five U.S. states. It serves as a vital water resource, providing drinking water, recreation, and hydropower to millions. In 2016, the river's ecological integrity was threatened by the emergence of a genetically distinct biotype of hydrilla (*Hydrilla verticillata* subsp. *lithuanica*), a fast-growing, submerged invasive weed first identified in Hartford County. By 2021, hydrilla had spread across more than 344 hectares along a 113-kilometer stretch of the river, prompting urgent management efforts. Due to environmental constraints, aquatic herbicides remain the primary tool for selective and effective hydrilla control. However, water movement in tidal areas, like the Connecticut River, can reduce herbicide half-lives, potentially preventing treatments from achieving the necessary concentration- exposure time requirements to be effective. This study evaluated bulk water exchange at five treatment sites using Rhodamine Water Tracer (RWT) dye as a proxy for herbicide behavior. The dye was applied at 10 ppb and monitored continuously with deployable sondes and at discrete points using a handheld fluorometer. Spatial dye distribution was visualized using kriging in ArcGIS

Pro, while sonde data were regressed to estimate half-life durations at each site. Results showed half-lives ranging from 0.35 to 72.36 hours, underscoring significant variability in water exchange across tidal zones within the same river system. These findings suggest that future herbicide applications should incorporate site-specific bulk water exchange data to inform active ingredient and rate selection for controlling submerged aquatic invasive species.

123 - Evaluating Concentration Exposure Times of Different Herbicide Combinations for Hydrilla Control

Eli Russell[1], Jonathan Glueckert[1], Corrina Vuillequez[1], Amber Riner[1], Benjamin Sperry[2]

[1]University of Florida, [2]US Army Corps of Engineers

Hydrilla (*Hydrilla verticillata*) is an invasive submerged aquatic plant in the US. With three known biotypes (dioecious, monoecious, and Clade C), hydrilla has been able to invade over 30 US states. Its rapid and excessive growth obstructs navigation, disrupts recreational activities, and displaces native plant species. Since hydrilla is a submerged plant, treatment can be challenging because the entire water column must be treated. Additionally, the herbicide must remain in contact with the plant for a sufficient period to effectively control it. Since each waterbody is unique, it can be challenging to achieve the required exposure time. Therefore, it is essential to know how long hydrilla needs to be exposed to a specific herbicide concentration to achieve the desired efficacy. With this information, applicators can tailor the treatment to provide optimal results based on the water exchange rate of the system. To answer this question, an experiment was conducted to evaluate the effectiveness of three herbicides at varying rates and exposure times for hydrilla control. Diquat, flumioxazin, and florpyrauxifen-benzyl were evaluated alone and in combination at the lowest and highest recommended label rates, as well as at several exposure times ranging from 3 hours to 24 hours. Plants were evaluated for 8 weeks after treatment with visual ratings and the collection of above-ground biomass at the end of the study. The results indicated that treatments containing diquat and florpyrauxifen-benzyl, in combinations or alone, along with longer exposure times, resulted in the best control of hydrilla. While low rates and shorter exposure times generally resulted in little to no control when compared to the nontreated check. These results underscore the importance of maximizing exposure time for improved efficacy and suggest that utilizing herbicide combinations could help reduce the necessary exposure time for achieving adequate control.

247 - Advancing Water Chestnut Control through Ecological Modeling and Robotics: Insights from Long Island

Carlos Morantes Ariza[1]

[1]New York State Department of Environmental Conservation

Managing aquatic invasive species (AIS) is a complex challenge shaped by the invader's life history, infestation intensity, waterbody size, and management resources. Effective control requires adaptable tools to help agencies prioritize strategies and track outcomes. This study integrates ecological modeling with automated survey technology to advance AIS management on Long Island, New York.

We developed a discrete-time population dynamics model to predict the spread of Water chestnut (Trapa natans) in Long Island water systems. Carrying capacity was estimated from depth-profiled area and average rosette size at seed maturity, while population growth was based on mean seed production per rosette, adjusted for contributions from the seed bank. We modeled two management approaches: manual harvesting and mechanical harvesting. Manual removal was parameterized as an exponential decay function based on maximum pulling rates per person-hour.

The model showed that traditional manual removal is ineffective, but squad-based manual harvesting (SMH) substantially improves outcomes. In a small Long Island waterbody, the model accurately predicted a ~60% reduction in T. natans infestation under SMH within a single season. Mechanical harvesting was also evaluated, with results estimating the minimum effort needed to achieve control within 3-5 years. Yet neither approach alone was sufficient for long-term success, underscoring the importance of integrated strategies.

An additional outcome of this work is the development of a fully automated invasive species surveyor for surface-level species. The system achieved detection accuracies of 87% for T. natans, 79% for Ludwigia peploides (water primrose), and 92% for Phragmites australis. It also provides geospatial accuracy with a 2.5 m resolution, enabling precise mapping for early detection and continuous monitoring. By combining predictive modeling with automated surveillance, this research bridges theory and practice. Future efforts will emphasize a shift from episodic harvesting toward a grazing perspective, promoting sustained suppression and adaptive management of invasive species.

C3 - Special Session: Cross-System Comparisons and Knowledge Sharing for the Management of Invasive Salmonids III

317 - PRESENTATION MOVED - EMPTY SLOT

N/A N/A[1]

[1]ICAIS

N/A

266 - Integrating non-trophic interactions to predict exotic species impact in a warming world

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Biological invasions are widely recognized as an important factor altering ecosystems. Since non-native species introductions burst over the last decades, a bunch of invaders can end up in the same ecosystem leading to possible ecological interferences (indirect effects) that may modulate their respective ecological impacts on native communities. This suggests that the impacts of exotic species would necessitate to account for the local invaders' pool to predict their impacts on native communities. The pervasive fish introductions in high mountain lakes represent a typical case of possible invader interferences where *Salmonidae* could modulate the functional and behavioral traits of minnows (*Phoxinus* sp.) thereby determining their top-down impacts. We tested how an alarm signal (chemical cues contained in the skin of the individuals) mimicking the presence of a predator affected a set minnows' functional and behavioral traits. The investigations were conducted at two distinct temperatures (low = 12°C and high = 16°C) to account for the thermal constraint on ecological interferences. In the presence of the alarm signal, metabolism increased at 16°C and decreased at 12°C and individuals increase their flight behavior or stopped swimming when they were exposed to the alarm signal. It also increases their handling time and reduce their attack rate. Although these results should be reinforced by models and complementary *in situ* measurements, they suggest that minnows' functional and behavioral traits would be affected by the presence of *Salmonidae*, limiting their ecological impact via a reduction of their consumption rate and displacement. In this perspective, mitigating the impact of exotic species may be a benefit of the implementation of multi-species rather species-centric management plan to account for ecological interferences.

186 - Using scales to understand growth dynamics of invasive pink salmon (Oncorhynchus gorbuscha) in Norway

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The abundance of invasive pink salmon (*Oncorhynchus gorbuscha*) in Norway has surged in recent years and has raised significant ecological concerns, yet little is known about their life histories and growth dynamics outside their native range. In their native Pacific habitats, early marine growth has been shown to influence subsequent survival and adult body size. Determining whether similar processes occur in invasive populations is therefore important to understand their potential ecological impacts. In this study, we analysed growth patterns and

adult body lengths of pink salmon that were captured in Norwegian rivers during 2019 and 2021. Scale samples were collected from 472 individuals across two different regions. Fish scales were used because they offer a record of individual growth dynamics, with spacings between subsequent scale circuli known to correlate to somatic body growth. Here, we used two standard scale metrics: scale length and the number of circuli from the focus to the last winter circulus. Scale erosion prevented us from reading the scales beyond the first winter. Early results suggest there was variation in scale metrics and in adult body length between cohorts and across geographic regions. Such differences may reflect spatial heterogeneity in early marine growth conditions or migratory patterns and potentially provide insight into whether pink salmon captured in different regions of Norway derive from one or multiple populations. By characterizing growth patterns during the first year at sea, this study will contribute new insights into the population biology of invasive pink salmon in Norway. Given their increasing abundance, further investigation into the links between growth, survival, and body size will be essential to assess the ecological consequences of this ongoing biological invasion.

68 - Negative effects of introduced trout on native small-bodied fishes are partially mediated by flood disturbance and suppression through active removal

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Natural disturbance regimes can shape the composition of mixed introduced-native species communities and affect the strength of negative interactions between them, creating mosaics of native species co-occurrence with invaders and local extinctions. Understanding the mechanisms shaping these patterns is critical for protecting native species and predicting interaction outcomes under global change.

Brown and rainbow trout have colonised most waterways in Aotearoa New Zealand since their introduction a century ago, and continue expanding into less accessible places. They compete with and prey on many native fish, especially river-resident galaxiids (RRG), most of which are threatened or at risk. We used a publicly available database spanning 28 years of fish surveys in two South Island catchments to test whether flood disturbance suppressed trout densities and indirectly benefitted RRG by alleviating trout pressure. Path analysis revealed disproportionate declines in trout density with increasing disturbance, causing an indirect positive effect on juvenile RRG density by reducing pressure from large trout. However, increasing disturbance did not increase total RRG density.

To better understand the mechanisms by which trout affect RRG populations, we regularly removed trout in three open streams and monitored the fish community in removal and nearby control sections with mark-recapture surveys. Trout suppression was most successful in colder months and benign habitats, and recolonisation dynamics depended on trout life-history, with steadier recolonisation in resident-dominated streams, but more recruitment in sections with

spawning migratory trout. RRG abundance and growth did not change with trout suppression, but RRG recruitment increased in removal sections.

Overall, our findings suggest flood disturbance suppresses trout but creates limited benefits for RRG. More active measures are needed to preserve RRG, such as temporarily boosting RRG recruitment through targeted trout suppression. Furthermore, demographic rates estimated in our study can inform mechanistic models to predict trout-RRG interaction outcomes under changing environmental conditions.

E3 - Workshop: Bridging the Gap between Knowledge and Action for a Better Future

194 - Bridging the gap between knowledge and action for a better future.

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[1]Queens University Belfast

Environmental challenges are accelerating, yet scientific research often remains inaccessible to the communities, businesses, and policymakers who need it most. This networking session aims to bridge that gap by fostering dialogue between researchers, practitioners, and policymakers, helping participants translate scientific knowledge into actionable solutions.

Through an interactive role-playing exercise, participants will engage with real-world environmental challenges—ranging from resource depletion and invasive species to plastic pollution and climate change—exploring collaborative approaches to tackle them. The session emphasizes the importance of making research accessible, building trust, and promoting informed decision-making to support sustainable development and resilient communities.

By combining experiential learning with structured discussion, this session will provide participants with practical insights and strategies to bridge the divide between knowledge and action, making scientific outcomes memorable and actionable for all stakeholders.

A3 - Special Session: Invasive Species at the Crossroads: Risks, Uses, and Management Pathways

216 - The commodification of risk in the business of aquatic invasive species

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Commodification of invasive species is a frequently offered suggestion to solve invasive species problems. The idea of creating commercial or recreational markets is appealing as potential silver linings to costly systems disruptions from invasive species. The downside risks of creating incentives to keep or even grow and spread populations at high enough levels to maintain investments in fisheries, recreation and tourism dependent on the invader are often downplayed, and qualitative narratives that can shape decision-making and preferences for invasive species management are lost or separated from those promoting the investments. Risk management becomes fragmented along information types, reducing effectiveness. Meanwhile, private and public actions to minimize risks to investors include many activities that increase the risk of ecological damages and system transformation. These range from traditional support for commercial fisheries, including regulations and limiting entry, to financial investments in technologies needed to maximize harvest potentials of unfamiliar species in a region, and more broadly, by promoting cultural adaptation through food tourism and new recreational experiences for both tourists and locals. This research examines cases where invasives have introduced business investments and competing narratives where the efforts to reduce risks to these investments have impacted the ability to manage the ecological consequences of the invasive, challenging the effectiveness of scientific research to ecological policy that optimizes societal well-being over the well-being of the new commodity. These cases include the Red King Crab, Snow Crab, and Pink Salmon in Norway and the Pacific Oyster in Denmark, among others. Risk management moves from a holistic set of diverse ecological and economic risks to a more narrow, quantified analysis of investment risk, reducing the scope and impact of policy and risk management efforts.

173 - When Farming Fuels Fisheries: Aquaculture, Invasions, and the Narratives that Normalize Risk

Melina Kourantidou[1, 2]

[1]University of Southern Denmark, [2]CNRS - AMURE

Aquaculture’s long-standing reliance on non-native species presents a persistent ecological and socioeconomic dilemma, as it has historically been a major driver of introductions. Although improved management and shifts in importation practices have reduced risks, aquaculture remains a potent vector of invasion - further complicated by narratives that reframe invasive species as resources. Combining FAO production data with non-native species records underscores this trend, reveals that several non-native species generating revenue in aquaculture have themselves been introduced through aquaculture. While some of these introductions are relatively old, others are more recent, showing that aquaculture-driven invasions are not only a historical legacy but also an ongoing reality. Against this backdrop, the

narratives promoted around aquaculture, and the fisheries that may follow, become important, since they shape how invasions are perceived, justified and managed. Global organizations and policy documents have encouraged practices such as recreational or commercial harvesting for established invaders, often without acknowledging the regulatory, ecological, and social conditions necessary for such practices to be effective. Such framings can risk normalizing invasions, justifying risky introductions, and risking incentivizing further spread by portraying invaders as economic opportunities. A pressing need thus arises to institutionalize a more precautionary narrative. While profitability often drives the adoption of non-native species in aquaculture, their use should be restricted to contexts where invasion potential is minimal or robust containment systems are in place, supported by enforceable regulation rather than voluntary codes. Management objectives and guidelines should prioritize biodiversity protection and ecosystem functioning, with harvesting referenced only as a by-product of control but should not become an end in itself, given the risk of disincentives and adverse effects. By reorienting narratives and policies toward prevention, containment, and native species prioritization, aquaculture - and the fisheries that may follow- can contribute positively while limiting the spread of invasive species.

32 - Aquatic biological invasions can exacerbate nutritional poverty rather than solve it

Josie South[1, 2], Jeppe Kolding[3], Leopold Nagelkerke[4], Paul van Zweiten[4], Adroit Takudzwa Chakandinakira[5], Takudzwa Comfort Madzivanzira[6], Sebastian Heilpern[7]

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Fish are a critical source of accessible nutrition, but when non-native species introduced through aquaculture establish in the wild, they inevitably alter the structure of ecological networks with impacts that cascade across sectors. For example, ecological impact mechanisms may alter trophic interaction strength and change community composition. This can in turn disrupt ecosystem services, such as fisheries income and nutrient provisioning to humans. The outcomes of such reorganisation could have unprecedented outcomes for human health in fishery dependent regions, with potential for socio-economically variable impacts depending on who is accessing the fishery and how. Using 51 years of standardised experimental gillnet data we show how Nile Tilapia (*Oreochromis niloticus*), introduced for aquaculture, alters the ichthyofaunal community organisation and subsequently ecosystem services in the world's largest man-made lake, Lake Kariba. Nile Tilapia invasion, in combination with climate change, drives a deficit in key nutrient delivery per 100g of fish caught resulting in lower fish catches, change in fish species, and reduction of income. We show how aquaculture initiatives, intended to confer livelihood gain and food security to vulnerable regions, can in fact drive the opposite effect. Upscaling invasion impact prediction to translate how ecological

change can drive negative shifts for human welfare can support better long-term planning in food security and invasive species policy.

165 - Seaweed in the Netherlands; view on non-indigenous species

Marjan Bovers[1], Marca Schrap[1], Arjan Gittenberger[2]

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Europe has identified the potential of seaweed farming and is promoting aquaculture of seaweed. In this study, we assessed the risks of seaweed farming in the Netherlands, focusing on non-indigenous species. A field study was conducted in 2019 to investigate the presence of non-indigenous species in Dutch seaweed farming. Non-indigenous seaweed (n=15) and animal species (n=20) were found. Farmed non-indigenous seaweeds were *Agardhiella subulata, Sargassum muticum, Ulva australis, Undaria pinnatifida*. These species are also non-indigenous to Northwestern Europe. Several other non-indigenous species (potential hitchhikers) were found as well. Farming of these seaweed species did not pose an additional risk to the environment as they had already established themselves and were widespread in the area where they were farmed. This was also the case for the other non-indigenous species which were found. As the risk of farming non-indigenous seaweed strongly depends on the local circumstances and the species involved, it is important to conduct a risk assessment before granting a site-specific licence to farm non-indigenous seaweed. In addition, the use of locally-collected starting material is preferred to prevent hitchhicking and introduction of non-indigenous species currently not present in the area.

Interestingly, a strong increase in the number of non-indigenous seaweed species new to the Netherlands was observed in recent years (>15 species instead of 2 to 3 species over a 5-year period). The high number of species (n=9) farmed in other areas of the world is noteworthy and signifies the importance of closely monitoring seaweed farming.

100 - The Chinese mitten crab: Delicacy and Delinquency - An analysis of the informal supply and trade of Eriocheir sinensis in Belgium

Jonas Schoelynck[1], Niels Moerkerke[1], Heleen Keirsebelik[1]

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The Chinese mitten crab (*Eriocheir sinensis*) originates from East Asia, where it has been part of culinary traditions for millennia. In Europe, however, the species is regarded as one of the most problematic invasive alien species, causing significant ecological and economic damage.

In addition, mitten crabs can accumulate contaminants such as toxic metals and PFAS, posing potential health risks when consumed. Within the European Union, trade in mitten crab is prohibited, with the exception of the Netherlands. Despite this restriction, anecdotal evidence suggests illegal capture, trade, and release in other member states, including Belgium. This research examined the existence of an informal market for mitten crabs in Belgium. A combination of literature review, market surveys, shop inspection, and social media screening was used to map the trajectory from capture to consumption. The study explored both the indications of trade and their broader sociocultural and economic context. The findings confirm that mitten crabs are available for purchase in Belgium, both in physical shops and through social media platforms. Most crabs appear to be sourced from the Netherlands, where commercial harvesting is permitted. The presence of this informal market presents risks of further species spread, as well as violations of food safety regulations. Based on these results, several policy recommendations are proposed. These include awareness campaigns along the entire supply chain, stricter enforcement of existing legislation, and the establishment of maximum contaminant levels to safeguard consumers. In addition, directions for future research are suggested to better understand both the ecological risks and the cultural drivers of this market.

62 - Invasive Species at the Crossroads: Risks, Uses, and Management Pathways

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Invasive species are multifaceted phenomena: they reshape ecosystems, affect biodiversity, alter livelihoods, and trigger substantial management costs. Yet they can give rise to economic and social dynamics, for example through commercial and recreational fisheries, aquaculture, tourism, or cultural practices, that some actors may appropriate as sources of value. This complexity presents dilemmas for managers and policymakers, who must navigate ecological risks alongside new socioeconomic realities that emerge across different contexts and scales.

This special session will explore invasive species through the lens of ambivalence, highlighting both the risks and contexts of use. Contributions will span diverse ecosystems and perspectives, addressing ecological impacts, socioeconomic implications, and governance responses. Examples will include, among others, fisheries that have emerged around invasive species, the integration of non-native species into aquaculture, and cases where invasive species influence conservation or restoration agendas. Insights from the forthcoming edited CABI volume *Aquaculture and Invasions* (Kourantidou & Oficialdegui, eds.) will be discussed alongside other case studies to highlight converging lessons across systems.

The format will combine short research presentations with an interactive panel discussion, encouraging dialogue among ecologists, economists, managers, and policymakers. The session aims to distill cross-cutting insights into when and how management strategies can effectively

address both the risks and contested uses of invasive species, offering participants practical lessons for research, policy, and practice.

D3 - Claw Count: Tracking the True Toll of Invasive Crayfish

47 - Claws and Effect: Predicting Impacts of Invasive Crayfish using Long-term Biomonitoring Datasets

Emma Baker[1], Bradley Matainz[2], Ffion Anthony[1], Esi Bossman[3], Dumisani Khosa[4], Josie South[1]

[1]University of Leeds, [2]Charles Sturt University, [3]GroundTruth Consulting, [4]South African National Parks

Crayfish are among the most successful and ecologically damaging freshwater invaders globally, causing biodiversity declines and altering recipient communities. However, understanding how the ecological impact of invasive crayfish evolves across time and space, as they interact with their recipient biotic and abiotic environment, is currently lacking. We therefore use long-term macroinvertebrate biomonitoring datasets to quantify community responses to crayfish invasion and forecast potential consequences for ecosystem functioning. Two case studies will be presented: (1) quantifying the impact of the data-deficient Narrow-clawed crayfish (*Pontastacus leptodactylus*) in the United Kingdom from initial establishment and beyond to reveal how this invasion unfolds over time and space, and (2) unravelling invasion dynamics of the emergent red claw crayfish (*Cherax quadricarinatus*) in Kruger National Park, South Africa by harnessing macroinvertebrate responses to predict when invasion likely occurred. Long-term monitoring datasets offer a unique opportunity to disentangle how impact varies at large spatial and temporal scales and observe predictable patterns of impact which can facilitate proactive and effective management of biological invasions.

40 - Does morphology predict establishment and impact behaviours across an invasion gradient of narrow-clawed crayfish?

Ffion Anthony[1], Josie South[1], Josh Firth[1]

[1]University of Leeds

Halting the spread of non-native populations is critical for managing the likelihood of further ecological impacts. Understanding what processes, (i.e. behavioural, morphological, abiotic, biotic) drive dispersal can be used to inform management for control of invasive populations. Investigations into these processes are rarely combined, here, we use field and laboratory data

to determine the morphological and behavioural correlates of dispersal and ecological impact in *Pontastacus leptodactylus* (narrow-clawed crayfish) along an invasion gradient. Individuals at the invasion front morphologically differed from the core. With core population having larger claws but front populations having larger carapace length but lower mass, indicating reduced fitness at the front because of high competition. There were no consistent intra-individual behaviours, suggesting lack of behavioural syndromes in this population. This is likely a link between behaviour and external drivers, and suggests that in this system, there may be greater selection for morphological changes than behaviour with possible linkages to form dispersal phenotypes. Cross disciplinary approaches to assessing invasion processes are necessary to better characterise the dynamics of an expanding population.

135 - Functional responses and thermal performance of marbled crayfish (Procambarus virginalis) under climate warming scenarios

Victoria Van Mierlo[1], Anthony Ricciardi[1]

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Risk assessment of invasion threats requires predictive ecological information, especially with respect to thermal tolerance under climate change. The marbled crayfish (*Procambarus virginalis*) is a well-established invader in Europe but has only recently established in North America, where the only known feral population is in the Great Lakes basin. Although genetically identical, marbled crayfish populations can invade environments of diverse physiochemical conditions. Adaptive phenotypes that are highly conserved within populations may result from post-release environmental selection on gene expression. We aimed to examine the potential trophic impact and acute thermal tolerance of marbled crayfish under current and projected surface water temperatures for the Great Lakes. Furthermore, we explored the effect of their invasion history by comparing individuals sourced directly from pet suppliers (i.e. cultivated) and those from a population established in the wild (i.e. feral). We hypothesized that individuals from a feral population would have greater per capita trophic impacts and acute thermal tolerance than the cultivated population, because the former must potentially contend with fluctuating/extreme water temperatures and competition for food, whereas the latter are reared under stable water temperatures and are fed regularly. Functional response experiments conducted at current (18°C) and projected (24°C) water temperatures revealed no significant effect of temperature on attack rate and maximum feeding rate, suggesting a thermally-robust trophic impact. Feral crayfish had higher attack rates and maximum feeding rates than cultivated individuals, at both temperatures. Experiments testing the acute thermal tolerance of crayfish acclimated at 18°C found no difference in the critical thermal maximum between cultivated and feral crayfish, suggesting a lack of selection for increased tolerance after establishment. These results suggest that invasion history and post-release selection can modify feeding efficiency but not thermal tolerance of marbled crayfish. Data will be provided on Dryad.

B3 - Coastlines Under Siege: New Insights and Monitoring Tools

288 - Detection of marine non-indigenous species using Autonomous Reef Monitoring Structures and DNA Metabarcoding in ports in France

Everthon XAVIER[1], Amelia CURD[1], Gabin DROUAL[1], Marc BOUCHOUCHA[2], Antoine CARLIER[1], Justine EVRARD[1], Killian GUYOMARD[1], Nicolas GAYET[3], Fabienne CHAVANON[2], Benoist DE VOGUÉ[2], Christophe RAVEL[2], Aurélien TANCRAY[1], Clément VIOLET[4], Flávia NUNES[1]

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Biological invasions pose a significant challenge to the functioning and management of complex marine systems, particularly in regions exposed to intense human activities and strong environmental gradients. Early detection and prevention are essential components of the management of marine bioinvasions. DNA-based methods have high potential for early detection, but depend on the accuracy of DNA barcodes and the completeness of reference sequence databases, particularly for non-indigenous species (NIS) with closely related native counter-parts. This study presents an assessment of marine NIS in two ports in France, that combines DNA metabarcoding of organisms recovered with Autonomous Reef Monitoring Structures (ARMS) with integrative taxonomy to enhance the detection of cryptic, low-abundance, and taxonomically challenging taxa. A total of 21 ARMS were deployed in Brest (Atlantic) and in Toulon (Mediterranean) - across natural (low-impact and high-impact) and artificial habitats. A total of 609 species were identified by DNA metabacording, and 78 were classified as NIS, dominated by Rhodophyta (13), Ochrophyta (9), and Annelida (9). In percentage, community composition not differed significantly between areas (Toulon=13%; Brest=14%), besides the greater number of NIS being found in Toulon (69) compared to Brest (35). In both locations, NIS and cryptogenic species were more prevalent in artificial areas. These results highlight the role of artificial structures as potential hubs for NIS colonization and dispersal. Bryozoan integrative taxonomy based on scanning electron microscopy and Sanger sequencing increased the accuracy of identification of this cryptic group of organisms. ARMS enabled standardized sampling of sessile and cryptic communities, while metabarcoding enhanced taxonomic resolution and detection of early-stage or low-abundance taxa that are often overlooked by traditional surveys. This approach provides a robust framework for monitoring biodiversity and marine bioinvasions in a diversity of habitats affected by increasing human pressure and accelerated environmental climate change.

275 - Mapping the Distribution of an Intertidal Invasive Red Macroalgae at a National Scale Using Satellite Remote Sensing.

Bede Ffinian Rowe Davies[1]

[1]Nantes Université

Macroalgae species make up a large proportion (40 %) of all Invasive Alien Species in the European marine environment. Yet, the monitoring of these macroalgal species is lacking: how they spread, change seasonally and affect local ecosystems is poorly understood. This lack of spatio-temporal information is prevalent even for species widespread across multiple countries and coastlines, such as the intertidal red macroalga *Gracilaria vermiculophylla* (formerly *Agarophyton vermiculophyllum*). Here we present the methods and results of using open-access Copernicus Sentinel-2 satellite imagery to map this invasive red maroalgae across the Atlantic Coast of France for the summer of 2024. We initially improved the training data of a published intertidal habitat classifier and validated the results using independently sourced data. By doing so, we achieved high levels of classification accuracy at predicting this red macroalgae (93.2% global accuracy and 0.82 F1 score). We found that, while there were no evident latitudinal patterns, *G. vermiculophylla* was most prevalent within transitional (i.e. estuarine) intertidal areas when compared to more open coastal areas, where some hotspots were still identified. Furthermore, while it has been suggested that the initial invasion of *G. vermiculophylla* was mediated through aquaculture activities, the presence or absence of aquaculture showed no clear relationship to the proportion of the red macroalgae covering the intertidal area. Moreover, the seasonal dynamics of extent for this red macroalga revealed difference between two sites, Belon Estuary in Brittany and Bonne Anse in the Gironde Estuary, known to have consistent *G. vermiculophylla* cover. This work provides an open-access map of *G. vermiculophylla* across the whole Atlantic Coast of France, as well as illustrating a framework that could be employed to allow rapid monitoring of invasive macroalgae species. Monitoring and understanding spatio-temporal dynamics is an essential step in managing both invasive species and the ecosystems that they effect.

203 - Southward bound:-What is controlling the spread of the barnacle Austrominius modestus towards its southern limits in Europe?

Mary Catherine Gallagher Gallagher[1, 2], Teresa Cerveira Borges[3], Sarah Culloty[4], Neil Ramsay[2], Ruth O'Riordan[4]

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Austrominius modestus, a barnacle species native to Australasia, has been present in European waters for >75 years. In the northern Wadden Sea, there were concerns that climatic warming in the 21st century allowed this 'ecological sleeper' to increase in abundance and spread. In SW Scotland, towards its northern invasive range, our research suggested that competition by native barnacles may be controlling its abundance. Towards its western invasive range, in Ireland, it started to dominate the intertidal barnacle community in Lough Hyne Marine Nature Reserve, outnumbering native barnacle species. Our simple competition model, in which *Austrominius* uses a different reproductive strategy than the native Arctic-boreal *Semibalanus balanoides*, described how climate change might favour the invasive species in SW Ireland. Farol on the Ihla da Culatra, in the Ria Formosa Nature Reserve, Algarve, Portugal, is, as far as we are aware, the most southerly site where it has been recorded as established in Europe. Relatively little research has been undertaken towards its southern limits in Europe. Intertidal surveys in the Algarve, between 2014 and 2025, showed that abundances peaked (10-100 decimeter^{-2}), at four sites in 2014, but by 2025 it had decreased, with only a few or no individuals being found at the 12 re-surveyed sites. Sites were dominated by the native barnacle *C. montagui*, with low abundances of the native *C. stellatus* and non-native *Amphibalanus amphitrite*. At the southern European limit of *Austrominius*, it is hypothesised that mortality and stress, due to desiccation or other environmental factors, may be controlling its abundance and spread, since it is known to be less tolerant to high temperatures than *C. montagui* and *A. amphitrite.* Comparative integrative research, across geographic regions, including in its native range, would allow a better understanding of what factors affect its current success, or lack of it, at distributional edges.

214 - WITHDRAWN - Local conditions and environmental gradients shape the abundance and size structure of a non-native intertidal species in Atlantic North America

Chris McKindsey[1], David Drolet[1], Cyrena Riley[1], Daniel Small[1], Kimberly Howland[1], Piero Calosi[2], Giuseppe Garlachè[2]

[1]Fisheries and Oceans Canada, [2]Université de Québec à Rimouski

Variation in abundance and size along environmental gradients provide insights into the capacity of species to adapt to changing environmental conditions and predict range expansions, this being particularly relevant for non-indigenous species. We evaluated how population density, body size, and size structure vary in relation to environmental factors across a broad latitudinal gradient in the non-indigenous snail *Littorina littorea*.

Ten locations were sampled that covered most of range of *L. littorea* in North America and measured snail density, body size, substrate rugosity, and algal biomass. We extracted other environmental factors from satellite data to assess the influence of local characteristics and environmental gradients on mean snail density, mean size and size structure. We found evidence of a weak positive relationship between snail density and rugosity. Mean body size showed a strong positive relationship with growing season length and a negative relationship

with air temperature. High and variable temperatures during summer, length of the growing season, and high rugosity, negatively impacted the frequency of small individuals. Instead, high water temperature during the spawning period, low temperature variability during summer, and low substrate rugosity are positively associated with a higher frequency of small individuals.

Results indicated that substrate rugosity positively influenced the abundance of this non-indigenous littorinid independent of the climatic conditions experienced. Variation in body size largely reflected the environmental gradient found throughout its range. We argue that high and variable summer temperatures may increase juvenile mortality, while warmer spawning periods and more stable summers may promote recruitment and population growth. These findings support the potential for *L. littorea* to expand its range poleward with the progression of climate warming.

276 - Long-term trajectories of deep artificial rock pool communities in a port area

Angelica Enrique-Navarro[1], Antoine Carlier[1], Gabin Droual[1], Thomas Burel[2], Amelia Curd[1]

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In the context of biodiversity offsetting in coastal areas impacted by human activities, artificial reefs are increasingly implemented to create novel “biodiversity-friendly” habitats that compensate for ocean sprawl. However, coastal ecoengineering still lacks large-scale, long-term, and fully replicated studies, essential to robustly assess the ecological value of such interventions and their potential to sustain resilient communities beyond habitat and management boundaries.
In 2019, the Port of Brest (France) built a new 14-hectare polder retained by a 900-m-long dike, designed to support the marine renewable energy sector. To enhance its biodiversity, 100 concrete rock pools (0.5 m³ each) were integrated into the dike revetment at three intertidal levels (high, medium, low). The benthic flora and fauna of 27 representative pools, distributed along three dike sections, were monitored from 2021 to 2025 during winter and summer spring tides. Rapid Assessment Surveys were used to characterize community composition and its temporal and spatial dynamics to evaluate long-term ecological performance and identify key environmental drivers.

Rock pool communities took approximately five years to reach a stable state, with 240 taxa recorded., Marked biodiversity gradients occurred across tidal levels, with high-shore pools hosting the greatest richness, medium pools showing intermediate values, and low-shore pools exhibiting the lowest. Non-indigenous species represented 10% of the total richness; the bryozoans *Watersipora subatra* and *Bugula neritina*, several red algae, and the fan worm *Bispira polyoma* were abundant and persistent. Certain taxa, such as the flat oyster (*Ostrea edulis*) and the slipper limpet (*Crepidula fornicata*), showed a preference for smooth concrete substrates.

This study bridges ecological research and applied coastal engineering, demonstrating how long-term monitoring informs nature-inclusive design. By transcending disciplinary and habitat

boundaries, these findings provide an evidence base for sustainable coastal management and highlight the need for extended funding frameworks that match ecological stabilization timescales.

Poster Session & Networking Reception

13 - A global account of established non-native fish species

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Fish introductions have occurred for centuries, mediated by aquaculture, ornamental trade, fisheries enhancement, deliberate releases, and artificial corridors. Despite their ecological, economic, and cultural significance, there has been no comprehensive, standardized synthesis of established non-native fish species worldwide that simultaneously addresses their taxonomic diversity, distribution, pathways of introduction, and impacts. Here we present the *Global Fish Invasion Database* (GFID), the most complete resource to date on established non-native fishes globally. Drawing on multiple international datasets, literature, and expert verification, GFID documents >1,500 established non-native fish species across 193 countries, spanning freshwater, marine, and estuarine systems.

Species richness was highest in families such as Leuciscidae, Cichlidae, Salmonidae, and Cyprinidae, with strong geographic concentration in North America, Asia, and parts of Europe. Temporal analyses revealed an accelerating accumulation of species reports since the 19th century, although annual first records have declined in recent decades, possibly reflecting improved regulation, reporting lags, or regional saturation. Introduction pathways differed between habitats: freshwater introductions were dominated by aquaculture and the aquarium trade, whereas marine introductions were strongly linked to corridors, most notably the Suez Canal. Pathway analysis also highlighted the predominance of intentional introductions, underscoring the strong role of human agency. Impact information was available for only a third of species, revealing major knowledge gaps. Where documented, ecological impacts were most often mediated by competition and predation, with additional economic and socio-cultural effects on fisheries, aquaculture, and traditional practices.

By integrating species identities, native ranges, distributions, pathways, and impact records, GFID provides the first standardized baseline for assessing and managing non-native fish globally. This database thus supports the identification of high-risk taxa and pathways, strengthens invasion risk assessments, and informs evidence-based management and biosecurity policies in freshwater, marine, and estuarine ecosystems.

256 - Development of eDNA technology applied to the monitoring of the invasive marine mussel Mytella charruana

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Mytella charruana is an invasive mussel species from south America that is present in coastline environments from Florida to South Carolina. It can outcompete the native mussel species, to the detriment of the marine biodiversity, and oyster nurseries operations. The purpose of this project is to develop an eDNA method for monitoring *M. charruana*. We collected sea water samples from four separate locations at Skidaway Island in Georgia. The locations were in proximity to the University of Georgia oyster hatcheries and along the Savannah River estuary, close to the Savannah commercial port. Approximately 500 mL of sea water were filtered, and DNA was extracted using the ZymoBIOMICS™ DNA Miniprep Kit. The DNA concentration and purity was measured using the NanoDrop Micro-UV/Vis Spectrophotometer and the Qubit™ 4 Fluorometer. DNA integrity was analyzed by agarose gel electrophoresis.

We obtained genomic DNA of optimal quality and with a concentration that varied from 45 to 128 ng/ul. The DNA purity from protein was optimal, while the purity from small molecules contaminants was variable across samples. We will use an 18S targeted sequencing approach to test for the presence of Mytella. and results will be discussed. This research will aid in the monitoring of the invasive *M. charruana* species, which will facilitate the prevention of property loss to businesses such as power plants and oyster hatcheries. The ability to detect the presence of *M. charruana* will also aid the efforts of environmental scientists and managers as they work towards mitigating the effects of this introduced mussel species along the eastern coastline of the United States.

280 - ARMOR (Advanced Response Model for Organism Removal): A Machine Learning Tool for Improving Boat Inspection Efficiency for Detecting Aquatic Invasive Species

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An important management tool for reducing the risk of introduction and spread of Aquatic Invasive Species (AIS) is the use of boat inspection and washing stations to intercept and remove AIS from trailered boats before they enter new water bodies. This approach is effective; however, it is expensive and time consuming for the boating public. In New York State (US), this strategy is a central component of the statewide AIS management plan via the Watercraft Inspection Steward (WISP) Program. Capitalizing on this program, in 2018 New York State implemented a digital data collection program to capture data to quantify AIS transport at WISP boat inspection sites. In this study we utilized a comprehensive statewide dataset comprising 1.8 million inspection records collected between 2018-2025 to develop machine learning models that evaluate whether boat inspection efficiency could be improved using real-time survey data

collected at boat launch sites. We developed optimized XGBoost and Random Forest models with 26 engineered features, including launch-specific historical statistics that proved most predictive of AIS detection. From an invasive species threat perspective, false negatives (missed detections of invasive species) pose irreversible ecological consequences, while false positives (unnecessary inspections) represent acceptable operational costs. Initial models have been built using 2018-2023 data, validated on 2024 data with aggressive threshold optimization. These models have achieved 99.6-99.7% accuracy of AIS detection. This level of accuracy resulted in 20-30% of false positives that would have resulted in inspectors unnecessarily inspecting boats. This tradeoff is adjustable in the model and has significant implications. Managers could reduce inspection volume by 70-80% while maintaining sensitivity above 95%. Integration into real-time decision support systems at boat launches could increase inspection efficiency while limiting risks.

95 - From practice to prediction: assessing feasibility in AIS management

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Effective management of aquatic invasive species depends not only on understanding which species pose the greatest ecological risk, but also on whether management is actually feasible. Prioritising species purely by risk assessment can be misleading: the “worst” invader may be almost impossible to control, while more modest invaders might be manageable at far lower cost, yielding greater overall biodiversity gains. To address this gap, the Horizon Europe project *GuardIAS* is developing a predictive tool to estimate the likelihood that specific aquatic invasive species management interventions will succeed, given species traits, habitat context, and characteristics of the invaded site. The goal is to support managers in making evidence-based decisions on when, where, and how to act.

A crucial step is building a robust evidence base. Many valuable lessons from aquatic invasive species management remain buried in local reports or unpublished records, meaning they rarely inform broader analyses. We therefore invite contributions of documented management case studies (both successful and unsuccessful) covering any aquatic invasive species and intervention method. Useful information includes species, habitat, scale of intervention, methods applied, investment of resources, and whether goals were achieved. All contributions will be harmonised into a shared open-access database, forming the foundation for the predictive tool and creating a resource for practitioners, researchers, and policy makers. During ICAIS, participants can register their interest via a QR code linking to a contribution form.

By pooling management evidence internationally, GuardIAS and the ICAIS community can strengthen the scientific basis for more effective, timely, and cost-efficient aquatic invasive species management.

200 - A taxonomic review of the calcareous sponges in Northern Ireland from shallow subtidal environments

Jack Alcorn[1], Christine Morrow[1], Annika Clements[1]

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The calcareous sponges (Class Calcarea) are a taxonomically challenging group, where molecular studies often show disparity between traditional classifications and the observed relationships at different taxonomic levels. Within Northern Ireland, one member of the calcareous sponge genera, Sycon, has been recorded: the native species *Sycon ciliatum.* However, there has been some variation in the Sycon morphologies which have been observed in marinas in recent years e.g. an exceptionally long Sycon-like sponge. This could represent either a separate species, potentially non-native in origin, or a growth form that reflects the very sheltered conditions found in marinas and harbours.

In this study, an integrative approach combining traditional morphological techniques for sponges such as spicules and skeletal analyses will be combined with molecular analyses. Other calcareous species from within marinas and also from natural habitats will also be investigated including *Grantia compressa*, *Leucosolenia spp*. and *Clathrina coriacea*.

This will also further our understanding of how morphology may differ across natural habitats in shallow subtidal coastal environments and those of marinas. This study will be complete by the end of April 2026.

302 - Population dynamics and trophic interactions of invasive apples snails (Pomacea maculata) in crawfish production systems

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The invasive apple snail, *Pomacea maculata*, has become widespread throughout freshwater ecosystems along the U.S. Southern Coast. Recently *P. maculata* has expanded into natural and managed aquatic systems where they are having severe economic impacts to aquaculture of the red swamp crawfish, *Procambarus clarkii*, an industry that accounts for $500 million USD in annual revenue. Explosive populations have been documented with *P. maculata* densities reaching > 12 mature snails and >30 egg masses per m^2. However, the ecological processes driving *P. maculata* population dynamics are poorly understood. A two-year study monitored *P. maculata* and *P. clarkii* populations in both C4 and C3 plant dominated habitats. Populations of the native *P. clarkii* were inversely related to *P. maculata* densities in all habitats. Populations of both omnivores were reduced in C4 relative to C3 plant dominated habitats. Stable isotope analysis revealed greater breadth in the diets of *P. maculata* than *P. clarkii*, with the food sources utilized by the invader completely overlapping those of the native species. Results

confirm direct competition for available food sources between the two species. Proliferation of the invasive *P. maculata* is highly detrimental to native *P. clarkii* populations, a species of immense economic and cultural importance to the region. Future management research should examine the potential to use ecological engineering approaches to protect *P. clarkii* populations by limiting *P. maculata* abundance. Prevention of spread of *P. maculata* into uninfested water ways is of critical importance.

164 - Assessment of risks posed by the import of potentially invasive freshwater leeches

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Import and use of live leeches for medical purposes has once again increased in recent years, both for certified medical clinics and in branches of alternative medicine. The Norwegian Scientific Committee for Food and Environment (VKM) were commissioned to assess biodiversity risks linked to the import of two species of live leeches: *Hirudo medicinalis* and *H. verbana*. Of the two species, only *H. medicinalis* is regarded as native in Norway, following the import and release of the species prior to 1800.

VKM applied the Environmental Impact Classification for Alien Taxa (EICAT) framework to evaluate potential hazards and identified the following mechanisms as potential hazards: predation, parasitism, competition, disease transmission, and hybridization. Likelihood of the hazards becoming a reality, and the potential magnitude of impacts were combined to determine risk levels. Confidence in the various assessments was assigned by expert judgment as well as the quality and availability of data.

Hazards associated with predation, parasitism and competition were assessed for both species. VKM found that the magnitude of impact following release of the species in Norway would be minimal for *H. medicinalis* and minor for *H. verbana*.

Regarding potential threats from disease transmission, VKM concluded that the risk would be low for both species, as the vast majority of imported animals are likely to be exported by professional breeders in Europe or the US.

Intraspecific hybridization was only assessed for *H. medicinalis*. VKM concluded that this would be moderately likely to occur and, if so, the impact on native populations would be minimal.

In conclusion, the two species of leeches, although they may establish in Norwegian habitats, were assessed to pose a low risk to biodiversity in Norway.

28 - From Form to Function? Evaluating Morphology as a Predictor of Trophic Ecology in the Invasive Narrow-clawed Crayfish (Pontastacus leptodactylus)

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Predicting and mitigating the impacts of invasive species before they become widespread remains a central challenge in invasion ecology. Ecomorphology, the study of relationships between morphological traits and ecological function, offers a promising approach for predicting how invasive species interact with recipient ecosystems. When combined with stable isotope analysis, ecomorphological approaches may reveal whether variation in morphology translates into differences in resource use and trophic niche among individuals within an invasive population.

Invasive freshwater crayfish are a major threat to biodiversity and ecosystem functioning worldwide through competition, predation, habitat modification, and disease transmission. Although the UK supports five non-native crayfish species, research and management efforts have focused predominantly on signal crayfish (Pacifastacus leniusculus). In contrast, the narrow-clawed crayfish (Pontastacus leptodactylus), introduced to the UK during the 1970s, remains comparatively understudied despite evidence of continued spread. This study investigates the trophic ecology of an invasive population of narrow-clawed crayfish inhabiting Boshaw Whams Reservoir, West Yorkshire, UK. Stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$) and 39 morphological traits were collected from 30 crayfish to determine whether individual morphological variation can predict trophic position and resource use. By integrating isotopic and ecomorphological data, we test whether individuals with distinct morphologies have different trophic structure within the population. This work aims to provide the first detailed assessment of trophic variation in UK populations of narrow-clawed crayfish and evaluate the utility of morphological traits as predictors of invasive crayfish feeding ecology. Improving our ability to infer ecological impacts from morphology could enhance risk assessment frameworks and support more proactive management of emerging freshwater invasive species.

104 - Invasive species know no borders: the complete Western expansion of Pseudorasbora parva and challenges of its ineffective management

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The topmouth gudgeon (*Pseudorasbora parva*) a small cyprinid native to East Asia, is considered one of Europe's most invasive fishes due to its high habitat plasticity, early maturity, and rapid reproductive cycle. Beyond outcompeting native species, the fish acts as an asymptomatic pathogen carrier that can severely impact the local ichthyofauna. Introduced

accidentally through contaminated fish stocks, *P. parva* has rapidly expanded across Europe. The first Iberian record dates back to 2001 in the Ebro River (Spain), and the species was subsequently detected in the Guadiana River basin in 2010. Despite early eradication efforts in Spain, including rotenone treatments, the species continued tospread, reaching the Portuguese section of the Guadiana River. In 2024, during an electrofishing survey, seven individuals (total length: 4.0 - 7.5 cm) were captured, marking the first official record in Portugal. In this location, *P. parva* represented 2% of the ichthyofauna in a system already dominated by invasive species. This finding is particularly concerning due to the proximity of the site to the Alqueva reservoir, the largest artificial reservoir in Western Europe, where control efforts would be nearly impossible. The reservoir's connectivity with other basins, including the Sado River, further increases the risk of dispersal, threatening endemic and endangered leuciscid fishes, such as *Iberochondrostoma lusitanicum*. This study highlights the continued spread of this invasive fish throughout the Iberian Peninsula, emphasizing the need for managing biological invasions with transboundary cooperation. Beyond regulatory measures, improved communication and coordination between nations are crucial to reduce the likelihood of *P. parva* spread and prevent further biodiversity lossin Iberian freshwater ecosystems.

131 - SeaClancy - Barriers against mitten crabs: An efficient control method?

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The Chinese mitten crab (*Eriocheir sinensis*) is among the most damaging invasive aquatic species in the world, with considerable ecological and economic impacts. As part of the EU-Interreg project "Clancy", specially designed traps have been deployed in various water bodies of the North Sea region to both monitor and remove crab populations.

SeaClancy, as a spin-off, introduces a new component to the trap concept in the form of crab barriers that are integrated into the structures of the tidal obstacles and weirs, thereby preventing juvenile Chinese mitten crabs from ascending into the rivers and trench systems of the North German lowlands. This could reduce the economic and ecological damage caused by the annual mass migration of young mitten crabs or channel it into a few river systems for targeted fishing.

The concept presented here expands the management tools for mitten crabs with an additional, inexpensive component that requires minimal effort.

The design and the selected locations for testing the barrier in January 2027 in Lower Saxony will be presented.

279 - Discovery and development of biological controls for problematic aquatic crustaceans with focus on burrowing

shrimp (Neotrypaea californiensis) and salmon louse (Lepeophtheirus salmonis)

Brady Hirshfeld[1]

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This poster details efforts to discover and develop biological controls for problematic aquatic crustaceans including Neotrypaea californiensis, a burrowing shrimp pest that affects oyster farming, and Lepeophtheirus salmonis, a louse whose parasitism of farmed salmon damages animal welfare, aquaculture revenues, and ecosystems. Interventions to control invasive and pest crustaceans have primarily relied on nonspecific synthetic chemical pesticides, which increasingly face local and international bans due to their association with negative health effects on nontarget species including humans. Mechanical alternatives are generally expensive, less effective, and can be laborious. Thus, there is significant demand for interventions with lower risk, higher specificity, and fewer boundaries to use, such as biological control agents. Microbial natural products research has produced successful biopesticides to control invasive terrestrial arthropods such as spotted wing drosophila (Drosophila suzukii) and Asian citrus psyllid (Diaphorina citri), and this work builds upon this foundation with a unique approach to discover and develop a biological control that can be aimed at specific invasive species with targeted formulation and application techniques. This research is discussed in full scope, including targeted environmental sampling methods, a knowledge-based process to isolate and select high-upside microbes, bioassay development using model and target species, fermentation optimization based on next generation sequencing data, and analysis of bioassay results. In total, 37 microbes sourced from habitats native to and invaded by N. californiensis and L. salmonis demonstrated strong anti-crustacean activity in bioassays. A subset of five high-priority microbes has shown consistent activity against N. californiensis in bioassays and have shown 100% kill of L. salmonis in preliminary experiments. Ongoing work to identify active compounds, optimize fermentation, and formulate a microbe-derived biological control are also discussed.

239 - Long-term sublethal exposure to polyethylene and tire wear particles: Effects on risk-taking and social behaviour in invasive and native fish

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The increasing prevalence of anthropogenic micropollutants such as polyethylene (PE) and tire wear particles (TWPs) in aquatic environments poses a significant threat to freshwater biodiversity. This study examined the chronic sublethal effects of dietary exposure to PE and TWPs on two cyprinid fish species with contrasting ecological strategies: the native crucian carp (*Carassius carassius*) and the invasive gibel carp (*Carassius gibelio*). Over a 60-day exposure period, we assessed behavioural responses related to risk-taking, burst swimming performance, and social associations under pollutant exposure. Fish were fed diets containing 0.1% PE, TWPs, or control feed and evaluated for behavioural changes in open-field tests and species-association assays. Both the pollutants induced significant alterations in risk-taking behaviour. PE exposure increased boldness and open-field utilization, while TWPs modified associative preferences and exploratory patterns. Notably, native crucian carp showed increased movement and exploration in heterospecific zones under TWPs exposure, while invasive gibel carp exhibited reduced movement and increased spatial withdrawal, particularly in conspecific zones suggesting species-specific sensitivity. Contrary to the pollution resistance hypothesis, the invasive gibel carp demonstrated less behavioural resilience than the native crucian carp under TWPs exposure. These findings indicate that both PE and TWPs pollutants can differentially disrupt behavioural ecology across species, potentially altering interspecific interactions and community structure in freshwater habitats. Our results highlight the importance of considering behavioural endpoints and species identity when evaluating the ecological risks of emerging contaminants. The long-term consequences of such behavioural disruptions may extend beyond individual fitness to influence invasion dynamics and biodiversity in polluted freshwater ecosystems.

79 - Recreational Vessels: An Overlooked Vector for Marine INNS? Method Development and Pilot Insights

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Invasive Non-Native Species (INNS) continue to threaten marine ecosystems, with vessel movement recognised as a major pathway for their global spread. While commercial shipping has been scrutinised, the role of recreational vessels—yachts, sailboats, and powerboats—remained largely unexamined in the UK. Commissioned by Natural England, this project carefully reviewed existing evidence and actively engaged with key stakeholders—including government representatives and the Royal Yachting Association—to co-develop a robust, cost-effective methodology for assessing potential biosecurity risks from recreational boating in UK waters.

A dual-survey approach was designed, combining in-person questionnaires with hull fouling assessments. Questionnaires captured vessel characteristics, maintenance routines, and biosecurity awareness, using the COM-B model to examine behavioural drivers. Hull fouling surveys relied on photographic evidence to estimate biofouling density as a proxy for INNS risk, avoiding the need for species-level identification. Stakeholder input directly shaped both the method and the rollout strategy, ensuring relevance, buy-in, and practicality at a national scale.

A pilot study in the Solent tested feasibility and logistics. Ethical considerations—including informed consent, data protection, and participant sensitivity—were embedded throughout. The pilot highlighted practical challenges which informed refinements to both methodology and training materials, ensuring accessibility for non-specialists and scalability for broader, cost-effective application.

Data collection over the next few years, informed by this methodology, will advance our understanding of how recreational vessels may contribute to the spread of marine INNS, determine whether further biosecurity interventions may be required and how they would best be targeted.

86 - First Insights into Nematode Infections in Exotic Freshwater Chelonians in Portugal

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Parasites have increasingly been recognized as essential elements in ecological balance, influencing host populations, trophic interactions, and ecosystem dynamics. In freshwater turtles, the diversity of endoparasites and ectoparasites is strongly associated with geographic distribution, invasive status, host density, and the biology and ecology of different species. This study aimed to characterize nematodes present in wild non-native turtles captured in the Ria Formosa Natural Park and in Lagoa Azul, an area where native species (Mauremys leprosa and Emys orbicularis) coexist with invasive species. Parasites obtained from necropsies and organ washings were examined under a binocular microscope and isolated, with more than 150 nematodes collected from 21 turtle individuals belonging to four species: *Trachemys scripta, Mauremys sinensis, Graptemys pseudogeographica,* and *Pseudemys concinna*. These results

reinforce the role of invasive species as potential vectors of parasitic agents, with an increased risk of transmission to native populations and a potential impact on human health, particularly through the sharing of helminths of zoonotic relevance. This work contributes to filling the knowledge gap on parasites of non-native freshwater chelonians in Portugal and to the assessment of risks associated with conservation and public health.

97 - Lost in non-translation: contributions of non-English-language literature to knowledge of aquatic invasive species

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Due to the inherently transboundary nature of many modern scientific problems, the international generation, sharing, and synthesis of scientific research are imperative for the successful prevention and management of biological invasions. English has arisen as the international lingua franca of science, which can facilitate global communication but has also resulted in numerous negative consequences due to language barriers. For one, many studies and evidence syntheses in invasion science overlook non-English-language literature, despite evidence that a substantial portion of scientific literature globally is still written in non-English languages. The consequences of this exclusion have recently been demonstrated for our understanding of the costs of biological invasions, but effects of excluding non-English literature on scientific knowledge in invasion science more generally are largely unknown. To address this knowledge gap, we will compare the informational content of English- and non-English-language literature using the case study of marine invasive species in Japan. Using both international and Japanese literature search systems, we will undertake a systematic search for English- and Japanese-language literature on 63 marine invasive species established in Japan and screen the resulting studies for relevance. We will then classify the information contained in each study within a series of categories relevant to invasion processes and ecology (transportation pathways, environmental tolerances, impacts, etc.). Finally, we will aggregate our findings within and across species to compare the knowledge contained within English- and Japanese-language sources. While data extraction is still in progress, preliminary results of the literature screening process indicate that Japanese-language literature is of greater importance than English-language literature as a source of information on the invasions of approximately 80% of the species on our list. The results of this study will reveal the potential consequences of overlooking non-English-language literature in marine invasion science, with implications for research and evidence syntheses in science more broadly.

129 - From pest to resource — different legal ways to monetize mitten crabs

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Currently, it is challenging in Europe to cover even a portion of the costs associated with managing invasive species, whether in terms of materials or personnel, through the legal sale of products made from them. In addition to reducing local mitten crab populations, the Clancy project is also investigating various possible uses that could ensure that the traps are cost-effective in the medium term. These include processing into high-value products, such as chitin and protein hydrolysate for fish cell cultures, as well as feed for zoo animals and a substitute for fish meal in sustainable fish feed. For long-term operation, we are investigating how trap maintenance can be integrated into existing dyke and landscape maintenance structures.

In this work, we compare the costs of constructing and operating mitten crab traps at different locations, which were installed as part of the Interreg Clancy project between 2023 and 2026, and assess these against the potential income from utilization processes. We also present concepts for integrating and modifying the traps for long-term continued operation as part of landscape and dyke maintenance measures. In addition, we provide an outlook on whether the concept can also be applied to invasive crayfish such as Procambarus clarkii.

187 - Enhancing Boater Engagement to Prevent the Spread of Aquatic Invasive Species: Lessons from Four Years of Outreach in Québec

Matys Tessier[1], Ève Courtois[2]

[1]Ozero Solutions, [2]RAPPEL

Recreational boating is the primary vector of aquatic invasive species (AIS) spread in Québec's lakes and rivers. Effective prevention therefore requires sustained efforts to educate boaters about proper watercraft cleaning practices. Direct human interaction has proven to be a powerful tool for fostering awareness and behavioral change.

Over the past four years, organizations in Québec have conducted intensive country-wide outreach campaigns to promote watercraft decontamination practices. The goal has been to create long-term behavioural change in boaters' habits towards effectively cleaning their vessels to reduce the risk of spreading invasive species. Through this experience, the organizations have identified key success factors for awareness-raising initiatives targeting the recreational boating community.

This poster will present the main lessons learned, including:

- strategies for simplifying and communicating decontamination protocols;
- outreach activities such as conferences and demonstrations using mobile washing stations;
- the role of diverse stakeholders, including municipalities along with local and regional organizations;

- approaches to communication, dissemination, and marketing aimed at reaching specific audiences;

- educational materials designed to support long-term behavioral adoption.

Quantitative and qualitative results will be presented as measures of effectiveness, such as the number of boaters reached, the scope of geographic coverage, and observed changes in knowledge and practices. These findings contribute to the broader discourse on AIS prevention by highlighting the importance of combining technical guidance with effective human-centered communication strategies.

219 - Retrospective Molecular Detection of Aquatic Invasive Species (AIS) from Ethanol-Preserved Plankton Samples

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Monitoring programs for aquatic invasive species (AIS), particularly for *Dreissena polymorpha* (zebra mussels) and *Bythotrephes spp.* (spiny waterflea), commonly rely on microscopy-based identification of preserved plankton samples. Although effective for confirming the presence of these organisms, microscopy may underestimate low-density established populations and is limited by sample processing constraints and taxonomic expertise. Molecular approaches such as polymerase chain reaction (PCR) can detect species-specific DNA signals and may provide complementary information for AIS surveillance. This study evaluated the feasibility of repurposing ethanol-preserved plankton samples for retrospective molecular detection of AIS. A total of 89 plankton samples collected from 21 Manitoba lakes between 2022 and 2024 were analyzed using microscopy and PCR assays targeting *Bythotrephes spp*. and *D. polymorpha.* Microscopy identified *Bythotrephes spp*. in 41 samples and *D. polymorpha* in 12 samples. PCR detected *Bythotrephes spp*. DNA in 49 samples, including 20 samples that were negative by microscopy. Agreement between microscopy and PCR for *Bythotrephes spp*. was fair (κ = 0.29), reflecting differences in the biological targets detected by the two methods. For *D. polymorpha*, PCR detected DNA in 55 samples. Late amplification (Ct >35) was also observed in filtration blank controls, whereas no-template controls remained consistently negative and filtration blanks contained no measurable DNA by fluorometric quantification. Because these findings could reflect either trace DNA below the fluorometric detection limit or late-cycle assay background amplification, a conservative Ct threshold (≤35) was applied, resulting in 34 samples being classified as positive. Agreement between microscopy and PCR was slight (κ = 0.19), and *D. polymorpha* detections should therefore be interpreted cautiously pending independent confirmation. These findings demonstrate that ethanol-preserved plankton samples can provide useful molecular information for retrospective AIS surveillance. The integration of microscopy and molecular approaches may enhance monitoring programs, although independent confirmation methods remain essential for reliable interpretation of molecular detections

121 - Halting an invasion: exploring the potential of traps to protect rivers from non-native Chinese mitten crabs

Oscar Jones[1], Joe Ironside[1], Daniel Mills[1]

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The Chinese mitten crab (CMC) *eriocheir sinensis* is a catadromous crab species native to Southeast Asia and is a voracious aquatic invasive species across North America and Europe. *E. sinensis* breeds in estuaries, juveniles undertake long upstream migrations (Cohen and Weinstein 2001), maturing in freshwater habitats, before returning 1-5 years later to the estuary for Autumn spawning. Their migratory behaviour and inability to swim means that deploying traps across the riverbed can capture and remove large numbers of migrating crabs, an approach successfully trialled in the Schelt River, Belgium (Schoelynck et al. 2021).

Our research covers three phases of a potential *E. sinensis* management plan, assessing site feasibility for CMC trapping, improving sampling methods and assessing the use of traps as a population control method. We developed a site selection survey, aiming to identify appropriate CMC trapping locations, that is currently being tested in England and Wales. Crab condo traps are small moveable traps which can be used to detect invasive crab species in marine environments (Hewitt and McDonald 2013). We successfully deployed condo traps in the river Dee, England, to catch juvenile CMC during spring migration. Additionally, we conducted refuge choice experiments aiming to refine condo traps specifically for *E. sinensis*, with initial results suggesting that the species prefers small spaces close to the riverbed. Effective sampling methods are crucial to detect *E. sinensis* and, in combination with our site selection survey will aid in identifying suitable locations for trapping migrating crabs in invaded waterways. We designed a unique version of the CMC trap that is intended to be adaptable for deployment in a wider range of waterway conditions and without the need for heavy machinery or permanent foundations. In August 2025 this innovative trap was installed in the river Dee, marking an important milestone in managing this invasion.

197 - Integrating Pet Trade Outreach and Engagement across Disciplinary Boundaries: Disease and Invasive Species Mitigation

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The global movement of animals and plants through the pet trade spans hundreds of countries and constitutes a multibillion-dollar industry. Unfortunately, this trade also facilitates the spread of invasive species and diseases, leading to biodiversity loss, economic damage, and potential risks to human health. These issues are often addressed separately by different organizations and agency divisions, with invasive species and disease typically treated as distinct topics. For

instance, conference presentations are often siloed into either invasive species, despite overlapping goals. However, the target audiences of outreach programs—and even many of the best practices—are the same for both issues. Delivering inconsistent yet similar messages to these shared audiences can cause confusion and frustration among pet trade industry members and pet owners, ultimately hindering effective action.

To enhance communication between aquatic invasive species and wildlife disease experts on a global scale, we are facilitating discussions with leading experts across disciplines. Our primary objectives are to (1) identify international organizations and leaders involved in managing the movement of exotic pets, especially focused on amphibians, reptiles, and fish; (2) develop evidence-based best practices to reduce the spread of invasive species and diseases in the pet trade, through collaboration with regulatory agencies, researchers, and conservation groups; and (3) promote adoption of these practices among pet wholesalers and retailers by creating adaptable outreach materials for use by international partners.

Our preliminary findings show that organizations tend to be focused on a particular species or group of species but often have overlapping best practices for both businesses and pet owners. The organizations also vary as to how much of their efforts are shared publicly, making it difficult for these groups to connect. Illegal trade is an additional challenge for some species in outreach efforts.

Learn more here.

157 - From Moon Phases to Molecular Biology: Untangling the Invasive Potential of the Peach Blossom Jellyfish

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While considered one of the most widespread freshwater invasive species globally, the ecological impact of the peach blossom jellyfish (*Craspedacusta sowerbii*) remains poorly understood. Accurately determining their ecological impact requires quantifying environmental factors in addition to developing a more effective detection method.

The primary objectives of this research project are:

I) Determine whether *C. sowerbii* presence is associated with changes in plankton and invasive aquatic plant richness

II) Examine how temperature and moon phase correlate with *C. sowerbii* blooms

III) Develop a sound method of detecting and empirically measuring populations of *C. sowerbii* through the use of eDNA and water sampling

We surveyed lakes in southeastern Michigan, half of which had *C. sowerbii* sightings within the last five years. We counted the number of medusae along a transect at each site, collected plankton samples, recorded water temperature, water clarity, and the moon phase weekly for seventeen weeks. We also used data from iNaturalist to quantify invasive aquatic plant species at each site. Preliminary data show a positive correlation between medusa sightings and the

waning moon, increased temperature and invasive aquatic plant species, and decreased water clarity. To develop eDNA tracking techniques, jellyfish were collected and housed in aquaria with differing concentrations to simulate variance in bloom size. eDNA was extracted from the samples to determine the limit of detection in laboratory conditions. Results indicate promising levels of assay sensitivity, which demonstrate suitability for upcoming field validation. By expanding our understanding of key biotic and abiotic factors that may help predict *C. sowerbii* presence, while making progress towards more effective population monitoring methodologies, we can shed light on the ecological impacts of this species.

43 - Improving trapping effectiveness for controlling the red swamp crayfish Procambarus clarkii

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In Tuscany (central Italy), a population of the alien red swamp crayfish *Procambarus clarkii* is present in Lake Romena threatening the native white-clawed crayfish *Austropotamobius pallipes* complex present in a national park close by. The aims of the study were to reduce the *P. clarkii* population abundance through trapping activities and improve the control effectiveness by using three different trap types: two types of wire mesh traps (cylindrical and rectangular) and the Artificial Refuge Traps (ART). We also aimed to assess the composition of the lake community, particularly the presence of crayfish predators (using eDNA), and the potential spread of *P. clarkii* outside the lake. The control activities conducted from 2022 to 2025 for 85 trapping days using a maximum of 78 traps led to a decrease of 82% in the abundance index Catch Per Unit Effort (CPUE) of crayfish population. Cylindrical traps, with larger mesh and narrower entrance, trapped the highest number of individuals (CPUE: 1.35), especially the larger ones (cephalothorax length; CL ≥ 35 mm) and the males. Rectangular traps (CPUE: 0.61), with smaller mesh and wider entrance, caught relatively more small (CL < 35 mm) males while ARTs were the less efficient (CPUE: 0.19) but captured relatively more females and smaller individuals. eDNA sampling highlighted the presence of a community mainly composed of alien species and some crayfish predators (e.g. fish). The surveys conducted in the surrounding areas revealed the presence of *P. clarkii* downstream of the lake. Control activities using different types of traps should be maintained and integrated with new techniques (like manual remove of females pleopods), to further decrease the population abundance and assess the feasibility of a possible eradication.

309 - How do hydroelectric generating stations influence early zebra mussel establishment in a large, regulated river system? Evidence from the Wolastoq | Saint John River (New Brunswick, Canada)

Meghann Bruce[1]

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How do hydroelectric generating stations influence early zebra mussel establishment in a large, regulated river system? Evidence from the Wolastoq | Saint John River (New Brunswick, Canada)

Zebra mussels (*Dreissena polymorpha)* were first confirmed upstream of the Wolastoq | Saint John River (W|SJR) watershed in Lake Témiscouata (Quebec, Canada) in 2022, raising concerns regarding downstream spread into this large (673 km long) river system in New Brunswick, Canada. Targeted biomonitoring surveys conducted at 187 locations between 2023 and 2025 provided evidence of early-stage colonization within the W|SJR watershed. In total, 22 adult zebra mussels were detected, spanning three locations over a 365 km range. All detections occurred on artificial infrastructure, including hydroelectric generating stations and a submerged telemetry receiver, despite targeted surveys of natural littoral habitats and hard substrates throughout the system, suggesting that hydroelectric infrastructure may provide localized conditions favorable for early establishment within an otherwise spatially limited invasion. To investigate how hydroelectric impoundments and associated environmental conditions may influence future colonization, a localized risk assessment (LRA) was conducted throughout the W|SJR watershed using habitat suitability indicators linked to zebra mussel establishment, including environmental and physicochemical factors, with emphasis on the saturation index of calcite (SIcalcite). Spatial assessment identified variation in colonization potential among reaches of the watershed, with several impounded sections exhibiting physicochemical conditions capable of supporting continued establishment and expansion. Our preliminary findings suggest that hydroelectric generating stations may act as focal points for early zebra mussel establishment by providing physical and chemical conditions that facilitate establishment. Understanding how infrastructure influences early-stage establishment dynamics is improving our understanding of localized colonization potential and associated economical and environment-ecological impacts within the W|SJR river system.

61 - All-You-Can-Eat Mussels: The Female Advantage in an Invasive Predator

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The invasive Atlantic blue crab, *Callinectes sapidus* Rathbun, 1896 (*C. sapidus)*, is spreading across the Mediterranean Sea, endangering native communities, fisheries, and aquaculture. Yet, knowledge on this species predation efficacy in non-native environments remains limited, and little is known about potential sex-specific differences in functional responses (FRs). Here, we present the first functional response study of *C. sapidus* outside its native range, comparing the functional responses of male and female crabs preying on the Mediterranean mussel *Mytilus galloprovincialis* Lamarck, 1819 (*M. galloprovincialis)*. Both sexes exhibited a type II FR, which was characterized by high attack rates and short handling times, indicating destabilizing effects on prey populations, consistent with patterns observed in other invading crabs. While there were no statistically significant differences in predation efficiency between sexes, females displayed higher predation rates across all prey densities, as well as a higher attack rate and a shorter handling time. Functional Response Ratios (FRRs) also revealed that female crabs had more than twice the predatory pressure of males, a difference that might reflect the increased energetic demands involved with reproduction and migration in mature female blue crabs. Our findings show that sex differences can significantly influence the impact of invasive predators. Neglecting these differences might result in an underestimation of ecological threats, especially in species like *C. sapidus*, where mature females can exert greater predation pressures on vulnerable prey like *M. galloprovincialis*. We emphasize the importance of including sex-specific comparisons into invasion ecology research to improve predictions of invasive species impacts.

287 - Beyond Borders: Integrating Science, Policy, and Practice to develop an All-Island Marine Invasive Species Strategy

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[1]National Biodiversity Data Centre

Marine and coastal non-indigenous species (NIS) pose escalating ecological, economic, and governance challenges across the island of Ireland. However, management efforts have historically been fragmented across jurisdictions, sectors, and data systems. This work aims to develop the first coordinated Marine and Coastal Non-Native Species Strategy for the island of Ireland, integrating scientific evidence, policy frameworks, and practitioner expertise to strengthen prevention, early detection, and develop a rapid response capacity.

A multi-disciplinary Steering Committee of scientific experts, regulators, and practitioners was established to guide the process. Development of the strategy includes: (1) a comprehensive State of Knowledge review synthesising current distribution, pathways, impacts, and regulatory frameworks; (2) a structured gap analysis assessing existing national and regional strategies

against international best practice; (3) a pathway risk analysis to prioritise vectors and inform targeted biosecurity measures; and (4) the preparation of technical guidance notes and codes of practice tailored to high-risk sectors.

The resulting strategy will provide a harmonised, evidence-based framework for marine and coastal NIS management across jurisdictions, aligning ecological priorities with practical implementation mechanisms. Implementation support includes stakeholder training, biosecurity capacity building, awareness initiatives, and a query support service to ensure translation of strategy into practice.

By integrating research, policy, and on-the-ground application across political and biogeographic boundaries, this initiative exemplifies the ICAIS 2026 theme of *Transcending Boundaries*. The framework advances collaborative governance for aquatic invasive species and provides a transferable model for other regions managing shared marine ecosystems under complex jurisdictional arrangements.

258 - ISO 6319: Enabling Environmentally Sound In-Water Cleaning Through Regulatory Harmonisation

Irene Tvedten[1]

[1]Bellona Foundation

The spread of invasive aquatic species (IAS) via ships' biofouling remains a global environmental challenge. While In-Water Cleaning (IWC) is recognized as a practical and potentially sustainable method to manage biofouling and limit the transfer of IAS, its uptake has been hindered by inconsistent national and regional regulations. These too often restrict or prohibit IWC, creating regulatory fragmentation that slows progress in effective IAS prevention.

ISO 6319, an international standard currently in final development, aims to address this barrier by providing a globally harmonized framework for how IWC operations are planned, conducted, and documented. The standard places strong emphasis on environmental protection and safety, and aligns with both the IMO 2023 Biofouling Guidelines and the IMO 2025 Guidance on In-Water Cleaning of Ships' Biofouling.

By offering a clear, internationally agreed methodology, ISO 6319 helps authorities develop coherent regulations, gives shipowners confidence in compliant IWC services, and creates a level playing field for service providers and ports. Crucially, harmonized standards can increase regulatory acceptance of in-water cleaning as an environmentally sound practice—making it more widely available and more effective in reducing IAS spread across global shipping routes.

At the same time, ISO 6319 also helps limit environmentally harmful in-water cleaning practices by helping ports and regulators assess whether or not IWC operations meet consistent environmental standards. For this reason, ISO 6319 advises testing IWC systems in line with ISO 20679, the international standard for testing the performance of ship biofouling IWC systems.

This presentation will explore how ISO 6319, a standard titled *"Conducting and documenting in-water cleaning of biofouling on ships,"* contributes to IAS prevention by enabling regulatory clarity and consistency in IWC operations, and will highlight the broader role of harmonized standards in supporting both environmental protection and operational feasibility in global maritime biofouling management.

229 - Effect of Chilling Duration on Sprouting of Hydrilla verticillata subsp. lithuanica Axillary Turions

Amber Riner[1], Madeline Watts[2], Jeremiah Foley[2], Benjamin Sperry[3]

[1]University of Florida, [2]Connecticut Agricultural Experiment Station, [3]US Army Corps of Engineers

Hydrilla (*Hydrilla verticillata*) is a highly invasive, submersed aquatic plant to the United States which contain three subspecies: *H. v. verticillata* primarily found in the southern United States, *H. v. peregrina* common in mid-Atlantic to northern latitudes, and *H. v. lithuanica* which was reported in Hartford County, Connecticut in 2016. This study aimed to determine whether a chilling period was necessary to break dormancy in *H. v. lithuanica* turions. Results showed no significant differences in sprouting in turions exposed to different chilling durations of 2, 4, 8, and 16 days at 4°C until 4 days after removal from cold treatment. By the end of the study, turions chilled for ≥ 8 days exhibited significantly higher sprouting (>97%) compared to the non-chilled control (73%). Additionally, time to 50% sprouting was reduced in chilled turions (2.6-3.7 days) compared to non-chilled turions (6.9-10.9 days). These results indicate that *H. v. lithuanica* has a flexible dormancy strategy and high sprouting potential after brief chilling, warranting early season management and posing a risk to regions with variable winters.

154 - Genomic analysis of the globally invasive, ecologically destructive Neotropical armored catfish genus Hypostomus

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With a tropical Central and South American native range and many invasive populations in North America, Africa, and Asia, the suckermouth armored catfish genera Pterygoplichthys and Hypostomus (family Loricariidae) exemplify how globally popular aquarium fishes can cause severe ecological and cultural disruption and costly economic damage when established outside their native range. With their distinctive sucker mouths, unique coloration and patterning, species within these genera have become popular in the exotic fish trade. Once established, these fishes can negatively impact ecosystems by burrowing into banks and causing erosion,

outcompeting native species, and harassing manatees by attaching to their skin. These fish also have no natural predators and are not easy to consume due to their heavily armored skin. This study examines the population genomics of invasive Hypostomus populations in Colombia's Magdalena River basin, Costa Rica's Río Caño Negro basin, Texas's San Marcos and San Felipe rivers, and various drainages in Florida.

To investigate the origins and spread of invasive Hypostomus populations, we collected spatially extensive tissue samples across their native and invasive ranges and applied reduced-representation genomic sequencing for population genomic analyses. Our goals are to identify if there are pathways of spread and determine which populations invasive lineages originate from.

Preliminary analyses suggest multiple introductions within Texas (e.g., San Marcos Springs and San Felipe Creek). Florida Hypostomus appear to have either spread from Texas or derive from a shared source population. Importantly, neither the Texas nor Florida populations show genomic similarity to samples from Costa Rica, suggesting alternative introduction pathways.

Documenting introductions and self-sustaining populations emphasizes the urgent need for management intervention before these populations expand further. By identifying source populations and invasion pathways, our results provide information for preventing additional introductions through the aquarium trade, monitoring high-risk areas, and mitigating the ecological impacts of Hypostomus.

188 - Is construction of nature-friendly ditch banks risky in the presence of floating pennywort?

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[1]FLORON

Together with water boards Aa en Maas and De Dommel, we investigated whether the presence of floating pennywort detracts from the value of a nature-friendly bank (NFB). To this end we looked at the effects on vegetation and macrofauna of NFBs with different degrees of steepness in watercourses with the presence of floating pennywort. Over the course of 2 years, 13 pairs of NFBs and nearby reference transects on a ditch bank that had not been restored were examined. On average, there was no significant difference between the plant Ecological Quality Rate (EQR; a Dutch measure of ecological quality for plants on ditch banks) and macrofauna QuickScan scores (QS score: a Dutch ecological quality score of macrofauna in watersystems) of the NFBs compared to their references. More plant species were found on the NFBs with very gently sloped banks than on the banks of their reference. The study provides no clear evidence that construction of NFBs along a watercourse infested with floating pennywort would create additional risks in the surveyed areas, which generally had limited ecological quality. However, active management targeting floating pennywort is recommended.

155 - Tangled Lines: Investigating Hybridization Between Atlantic Salmon (Salmo salar) and Invasive Brown Trout (Salmo trutta) in Cape Breton, Nova Scotia

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Brown trout are considered one of the world's most pervasive freshwater-fish invaders, readily establishing self-sustaining populations in waterbodies across the globe as introduced recreational fish. Beyond the direct ecological and economic effects of invasive fish species on local ecosystems, a frequently overlooked impact is that of species hybridization. As a result of either pre- or post-zygotic breakdown, hybrids between introduced and naturally occurring fish species can lead to wasted reproductive effort should subsequent filial generations prove to be an evolutionary dead end (for example, via genetic incompatibility leading to outbreeding depression); or alternatively, hybrid vigour and eventual genetic swamping. In this pilot study, we investigated the extent of hybridization between non-native brown trout and native Atlantic salmon in Cape Breton. Since their Introduction to Nova Scotian waters over 100 years ago, and specifically to the Margaree River in the 1950's, brown trout have steadily increased in occurrence and abundance, raising vocal concerns of local community members regarding the potential for hybridization with the Atlantic salmon population. We sampled juvenile salmon and brown trout parr (n = 250 across 10 sites), and performed next-generation sequencing of multiple species-specific SNPs to determine the incidence of hybridization in the river, including hybrid class analysis. Our findings shed light on the likelihood of hybrids impacting the reproductive value of Atlantic salmon, and the extent of admixture in the population. These results will inform next steps, including: i) determining the rate of hybridization in the Margaree River over time using archived scale samples of juvenile Atlantic salmon collected over the past two decades; and ii) working with Indigenous rightsholders, NGOs, and recreational anglers to investigate the behavioural, physiological and transcriptomic adaptive capacity of salmon x trout parr to assess the magnitude of threat hybrids can pose on native fish species population persistence.

207 - Using environmental DNA surveys alongside visual searching to detect non-native species in ports and marinas

Phil Davison[1], Jan Maclennan[2]

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Marinas and ports are high-risk 'hotspots' for the introduction and spread of marine non-native species, making them important sites for monitoring. We conducted environmental DNA (eDNA)

surveying at 19 ports and marinas in England and Wales, analysing 9 litres of water from each site using two methods: 1) targeted assays for six priority species; and 2) metabarcoding using the mitochondrial COI gene. The results of the eDNA surveying were directly compared with Rapid Assessment Surveys (visual searching) conducted at each site on the same day. We found differences in the species recorded by the two methods. The eDNA metabarcoding detected 17 non-native species not found during the visual searches, but conversely the visual surveys proved more effective for detecting the taxonomic groups most likely to attach to hard substrate (e.g. tunicates, bryozoans and barnacles) for which these methods have been optimised. Some of the species found only by visual surveying are not yet represented in DNA sequence databases, which is currently a limiting factor for this method. We recommend that using a combination of visual surveying and molecular methods is likely to yield the most comprehensive list of non-native species for a site.

136 - Do the reproductive traits of invasive round goby from the Middle Danube change after 10 years?

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The round goby is one of the successful invasive species with a high degree of phenotypic plasticity and biological flexibility. Thus life-history traits of three subpopulations (2010, 2011, 2020) of round goby from the middle section of the Danube River were examined from a time perspective. According to the tested hypothesis derived from the Theory of alternative ontogenies and invasive potential, round goby females from 2020 (long-time established population) should have larger somatic parameters, lower fecundity, bigger sizes of oocytes, and larger body size at maturity than the females from 2010 and 2011 (short-time established population). Contrary to our prediction the females from 2020 had opposite values of all tested parameters, i.e. showed more generalized life-history traits than females from 2010 and 2011. In terms of real fecundity values, females from 2020 showed specialized life-history traits characteristic of long-established populations in later stages of invasion. The observed shift of round goby towards a more generalized strategy may be attributed to increased competitive pressure associated with the rising abundance of the invasive bighead goby and racer goby, ultimately leading to a decline in the relative abundance of round goby. This study was supported by VEGA, project 1/0448/23.

6 - Leveraging Advanced Technologies for Early Detection and Management of Aquatic invasive species

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The rapid spread of aquatic invasive species (AIS) poses significant threats to freshwater ecosystems, economies, and human health. To mitigate these impacts, it is essential to develop and deploy innovative tools and technologies for predicting, monitoring, and controlling AIS. This study explored the application of cutting-edge technologies, including machine learning, remote sensing, and environmental DNA (eDNA) analysis, to improve AIS management. We developed a machine learning model that integrates environmental and biological data to predict the likelihood of AIS invasion in freshwater ecosystems. Our results showed that this model can accurately identify high-risk areas, enabling proactive management and prevention efforts.

We also employed remote sensing technologies to monitor AIS distribution and abundance in real-time, allowing for rapid response and targeted control measures. Furthermore, we utilized eDNA analysis to detect AIS presence in water samples, providing a sensitive and non-invasive method for early detection. Our findings demonstrated the potential of these technologies to revolutionize AIS management by enhancing prediction, detection, and control capabilities. By leveraging these advanced tools and technologies, we can improve our ability to prevent AIS introductions, reduce their impacts on ecosystems and economies, and protect human health. This research highlighted the importance of interdisciplinary collaboration and technological innovation in addressing the complex challenges posed by AIS. By embracing these new tools and technologies, we can develop more effective and sustainable solutions for managing AIS and promoting ecosystem resilience.

243 - A Basin-Level Spatiotemporal Framework for Linking Environmental Disturbance to Freshwater Invasion Impacts across Europe

Darren Stuart[1]

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Freshwater ecosystems are among the most transformed environments in Europe, yet how catchment disturbance, hydrological change, riparian degradation, infrastructure, aquaculture and fishing pressure relate to documented invasion impacts remains poorly resolved at continental scale, particularly after controlling for recording-effort proxies. To address this gap, we developed a reproducible basin-level workflow linking freshwater ecological impact records from InvaPact, a contemporary global evidence base associated with the Extended Environmental Impact Classification for Alien Taxa framework (Carneiro et al. 2026), to HydroBASINS/BasinATLAS level-04 catchments across Europe from 1950 to 2024. Environmental predictors were harmonised to five-year time steps and generated for all basin × time combinations, allowing contemporary and lagged associations to be assessed without making predictor availability depend on where invasion impacts had been documented. Catchment land-use and population variables from HYDE 3.5 were combined with ERA5-Land runoff to represent runoff-mediated disturbance transmission, while riparian exposure was

derived from 250 m HydroRIVERS buffers intersected with HYDE land-cover layers. Additional covariates captured static fragmentation context from Global Dam Watch, aquaculture and inland fishing pressure from RiverThreat baselines scaled by FAO country-year trends, observation intensity from GBIF documentary-volume proxies, and invasion context from GRIIS-linked non-native richness metrics. The resulting Europe-only workflow produces model-ready basin × five-year predictor tables, linked impact-record tables and species × basin × five-year analytical panels for testing direct, lagged and interaction-based disturbance effects. This framework enables tests of whether disturbance facilitates invasion pressure, amplifies realised ecological impact, or both, while distinguishing broad catchment pressure, hydrological transmission, riparian exposure, infrastructure context and sampling intensity. By combining open environmental products with a global impact evidence base, the workflow supports continental assessment of where disturbance-associated vulnerability to non-native species impacts may be greatest across European freshwaters.

224 - Progress in the classical biological control of parrot's feather, Myriophyllum aquaticum for Great Britain

Corin Pratt[1], Anna Tilling[1], Daisuke Kurose[1], Elizabeth Pendlington[1]

[1]CABI

Myriophyllum aquaticum is a perennial aquatic herb native to South America but invasive in North America, Europe, Africa, Australasia and Asia. The plant thrives in freshwater habitats and can colonise and dominate aquatic environments, reducing biodiversity and outcompeting native flora. The dense growth of *M. aquaticum* can impede recreational activities and disrupt local ecosystems. In Great Britain (GB) only female plants have been recorded, but the plant reproduces effectively by fragmentation, facilitating rapid spread in suitable environments. Plants can be spread by human activity and exhibit rapid growth in nutrient enriched water bodies. Traditional control of *M. aquaticum* via manual and mechanical means is typically short-term, costly and can cause fragmentation and spread, with herbicide treatment in water bodies undesirable and tightly regulated. In GB, research into the classical biological control (CBC) of *M. aquaticum* was initiated in 2020, focusing firstly on *Lysathia cilliersae*, a leaf beetle that was released in South Africa in 1994 and proved an effective agent, and more recently on *Listronotus marginicollis*, a stem mining weevil also determined to be specific and damaging in South African studies, but not released. Both insects are native to Argentina, which is within the native range of *M. aquaticum*. CABI UK sourced *L. cilliersae* from a South African culture at Rhodes University and *L. marginicollis* from cultures at FuEDEI, Argentina and CSIRO, Australia. Research into the CBC of *M. aquaticum* for North America is run in parallel at CABI Switzerland, allowing collaboration and data sharing. Host-specificity testing, multi-generational studies and impact assessment data will be summarised for the two species, in addition to molecular research to elucidate the identity and taxonomic position of a red-stemmed *Myriophyllum* species previously known only via the plant trade but found naturalised in GB and exhibiting various traits comparable to those of *M. aquaticum*.

69 - Evaluation of the Impacts of a Non-native Fern, Lygodium microphyllum, on Native Vegetation in Herbicide Treated and Un-treated Wetlands in Florida

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Lygodium microphyllum is an invasive fern in Florida wetlands including the Everglades. Ten natural areas in southern Florida, USA were evaluated to determine the impact of *L. microphyllum* on native plants in un-treated and herbicide treated sites. Ground cover of *L. microphyllum*, native species, and other non-native species was recorded along line transects in herbicide treated sites, untreated sites with *L. microphyllum* present, and control sites where no *L. microphyllum* was present. Percent cover of *L. microphyllum* was significantly different ($P < 0.001$) between treated (= 17.9) and untreated (= 67.2) sites. Percent total coverage of native vegetation was significantly different ($P < 0.001$) among controls (= 114.6), untreated (= 69.9), and treated (= 39.7) sites. For percent cover of non-natives other than *L. microphyllum*, significant differences ($P < 0.001$) were detected for treated sites (= 9.6) compared to untreated (= 2.1) and control (= 3.6) sites. Plant cover was dominated by native ferns in control sites, native ruderal species in treated sites, and *L. microphyllum* in untreated sites. No significant differences ($P = 0.31$) were detected for species richness among sites. Evenness was significantly different ($P < 0.001$) among control (= 0.67), treated (= 0.32) and untreated (= 0.29) sites. Significant differences ($P < 0.001$) were found for species diversity among control (= 0.81), treated (= 0.61) and untreated sites (= 0.60). In untreated sites, percent cover of *L. microphyllum* in relation to native plant cover revealed a strong negative relationship ($R^2 = -0.95$, $P < 0.0001$) with native plant cover decreasing as *L. microphyllum* cover increased. The invasion of *L. microphyllum* in south Florida wetlands results in decreased native plant cover and diversity, and sites treated with herbicide become invaded by other non-native species.

133 - Microplastics uptake by Procambarus clarkii in three central Texas streams dependent of different water sources

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In Central Texas, a variety of stream are common that include spring runs fed by groundwater input, perennial streams fed by treated wastewater effluent, and ephemeral streams dependent on precipitation. Benthic macroinvertebrates form a crucial trophic link in these streams. The degradation of increasingly prevalent plastic waste in the environment has led to the contamination of terrestrial and aquatic environment with microplastics. Microphagous collectors such as *Procambarus clarkii* (Louisiana crawfish) are more likely to ingest microplastics than

other benthic macroinvertebrates. *P. clarkii* is a cosmopolitan species which has invaded freshwater and brackish ecosystems globally. Its ability to tolerate poor water quality along with its rapid growth and reproduction have contributed to its widespread invasion. In Europe, it is a vector for crayfish plague and a polytropic keystone species which can disturb ecosystems through burrowing, herbivory, and predation or competition with native species. *P. clarkii* samples were collected using dip nets and minnow traps from the upper San Marcos River (spring fed), San Antonio River's Mission District (dependent on treated wastewater effluent for flow), and isolated pools in the ephemeral Leon Creek (dependent on precipitation for flow). All three streams occur in the urban environment and *P. clarkii* are expected to be exposed to high concentrations of microplastics. *P. clarkii* samples were collected from each stream and analyzed for microplastics. Samples were dissected to remove the gills and digestive tract, then dehydrated and digested using 30% H_2O_2. Brine solutions were used to float the microplastics in the samples prior to filtration through 5 μm glass membrane filters. Filters were stored in Petri dishes and analyzed for microplastics under a microscope, with a subsample of microplastics analyzed using Fourier Transformed Infrared (FTIR) to confirm their chemical identities. The study is in progress and results will be reported at the conference.

250 - Geographical and Habitat Overlap Among Four Highly Invasive Aedes Mosquitoes

David Bruce Conn[1, 2], Denise Andriot Conn[1], Hannah Atsma[1], Laurel Blount[1]

[1]Berry College, [2]Harvard University

Over several centuries various species of mosquitoes in the genus *Aedes* have emerged as highly invasive, spreading widely as alien species across broad geographical ranges. Four species that are important vectors of diverse pathogens infecting humans and animals present significant health threats. *Aedes aegypti* originated in Africa and the Mediterranean region but invaded many areas of the Americas centuries ago. More recently, in the 1900s, *Aedes albopictus* and *Aedes japonicus* expanded from their native ranges in Asia to invade North America and Europe. In recent decades the North American native, *Aedes atropalpus*, has been found at various locations throughout Europe and poses new threats despite early discovery and some success at control. All these species can breed in small accumulations of freshwater inside diverse containers, but while *Ae. aegypti* and *Ae. albopictus* are generally urban and synanthropic, *Ae. japonicus* and *Ae. atropalpus* may pose a broader threat due to their ability to flourish in more wildland habitats. Because of their potential importance to human and animal health across much of the world, we have tracked these four species in studies across the Caribbean Basin and the entire eastern region of North America from south Florida to the St. Lawrence River Valley of northern New York State USA and southern Ontario Canada. Our extensive multi-year surveys show that *Ae. aegypti* remains firmly established across the Caribbean and southern Florida. *Ae. albopictus* is minimally present in southern Florida but is among the most common urban mosquitoes in the southern United States as far north as the

Ohio River. *Ae. japonicus* occurs as far south as Georgia with strong populations as far north as the St. Lawrence River where it inhabits both urban and rural settings Our studies in northern latitudes show *Ae. japonicus* displacing native *Ae. atropalpus* in sylvan riverine rock pools.

170 - Anticipating African Future Fauna in Southern Iberia: Unveiling the Ecological Consequences of Tropicalization (InvaTropic)

Gustavo Freire de Carvalho-Souza[1], Ángela Rodríguez-Ruiz[1], Jesús Manuel Aragón[1], Elena Ortega-Jímenez[1], Julio Bohórquez[1], Mónica Nuñez[1], Bruno Almón[2], Isabel Muñoz[2], Inma Herrera[3], Enrique Ostale[4], Hicham Chairi[5], Hoceim Bazairi[6], Bouabid Badaoui[6], Oussama Bououarour[6], Imane Rahmouni[6], Mohamed Selfati[7], Beyah Meisse Habib[8], Temim Deli[9], Khaled Mohammed-Geba[10], Asmaa Khallaf[10], Andrés Martínez[11], David Soto[12], Pedro Morais[13], Matthias Obst[14], Katrina Exter[15], Stuart Jenkins[16], Ricardo Pérez-Martín[17], Jose Antonio Cuesta[1], Carmen González Sotelo[17], Enrique González-Ortegón[1]

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Climate change is driving the northward expansion of tropical species, a process commonly termed “tropicalization.” The southwestern Iberian Peninsula, particularly the Gulf of Cadiz, is emerging as a hotspot for this phenomenon, where African fauna and non-native species (NNS) increasingly appear. This process, also referred to as “African Creep,” has implications for biodiversity, fisheries, and ecosystem resilience, yet its ecological and socioeconomic impacts remain poorly understood.

The InvaTropic project aims to anticipate the arrival of African fauna into southern Iberian waters, unravel their ecological impacts, and explore the role of marine heatwaves in shaping species distributions. We will integrate environmental DNA (eDNA) metabarcoding, isotopic and trace-element chemical origin characterization (COC), and physiological stress experiments to provide a comprehensive framework for detection, origin tracing, and impact assessment of new arrivals. eDNA metabarcoding, with optimized pipelines for variable markers, will be applied across natural and human-modified habitats to detect early signals of NNS. COC analyses combining stable isotopes, trace metals, and rare earth elements will allow inference of species’ origins and migration pathways. Physiological experiments will examine the metabolic

responses of key taxa to marine heatwaves, clarifying resilience and vulnerability across latitudinal gradients.

This interdisciplinary effort involves international collaboration with partners in Mauritania, Morocco, Tunisia, Egypt, Portugal, the UK, Belgium, and Germany, ensuring a regional perspective on invasion routes and ecological responses. The outcomes are providing important insights into early detection, monitoring, and management of NNS, directly supporting the Marine Strategy Framework Directive and European Biodiversity Strategy (2030).

177 - Spread and local drivers of the invasive mollusc Melanoides tuberculata in Central Burkina Faso

Salam Sankara[1]

[1]Joseph Ki-Zerbo university

Since the first report of the exotic mollusc *Melanoides tuberculata* in 2017 in Reservoir No. 3 of Ouagadougou, the species has continued to spread to adjacent water bodies. In this study, we investigated the local factors likely to influence the expansion of the exotic mollusc *M. tuberculata* at 119 sampling points in the region from November 2020 to September 2021. Specimens were collected using an Eckman grab. The random forest (RF) algorithm was used to identify the main local predictors of *M. tuberculata* establishment. Model performance was evaluated by calculating metrics such as the Kappa index, F1 score, and Area Under the Curve (AUC). The results showed that five years after its first report, 11 of the 15 areas of the Centre region were invaded by *M. tuberculata*. The model performed well in determining local predictors that favour the occurrence of *M. tuberculata*, with Cohen's Kappa, F1 score, and AUC values of 0.55, 0.70, and 0.833, respectively. Habitat type (particularly water reservoirs), mollusc diversity, substrate type, pH, and fishing activities were among the main predictors that facilitated the establishment and spread of the mollusc in the Centre region. This study also showed a high spread of *Melanoides tuberculata* in the Centre region. Knowledge of these factors is important for strategies to control this species in Burkina Faso. The high spread of *Melanoides tuberculata* in the Centre region highlights the need for more studies to assess its potential effects on local benthic macroinvertebrate fauna. Further parasitological studies are also needed to determine the parasite load of the species and the associated health risks.

261 - What drives invasions? A historical review of recreational fish invasions in Nova Scotia

Nicole Cameron[1], Sarah Kingsbury[2], Jason LeBlanc[3], Hannah Harrison[1]

[1]Dalhousie University, [2]Fisheries and Oceans Canada, [3]Nova Scotia Department of Fisheries and Aquaculutre

Human activities facilitate biological invasions in natural environments worldwide. These invasions are an ecological and social concern due to their impact on ecosystems that are important to humans. Aquatic invasive species (AIS) are of special concern in Nova Scotia, Canada, due to their impact on Nova Scotia's fisheries, which have significant cultural and economic value in the province. Smallmouth Bass (*Micropterus dolomieu*) (SMB) and Chain Pickerel (*Esox niger*) (CP) were introduced in select areas of the province in the 1940s for angling, and through a series of authorized, unauthorized, and accidental introductions, they now persist in many watersheds and pose a risk of continual spread. Despite their invasive status, where these fish have long been established, they are also valued as sport fish, leading to tensions around AIS management strategies and eradication attempts. To better understand the social values, stakeholder-manager conflicts, and continued spread, we have conducted a historical review of the ecological invasions and human dimensions correlated with the invasion of SMB and CP in Nova Scotia. First, we compiled all existing data of SMB and CP reports in Nova Scotia and observed their increasing rate of occurrences over time. Second, we identified and assembled a collection of major social and cultural events (e.g., policy changes, technological advances) that could have influenced their invasion and detectability. By combining the complementary timelines of the ecological invasions and the relevant sociocultural events, we developed a novel understanding of the human dimensions that have played a role in the invasion dynamics and insights into how social values and events may impact further decision-making. The publication of these timelines and the associated data will be a novel, interdisciplinary contribution to AIS scholarship and will aid in future policy decisions that need to balance the ecological and social concerns of AIS management.

179 - Investigating the dominance of non-indigenous and cryptogenic species in biofouling communities between two marinas with varying salinity.

Christopher Hamill[1], Christine Morrow[1], Annika Clements[1]

[1]Queen's University Belfast

Marinas serve as an important anthropogenic vector for the movement of non-indigenous species, by attachment to the hull of vessels (biofouling) or by retention of larvae in ballast water. Predicting which environmental factors can make areas preferential for invasive species can be critical in predicting their spread.

Previous studies have examined the impact of extreme salinities on marine INNS, usually for shorter term immersion. This study aims to examine the effects of more moderate and variable salinity in the environment on the succession and dominance of INNS in the biofouling community. This was done over an extended period (February 2025 to May 2025).

To study this relationship, we used a series of plastic settlement panels (simulating the structure of marinas) at varying depths (as salinity differs with depth) at two sites: Belfast harbour (lower and more variable salinity) and Bangor marina (higher and less variable salinity). To further

inform our data we have used a CTD measure repeatedly to create a baseline for the differences in salinity and temperature with depth between the two sites.

The panels were photographed every 3 weeks, and the community is currently being identified to the lowest taxonomic unit, and the percentage coverage of each species will be determined. Scrape samples were taken at the end of the sampling period for analysis of the whole community in a laboratory setting at the end of the spring/summer growth increase. This also offers an opportunity to compare the effectiveness of a photographic survey for identifying invasive or cryptogenic biofouling species to scrape sampling and laboratory analysis.

Once samples are identified, data will be used for univariate and multivariate analysis of the full community composition and dominance of invasive and cryptogenic species (project will be complete by April 2026).

300 - New Trait Unlocked: Discovery of Dormancy in the Invasive Sea Spider Ammothea hilgendorfi

Antoine Flandroit[1], Naomie Geerinckx[1], Benjamin Decoux[1], Dilan Perales Garcia[1, 2], Raphaël Conotte[1], Vanessa Tagliatti[1], Igor Eeckhaut[1], Guillaume Caulier[1]

[1]University of Mons, [2]Ghent University

Ammothea hilgendorfi (Böhm, 1879) is a sea spider (or pycnogonid) species native to the North Pacific Ocean that was introduced to Europe in the late 1970s and, more recently, has formed an invasive population in Belgium. The fact that a pycnogonid bioinvasion is unprecedented worldwide raises questions on the reasons for the thriving success of *A. hilgendorfi*. The present study serves as a stepping-stone highlighting a crucial trait for the species to withstand environmental stresses: dormancy. Survival experiments combined with metabonomic analyses (i.e., ^{1}H-NMR) identified precise conditions under which dormancy is induced, as well as significant differences in four metabolites between dormant and non-dormant individuals. This discovery therefore represents the first evidence of dormancy in the entire pycnogonid class and questions whether this trait also exists in native counterparts. In parallel, sarcosine, a modified amino acid, was identified as by far the most abundant metabolite in *A. hilgendorfi*, opening new avenues of research to uncover its roles and potential links to invasion success.

90 - U.S. Geological Survey and partner research on an emerging invasive fish species, Black Carp Mylopharyngodon piceus

Patrick Kroboth[1], Michael Colvin[1], Catherine Richter[1], Matthew Neilson[2], Mark Wildhaber[1]

[1]U.S. Geological Survey Columbia Environmental Research Center, [2]U.S. Geological Survey Wetland and Aquatic Research Center

Black Carp *Mylopharyngodon piceus* are a potamodromous large-riverine fish species originally from eastern Asia and used internationally as a food fish and biological control for mollusks in aquaculture. Since importation into the United States, Black Carp have escaped from culture facilities and are expanding in range and abundance in the Mississippi River Basin (MRB). Black Carp are described as molluscivores with the potential for direct predation on the numerous protected mollusk species in the MRB. Of the information available from the species' wild native range, much is vague or confounded by combined observations with Silver Carp *Hypophthalmichthys molitrix*, Bighead Carp *Hypophthalmichthys nobilis*, and Grass Carp *Ctenopharyngodon idella*. Because Black Carp are still uncommon, though apparently increasing in number since first wild detections in the 1990s, relatively few Black Carp have been captured by science or management agencies, and efforts to sample Black Carp broadly across their potential range, would not be cost-effective. In 2015, the Illinois Department of Natural Resources, Southern Illinois University, U.S. Geological Survey, and U.S. Fish and Wildlife Service coordinated to document the capture of Black Carp using a public outreach program. This program capitalized on an existing skillset and knowledge base from commercial fishers to acquire difficult-to-gather data on this emerging invasive species, subsequent information has been adapted into the a research program focused on understanding the species life history, movement and habitat use, development of detections methods (i.e. physical capture and eDNA), development of structured decision-making approach to guide research and management in priority river segments, and initial testing to develop attractants for improved capture efficiency. A summary of completed research and results within these subject areas will be presented and progress of on-going projects and available research products.

315 - The BRIDGE Program: Bridging Networks to Advance Collaboration and Communication on Marine Biosecurity

Amy L Freestone[1], Andrew L Chang[1], Martin Thiel[1], Mark E Torchin[2], Katrina Lohan[1], Alison Cawood[1], Mark S Minton[1], Gregory M Ruiz[1]

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Biological invasions by non-native species can harm local economies, food security, and human health and well-being. Non-native species continue to spread rapidly on land, in freshwater, and in our oceans. Limited knowledge of the extent of invasions in our oceans creates gaps that weaken biosecurity efforts to prevent and manage marine invasions. Clear communication pathways for consolidating information on known marine invasions across international stakeholders and widely adopted standardized protocols for detecting new or undocumented invasions are needed to bridge these gaps and minimize impacts on society. Harnessing complementary expertise across highly invested regional and global networks, in 2025, we launched the BRIDGE program: Bioinvasion Research Integration across Dynamic Global Ecosystems. BRIDGE advances fundamental science at scales needed to inform effective biosecurity policy and contributes to training a workforce poised to leverage international team science to engage with this challenge. BRIDGE provides a platform for collaboration to establish

the standardized framework, protocols, and capacity to address critical knowledge gaps at scale that limit invasion science. BRIDGE is establishing lines of communication and a community of practice among data-generators for increased coordination on best practices and quality control. Working groups are co-developing methods for standardized, efficient non-native marine species detection and expanding available tools for data sharing and management, including robust pipelines for rapid delivery to existing repositories. Focused activities will develop integrated measures of vector dynamics to estimate propagule supply across scales and identify key opportunities for collaborative experiments to diagnose underlying mechanisms that shape invasion outcomes and improve detection efforts. Through virtual meetings and annual in-person workshops, trainings, and scientific exchanges, the BRIDGE program aims to catalyze research in marine invasion science and mobilize this science to improve biosecurity management and policy. We welcome partners who are interested in engaging through BRIDGE to accelerate biosecurity science and impacts.

151 - [PRESENTATION WITHDRAWN] Quantifying the Drain of Physiological Resources by the Haematophagic Feeding Behaviour of Anguillicola crassus, and Associated Impacts, on the European Eel Anguilla anguilla.

Derek Evans[1], Niamh Heatley[2], Jaimie Dick[2]

[1]Agri-Food and Biosciences Institute, Northern Ireland, [2]Queen's University Belfast

The European eel is a catadromous species with a large native range and complex lifecycle. Following rapid decline in recruitment in the early 1980s, and current recruitment less than 10% pre-1980s levels, ICUN have listed it as critically endangered. ICES have named suspected causes for this decline, including the non-native haematophagic nematode parasite *Anguillicola crassus*. Native to East Asia, *A. crassus* infects anguillid species, feeding on blood from the capillary rich walls of the swimbladder. Since discovery in Germany in 1982 the parasite has spread rapidly, now considered ubiquitous throughout the eel's native range. Infection causes extensive damage to the swimbladder, inducing changes in swimming behaviour and environmental stress responses. This has raised concerns about reproductive potential linked directly to its migratory fitness and ability to perform the transatlantic swim to its spawning grounds, therefore placing stock recovery actions aimed at addressing historically low recruitment into further doubt. *A. crassus* pathology is relatively well understood, but it is unknown how much of the host's blood, and therefore physiological resources, an infection consumes. This project discusses exploratory methods for measuring eel whole blood volume and *A. crassus* haemolymph, with development of potential relationships between infection parameters, blood volume and eel biometry.

139 - Evaluation of the salinity tolerance of giant salvinia (Salvinia molesta) using concentration-exposure time methods

Corrina Vuillequez[1], Jonathan Glueckert[1], Benjamin Sperry[2]

[1]University of Florida, [2]US Army Engineer Research and Development Center

Giant salvinia (*Salvinia molesta*) is present in 20 countries and is regarded as one of the world's worst aquatic weeds. While the species is present in the southern United States, giant salvinia has not yet become established in Florida. Florida is particularly vulnerable to giant salvinia invasion due to the warm climate and suitable conditions for growth. However, the tolerance of giant salvinia to the tidally-driven salinity levels present in Florida has yet to be investigated. Therefore, the salinity tolerance of giant salvinia over a range of salt concentrations and exposure times was evaluated at mesocosm scale using methods common in herbicide concentration-exposure time studies. Salinity levels ranged from 0.25 to 16 parts per thousand (ppt) and exposure times ranged from 0.75 to 24 hours. A static exposure (two weeks) at each salinity level was included for reference. Biomass and survival were recorded following the two-week experiment. Two experimental runs were conducted. In both runs, no clear exposure time response was observed until salinity level reached 8 ppt (25% seawater). All exposures to 16 ppt resulted in significant biomass loss, while 8 ppt reduced biomass at longer exposure times (at static in run 1, and at 6, 12, 24 hours and static in run 2). In run 1, salinities of 4 ppt and under had no effect on biomass, while in run 2, the effect of these salinities was minimal. Complete mortality was not observed in any treatment. These data indicate that giant salvinia can survive and persist after short exposures to partial saline conditions similar to those found in lower portions of tidally-influenced rivers in Florida. Based on this finding, we suggest that early detection rapid response methods continue to be employed when giant salvinia is detected in tidally-influenced areas of Florida.

158 - Evaluation of microplastic uptake by Asian Clams within perennial streams in Central Texas

Jeffrey Hutchinson[1], Ananya Seth[2]

[1]Professor/PI, [2]Undergrdauate Research Assistant at UTSA

Asian clams (*Corbicula fluminea*) have been demonstrated to serve as effective bioindicators for microplastic contamination in marine and coastal ecosystems. This study provides a preliminary analysis of microplastic uptake by Asian clams in a wastewater effluent fed river (San Antonio River) and a spring fed river (San Marcos River), focusing on their potential as a bioindicator of microplastics concentration in two pools located within the San Antonio River in San Antonio, Texas and San Marcos River in San Marcos. The research will involve collecting Asian clams (n = 30 in each river) in March-April, 2025 from perennial sites to quantify and characterize the

microplastic polymers they ingested by Asian clams. Clams will be processed using an established protocol involving digestion with KOH to dissolve organic matter, purification via emersion within salinity gradients, and extraction via vacuum separation. Key study objectives include assessing the concentration and types of microplastic polymers and their relative abundance in the clam tissues, and differences between microplastics concentrations in Asian clams in wastewater effluent fed river and a spring fed river. Evaluating Asian clams' ability to uptake microplastics can signal microplastic pollution in aquatic environments. This study aims to contribute valuable data on pollution trends in different perennial streams and offer insights if the Asian clam may be a bioindicator species that could aid in long-term environmental monitoring.

Plenary Presentation #1: Ian Duggan | Plenary Presentation #2: Melodie McGeoch

296 - Mitigation trumps remediation: Lessons from research on vectors for the movement of freshwater invertebrates in New Zealand

Ian Duggan[1]

[1]The University of Waikato

New Zealand would appear to have many advantages with respect to managing the rate of freshwater invasions. This includes it being comprised of a series of isolated islands, and having rivers too small to harbour shipping vessels carrying ballast water. In particular, being an isolated archipelago presumably allows the potential for more effective border protection than in many other regions. Nevertheless, it has been, and remains, far from immune - the border is leaky, as evidenced by the recent establishment of freshwater clams (Corbicula), first detected in 2023. Various transportation vectors have moved non-native freshwater species both into and within New Zealand, with around 200 recognised as established to date. I will first focus broadly on the invasion vectors for freshwater animals into New Zealand and discuss attempts to keep non-native species out, including pre-border and border controls, with evidence of where these are known to have worked. Transportation of species into and within the country has ranged broadly from accidental, to intentional legal importations for sport and the aquarium trade, to ‘piscatorial eco-terrorism’. As with Corbicula, other species have vectors that remain uncertain.

Most recent freshwater invaders in New Zealand have been invertebrates, and particularly zooplankton - a group for which taxonomic expertise is declining both in New Zealand and globally. While the country has not yet seen the high profile, ecologically and economically damaging predatory cladocerans Bythotrephes and Cercopagis, the continued establishment of other zooplankton taxa indicates the door remains open. Here I will discuss invertebrates hitchhiking with plants, birds and fish, movement via the aquarium trade, and more. I argue that

we need to exercise our imaginations to identify unexplored vectors, even when sometimes we might not get positive results, to reduce future threats.

297 - Governing biological invasions under rapid environmental change

Melodie McGeoch[1]

[1]Monash University

TBD

B4 - Under the Carapace: Patterns and Processes Driving Crab Invasions

160 - Population genomics of Chinese mitten crabs across Europe

Christine Ewers[1], Jonas Schoelynck[2], Heleen Kersebeilik[2], Sonja Leidenberger[3], Nick de Meersman[4], Pieter Boets[5], Céline Rolet[6], Bastien Chouquet[7], Torsten Heyer[8], Sengdavanh Thepphachanh[8], Björn Suckow[9], Oliver Hauck[9], Monika Normant-Saremba[10], Joe Ironside[11]

[1]Kiel University, Germany, [2]University of Antwerp, [3]University of Skövde, [4]Flanders Environmental Agency, [5]Province of East-Flanders, [6]Groupe d'Etude des Milieux Estuariens et Littorau (GEMEL), [7]Cellule de Suivi du Littoral Normand, [8]Dresden University of Technology, [9]Alfred-Wegener Institut, [10]University of Gdansk, [11]Aberystwyth University

The Chinese mitten crab is one of the world's 100 worst invasive species, and has spread through much of Europe and North America. Its invasion history and evolution in the introduced range are poorly understood. For example, a cryptic introgression of Japanese mitten crabs has been reported for part of its range, but its extent and consequences for the invasive potential of mitten crabs remains unknown. We conducted low coverage whole genome sequencing (lcWGS) on 12 populations of Chinese mitten crabs across Europe. In combination with data from the native range, first experimental and historical sequencing data, we reconstruct the invasion history, patterns of connectivity and search for signatures of local adaptation.

19 - Hepatospora eriocheir infection affects the fitness of adult Chinese mitten crabs in their non-native range

Heleen Keirsebelik[1], Christine Ewers[2], April Grace Opinion[1], Magdalena Stachnik[3], Monika Normant-Saremba[4], Jonas Schoelynck[1]

[1]University of Antwerp, [2]Kiel University, [3]National Veterinary Research Institute of Poland, [4]University of Gdańsk

For many invasive crustaceans, including the Chinese mitten crab (*Eriocheir sinensis*), the prevalence and impact of parasites in their introduced range remain largely unexplored. The microsporidium *Hepatospora eriocheir* was recently detected in mitten crabs across Europe, yet little is known about its physiological effects on its host. In this study, we experimentally investigated the influence of *H. eriocheir* infection on physiological biomarkers in adult mitten crabs collected from rivers in Germany and Belgium. We assessed metabolic rates (routine and maximum metabolic rate, aerobic scope), haemolymph glucose and lactate levels, and lipid content in the hepatopancreas. Infection prevalence reached 27% in adult Chinese mitten crabs from the Scheldt population (Belgium) and 38% in individuals from the Elbe population (Germany). Infected individuals showed a significantly reduced maximum metabolic rate and aerobic scope, while the routine metabolic rate remained unaffected. Glucose levels were lower in infected crabs both at rest and post-exercise, which indicates that energy reserves have dropped, whereas lactate levels showed no significant difference. The lipid content in the hepatopancreas was also reduced, likely due to the direct exploitation of the host's resources by the parasite and the damage caused to the hepatopancreatic tissue. Together, these patterns indicate an impaired energy metabolism, which may hamper energetically demanding activities such as migration and reproduction. The Chinese mitten crab is a catadromous species, and as the examined crabs were at the life stage when they commence a long-distance migration for their single reproductive event, infection by *H. eriocheir* may compromise their ability to complete this migration and successfully reproduce.

228 - What's on the menu in coastal British Columbia: Investigating trends in Carcinus maenas diet

Milène Wiebe[1], Kyle Artelle[2], Stephanie Green[1]

[1]University of Alberta, [2]State University of New York College of Environmental Science and Forestry

Understanding the diet of invasive species in their invaded range reveals ecological impacts through both predation and competition, which can vary across habitats, regions, and invasion timelines. On the West Coast of Canada, the European green crab (*Carcinus maenas*) is a marine invasive species considered to be an opportunistic omnivore, impacting unique intertidal communities along the coast. However, with a lack of diet studies within the region, managers rely on studies performed in other established ranges to infer impacts which could result in overlooked impacted species. In collaboration with three communities engaged in *C. maenas* removal programs along the West Coast of Canada, we developed a diet study to investigate regional and temporal variation in green crab diets. Once *C. maenas* were received from

collaborators, crabs were sexed and measured to account for differences that may arise due to morphology (i.e. size and sex). Stomachs were dissected with contents visually analyzed and identified to the lowest taxonomic rank possible. Mid- and hind-guts were also removed and underwent DNA metabarcoding alongside stomach contents to determine species that could not be visually identified due to digestive state. While DNA metabarcoding results are still pending, visual analysis reveals a high frequency of occurrence of crustaceans, specifically *Hemigrapsus*, alongside bivalves and marine snails. While these results are in line with other *C. maenas* diet studies, managers will be able to use the region-specific results of this study to prioritize control efforts. As this is also the first *C. maenas* diet study on the West Coast of Canada, this study is filling a knowledge gap that may be used to compare prey species at a global scale. Finally, by assessing diets between invasion timelines, we gain insight into how *C. maenas* impacts may evolve over time across established areas.

E4 - Weed Watchers: Tracking, Tackling, and Preventing Plant Invasions

226 - Developing Aerial Surveillance Methods for detecting Water Hyacinth (Pontederia crassipes)

Amber Riner[1], Jonathan Glueckert[1], James Leary[1], Benjamin Sperry[2], Gregory Macdonald[1]

[1]University of Florida, [2]US Army Corps of Engineers

Water hyacinth is a fast-growing, floating aquatic invasive plant that threatens biodiversity and impedes navigable water body and flood control across the southeastern United States. Traditional management involves frequent monitoring and herbicide application from airboats, but missed plants can lead to reinfestation. Surveys using Unoccupied Aerial Systems (UAS) provide an efficient alternative for large-scale monitoring, and deep learning can enhance plant detection in aerial imagery. In this study, we evaluated three deep learning models UperNet, Unet, and DeepLabv3 for water hyacinth detection using RGB imagery. To assess model transferability, we evaluated trained models under three conditions: (1) on datasets from the same water body and time period as the training images, (2) on datasets from the same water body but a different season than the training images, and (3) on datasets from a different water body but the same time period as the training images. All models exhibited higher recall than precision, indicating strong plant detection capabilities but frequent misclassifications. DeepLabv3 outperformed other models on images similar to the training data (69% accuracy), Unet outperformed other models on conditions different than the training set (> 57 % accuracy), and UperNet exhibited the lowest accuracy. These findings highlight the potential of UAS and deep learning for water hyacinth surveillance, offering a scalable approach to invasive species management.

118 - The enemy of my enemy is my friend? The use of rhododendron and nettle extracts for the control of invasive Japanese knotweed.

Aidan Clancy[1]

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The propagation of plants throughout the world is not a new phenomenon, having been undertaken since at least the 1500's and potentially earlier. A select number of these plants have established themselves as invasive in new locations. Japanese knotweed is floral invasive alien species (IAS), spreading beyond the Sinosphere to other regions, including much of North America, Europe, and the UK. Previous studies have projected impacts of this species in the UK alone at several million pounds per annum, serious ecological consequences on native wildlife. Set against a backdrop of increasing reluctance to rely on conventional herbicides for management, the scientific community has been exploring novel methods to manage IAS. This study investigated how extracts from the leaves of stinging nettles (*Urtica dioica*) and pontic rhododendron (*Rhododendron ponticum*), suspended in both water and isopropanol impacted several developmental metrics in Japanese knotweed plants. We found that extract type consistently and significantly impacted all developmental metrics, with solvent, concentration, week number and multifactorial interactions between the above, regulating the effects. These findings suggest that the usage of allelochemicals to inhibit the development of Japanese knotweed is viable and allelopathy could be a novel management tool for controlling the spread of invasive species.

126 - Desiccation tolerance of giant salvinia (Salvinia molesta) in simulated boat trailer conditions

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The continued spread of giant salvinia (*Salvinia molesta*) threatens the ecology and utility of water bodies worldwide. Boat traffic has been shown to be a major vector of aquatic invasive species. However, the potential for giant salvinia survival under boat trailer conditions is currently unknown. Therefore, experiments were conducted to evaluate the viability of giant salvinia following desiccation events under simulated boat trailer conditions. Giant salvinia was subjected to four environments: open-air, plastic boat bunks, wood boat bunks, and carpeted boat bunks for exposure times that ranged from 12 hours to 16 days. After predetermined time intervals, plants were placed into recovery mesocosms, and moisture loss and survival were recorded. Data from two separate experimental runs were fitted to a log-logistic model and regressed over exposure time. Effective times (ET) to result in 50% (ET_{50}) and 90% (ET_{90}) mortality were estimated from regression models. In open-air conditions, plants did not survive

following 12 hours of desiccation. Based on ET_{50} values in run 1, plants on plastic boat bunks survived 1.5 to 1.9 times longer than on wood or carpet boat bunks, respectively. However, no differences in ET_{50} values between boat bunk types were observed in run 2. Regardless of run or environment, 100% mortality was observed after eight days of exposure. These results indicate that giant salvinia may require at least eight days of desiccation in boat-trailer conditions to prevent spread to new systems. This has critical implications for frequent boaters, and we suggest that boats are left out of water for over a week after contact with giant salvinia to ensure full mortality of the species and prevent further invasion.

C4 - Special Session: Cross-system Comparisons and Knowledge Sharing for the Management of Invasive Salmonids IV

58 - Risky Refugia? Using acoustic telemetry and underwater video to characterize effects of Aquatic Invasive Species on juvenile Atlantic salmon (Salmo salar) within thermal refugia

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Cold-adapted fishes are increasingly overlapping with warm-adapted invasive species as rivers warm under climate change. Consequently, cold-adapted fish, such as Atlantic salmon (*Salmo salar*), must respond to rising temperatures and also contend with novel predation/competition pressures from invasive species. While cold-water refugia buffer heat-stress effects of high temperature events, juvenile fish that aggregate in them may increase their exposure to warm-adapted invasive predators, like smallmouth bass (*Micropterus dolomieu*), and established introduced competitors, like brown trout (*Salmo trutta*). Thus, whether salmon can maintain fitness under both warming rivers and invasive pressures depends on their behavioral flexibility to balance thermoregulation through cold-water refugia use with minimizing predation/competition risks. Here, we provide the first assessment of the use of cold-water refugia by invasive species and test whether juvenile Atlantic salmon adjust their behaviors under combined elevated temperatures and invasive species interactions in the Margaree River, Cape Breton, Canada. Using a Vemco positioning acoustic array in one of the smallest study areas ($80m^2$) reported for this technology, we tracked habitat use (e.g., total space, activity changes) of acoustically tagged juvenile Atlantic salmon, and adult smallmouth bass and brown trout. Pairing these data with observations of behaviors (e.g., predation or competition attempts, use of in-stream cover) from underwater video, we evaluated how invasive species interact with salmon within refugia under high and low heat-stress events, and how salmon altered refugia use in response. We further measured salmon fitness metrics (i.e., weight, length, growth rate)

across sites with- and without access to refugia with varying invasive pressure to assess whether cold-water refugia offered fitness advantages. Our findings reveal how juvenile Atlantic salmon behaviorally cope with warming rivers and invasive species. This information can guide the design and management of cold-water refugia to support behavioral responses which reduce salmon vulnerability to invasive species as climate change persists.

175 - Kinship analysis and otolith geochemistry to track the homing of invasive Pink salmon

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Pink salmon (*Oncorhynchus gorbuscha*) are rapidly expanding across the North Atlantic and Arctic, raising concerns for native fishes and ecosystems. Understanding whether invasive populations exhibit natal homing is critical, as homing is a prerequisite for local population establishment and long-term persistence. Here we present a case study from northern Norway as a proof of concept of using complementary genetic and geochemical tools.

Kinship analysis of spawners collected in 2019 identified half- and full-sibling pairs within rivers at frequencies higher than expected by chance, consistent with natal homing. In parallel, strontium isotope ratios ($^{87}Sr/^{86}Sr$) from otoliths of juvenile and adult Pink salmon sampled in Kongsfjordelva provided geochemical confirmation of individuals returning to their natal river. While most returning adults displayed signatures inconsistent with Kongsfjordelva, a subset matched local isotope baselines, providing evidence for homing.

Our findings provide the first direct evidence of homing behaviour in invasive Pink salmon in northern Norway and demonstrate the utility of combining kinship and geochemical approaches to disentangle the invasion dynamics of Pink salmon. Although sample sizes were limited and methods were applied to different individuals, the complementary evidence highlights both the potential for population establishment and the need for systematic monitoring. Establishing a comprehensive isotopic baseline and expanding genetic sampling across rivers will enable robust estimates of homing rates, dispersal, and straying.

This work underscores how cross-system methodological advances can inform management. Genetic kinship tools provide scalable screening for homing signals, while geochemical tracers yield definitive natal origin assignments. Together, these approaches can guide management by identifying rivers at risk of local establishment, evaluating the efficacy of control measures, and anticipating spread into vulnerable watersheds. As Pink salmon continue to expand their range, integrating such tools across ecosystems will be essential to safeguard native salmonids and inform coordinated international responses.

63 - Gasperbro or Gasperfoe? Investigating the Relationship Between Gaspereau (Alosa spp.) Migration and Aquatic Invasive Predators to Assess Impacts on Atlantic Salmon Parr (Salmo salar) Using Behavioural Transcriptomics

Holly Mosco[1], Kristen Cyr[1], Isabelle Tormasi[1], Daniel Heath[1], Christina Semeniuk[1]

[1]University of Windsor

Juvenile Atlantic salmon (*Salmo salar*) face increasing stress from rising temperatures and increased predation from invasive predators. These stressors can induce physiological stress and produce concomitant behavioural responses that conflict; for instance, heightened thermal-stress behaviours (i.e., erratic movements) while attempting to remain inconspicuous (via reduced activity). Given that juvenile salmon inhabit riverine systems, they also interact with other diadromous fishes that potentially serve as prey buffers or increase predation risk through apparent competition. This study examines how juvenile salmon molecularly and behaviorally respond to interacting thermal stress and predation stress by invasive smallmouth bass (SMB; *Micropterus dolomieu*), and how these responses shift with juvenile gaspereau (*Alosa spp.*) migration. Using a combination of tools and techniques to track ecosystem-wide changes, we sampled salmon parr across three sites in the Margaree River, Nova Scotia, Canada, at three different timepoints that differed in temperature, SMB presence, and gaspereau (alternative prey) abundance. This design captured three treatments: 1) cold temperature and high predation (no alternative prey), 2) high temperature and low predation (alternative prey), and 3) warm temperature and sustained low predation (prolonged exposure to alternative prey). Gill tissue and mucus were collected from eighty-one salmon to evaluate transcriptomic expression of five thermal-stress genes and fifteen general stress-response genes (i.e., predation stress). Before tissue sampling, salmon underwent streamside behavioural trials to examine responses to novel environmental conditions and simulated predator attacks. This pairing of molecular tools with assays that evaluate behavioural responses to multiple stressors reveals how invasive predators and rising temperatures interact to affect salmon's ability to respond and adjust to environmental change. Taking a multispecies holistic approach to study impacts of invasive species can also improve management strategies by implementing whole-ecosystem approaches, including time-specific SMB removals in relation to gaspereau migration, or ensuring gaspereau maintain stable populations to remain effective prey buffers.

199 - Autonomous eDNA Monitoring for Early Detection of Invasive Pink Salmon in Icelandic Rivers

Erik Karlsson[1], Lars Magnus Wulff Jacobsen[1], Thorleifur Ágústsson[2], Einar Eg Nielsen[1]

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Invasive species threaten biodiversity conservation and restoration efforts. Beyond their ecological and economic impacts, many also facilitate the emergence and spread of infectious diseases, affecting wildlife and potentially humans. In Europe, many of currently listed threatened species are affected by invasive alien species. Rapid detection and monitoring tools are therefore essential to mitigate their spread and impact.

Pink salmon, *Oncorhynchus gorbuscha*, native to the Pacific Ocean, were introduced to the Atlantic by the Soviet Union in 1956 and have since spread rapidly across northern Europe. Their numbers are increasing in countries including Norway, Sweden, Denmark, Finland, the UK, Ireland, Iceland, the Faroe Islands, and Greenland. In non-native rivers, pink salmon form large spawning aggregations, potentially introducing novel pathogens and parasites to vulnerable endemic species such as Atlantic salmon (*Salmo salar*) and Arctic charr (*Salvelinus alpinus*). They also compete for food and spawning grounds and may disrupt the natural behaviour of native fish through aggression, leading to negative impacts on local fish populations.

To address this, we evaluated the use of automated environmental DNA (eDNA) sampling for early detection of pink salmon in Icelandic rivers. We deployed a robotic Environmental Sample Processor (ESP), developed by MBARI, in Eyjafjarðará, a river in northern Iceland, during the 2025 spawning season. The ESP system autonomously collects and filters water samples, extracts DNA, and conducts internal qPCR analysis targeting pink salmon, brown trout, and Arctic charr. It also preserves samples for potential downstream metabarcoding analysis.

Here we will present results demonstrating the potential of autonomous eDNA monitoring as an early warning system for pink salmon invasion. We discuss the opportunities and limitations of this approach for near real-time surveillance of invasive species in Arctic and sub-Arctic freshwater ecosystems.

A4 - Shell Shocked: The Invasive Mollusc Takeover

50 - Invasion dynamics and impact of non-native molluscs in the Great Lakes

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The abundances of non-native species in invaded ecosystems can range from negligible to extremely high, and their effects include competition with and predation on native species, habitat alteration, and the transmission of diseases. Currently, 16 non-native mollusc species are established in the North American Laurentian Great Lakes, including 14 exotics introduced from other continents and two North American transplants. These species represent 52% of the

diversity of all free-living non-native benthic invertebrates in the lakes. Early introductions (*Bithynia tentaculata, Pisidium moitessierianum, P. amnicum,* and *Valvata piscinalis*) arrived in the 19th century via solid ballast, whereas recent introductions (*Dreissena polymorpha, D. rostriformis bugensis*, and *Potamopyrgus antipodarum*) were primarily transported in ballast water. Most exotics originated from Eurasia (62%) or Asia (19%), with one species from New Zealand. Mollusc densities vary greatly from rare (e.g., *Corbicula fluminea* and *Radix auricularia*) to extremely high (*D. r. bugensis*). Non-native mollusc diversity is highest in shallow Lake Erie and lowest in Lake Huron. The ecological impact of exotic species is largely proportional to biomass, ranging from negligible (e.g., sphaeriids, *C. fluminea*, and *Radix auricularia*) to substantial impacts from *D. r. bugensis*, which has transformed entire ecosystems in the four lower Great Lakes. We also examine potential future invaders (e.g., *Limnoperna fortunei*) and project their likely distributions and impacts. Ongoing and projected temperature increases will likely enhance conditions for currently restricted species and increase the risk of new introductions from warmer regions, further accelerating ecosystem change.

48 - Multiple invasions decimate the most imperiled freshwater invertebrates

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Invaders can have devastating impacts on freshwater ecosystems, but these impacts can subside over time as ecosystems “adapt” to the invasion of new species. We analyzed changes in species composition and density of molluscs in Oneida Lake (New York, USA), one of the best studied North American lakes, based on detailed surveys conducted in 1915-17, 1967-68, 1992-95, 2012, and 2022-23, and on annual benthic surveys from 2009 through 2023. Eutrophication and habitat alteration after 1920 resulted in a 25% decline in species richness and a 95% decline in the density of native gastropods by 1967, while species richness of unionids did not change. The arrival of zebra mussels in 1991 and quagga mussels in 2005 was associated with an increase in species richness and density of native gastropods and an extirpation of unionids by 1995. However, an invasion by the round goby in 2013 led to a significant decline across all gastropod families, disproportionately impacting soft-shelled and shallow-dwelling species, while other species, including invasive dreissenids, partially recovered 3 to 7 years after the goby invasion. This mollusc recovery was depth-related and was limited to deeper areas. Altogether, molluscan communities were sensitive to ecosystem change and invasive species, with some invaders offsetting the impacts of eutrophication and habitat alterations. Overall, the impacts of multiple stressors resulted in declines in species diversity and density of native gastropods and extirpation of unionids, *Sphaerium* spp., and *Musculium* spp. Dreissenid mussels currently comprise 89% of the density and 99% of the wet biomass of all molluscs in Oneida Lake. While individual stressors have taxon-specific and sometimes

positive impacts, eutrophication and species invasions have collectively decimated the native mollusc community over the past century.

93 - Influence of patch dynamics of dreissenid mussels and round goby predation on benthic communities

Ty Colvin[1, 2], Anthony Ricciardi[1], Zofia Taranu[2]

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The round goby (*Neogobius melanostomus*) and dreissenid mussels (the zebra mussel *Dreissena polymorpha* and the quagga mussel *Dreissena bugensis*) commonly co-occur in their invaded ranges in western Europe and in the Great Lakes-St Lawrence River basin. Invasions by these species can transform benthic communities, but in contrasting ways. The round goby is a generalist predator that can reduce benthic invertebrate diversity and abundance. Dense dreissenid mussel colonies enhance the local abundance and richness of small invertebrates by providing nourishment (biodeposits) and structurally complex habitat (mussel beds); at the same time, they reduce larger benthic invertebrates through biofouling and competition for space. In a field experiment using artificial substrates, we tested how dreissenid mussel shells provide refuge from round goby predation and how these invaders interact to restructure epibenthic communities in the upper St. Lawrence River. We deployed bricks with attached empty mussel shells arranged in various topographies (i.e., no mussels, single large patch, single small patch, chequered patches), with and without goby exclusion cages. The bricks and cages were deployed in shallow water and left undisturbed for three months to allow colonization until retrieval. All individual invertebrates were collected from the bricks, processed through a 500µm sieve, and preserved in 75% ethanol for identification. Macroinvertebrate community data and taxonomic and functional diversity metrics were compared between treatments. Our results demonstrate that dreissenid mussel patch topography affects macroinvertebrate diversity by providing structurally complex habitat. Overall, the results suggest that patch dynamics (e.g. driven by disturbance) mediate the influence of dreissenid mussels on local diversity.

237 - Tracking feral Pacific oysters in Irish waters

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In his travels through Japan between 1775 and 1776, Carl Peter Thunberg, a student of Linnaeus, came across a large edible oyster that he described as new to science. The natural range of this Pacific oyster, *Magallana gigas*, stretched across Japan, reaching as far north as Hokkaido, where the Siberian currents bring about snow and sub-zero temperatures for several

months per year. As it was mistakenly believed that it would be too cold for this species to reproduce in NW Europe, Pacific oysters were imported to be cultivated in the 1970s and 80s. As a result, feral Pacific oyster reefs are now widespread throughout Europe. To study, in detail, what determines where settlement and reef formation takes place, 172 intertidal sites in the Republic of Ireland were surveyed in 2024 and 2025. Additionally, 45 surveys conducted since 2009 in bays with subtidal shellfish fisheries were considered. The revealed patterns of feral oyster distribution may be attributed to extent of diploid and triploid oyster farming, to harbours, to bay residence times, and to the availability of shelter from currents and waves. Feral oysters were not recorded in every bay with intensive shipping or oyster farming, however, and they were also found in areas with only limited human activity. In any case, establishment hotspots with several generations of oysters, seemingly play an important role in their proliferation. It became apparent when studying over 700 feral oysters that particular primary and secondary settlement substrates may determine the locations of these hotspots. For example, Pacific oysters have a clear tendency to settle on other Pacific oysters, even at sites with availability of many other habitat forms like shells, pebbles, and boulders. The insights gained here may help identifying strategies to mitigate impact and further spread of Thunberg's giant oyster, both within Ireland and internationally.

D4 - Special Session: Transcending Boundaries Between The Science and Management of Ships’ Ballast Water and Biofouling I

231 - Assessing the impact of ballast water management on zooplankton transport in ballast tanks.

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Ballast water is a major unintentional transport mechanism for aquatic organisms worldwide. Over the last 20 years, through regulations on international and national scales, there have been significant management efforts to stop the spread of organisms via this mechanism. Initially, open-ocean exchange was implemented to both reduce organism concentrations at discharge and replace coastal organisms with oceanic organisms. At the same time, onboard ballast water management systems (BWMSs) capable of treating ballast water prior to discharge were developed and certified for use on the global commercial fleet. It has been

almost 10 years since the introduction of onboard BWMSs in commercial usage. We have seen rapid installation and use of these systems on vessels arriving to US ports in the last 5 years.

In this study, we analyse zooplankton concentration data (≥50µm organisms) collected from ~700 ballast water tanks to assess effectiveness of these management methods in reducing concentrations prior to discharge. We collected samples directly from tanks to compare zooplankton concentrations present in unmanaged, exchanged and treated ballast water.

As management has been applied to ballast water (i.e. exchange and treatment), we observe decreases in the median concentration of organisms present prior to discharge. With exchange, most striking was a reduction in frequency and magnitude of high-density discharge events. With onboard treatment systems, we observed median zooplankton concentrations <1 organism/m^3, a value three orders of magnitude below exchanged and untreated samples.

This study highlights the efficacy of management regulations in reducing overall discharge concentrations. However, we still observed high density discharges, which could be for multiple reasons (e.g. high uptake concentrations, challenging port conditions). We recommend ongoing sampling programs to achieve a robust understanding of ballast treatment performance, including potential reasons for these high-density observations, and providing feedback to vessels on approaches to maximise efficacy of their BWMS.

227 - Lessons learned from research on efficacy of ballast water management systems in Canada

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Many international commercial ships are now using ballast water management systems (BWMS) to treat their ballast water to minimize the introduction and spread of potentially harmful aquatic organisms and pathogens following the entry-into-force of the International Convention for the Control and Management of Ships' Ballast Water and Sediments.

A comprehensive research campaign was conducted during 2017-2025 to evaluate the performance and efficacy of BWMS across the four Canadian coasts (Pacific, Atlantic, Arctic and Great Lakes). Results from 80 sampling events show variability in rates of meeting the Regulation D-2 standard for the largest organism size class, while paired uptake and discharge samples show large reductions in the abundance of living organisms even when the standard is not being met. This talk will examine different patterns and drivers in the data and reflect on challenges and lessons learned in the management of ballast water.

245 - Evaluating the efficacy of ballast treatment plus exchange in enhancing prevention of species introductions in Canadian Arctic waters

Kimberly Howland[1], Sarah Bailey[2]

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Shipping activity has increased dramatically in the Canadian Arctic since the mid-2000's due to increased accessibility and interest in this region by various sectors including industry, tourism and fisheries, with potential for impacts to sensitive Arctic marine species and habitats. Ballast water discharge from ships has been identified as a primary source for aquatic non-indigenous species (NIS) introductions globally. While regulatory updates have led to recent changes in ballast water practices with ships now using ballast water management systems (BWMS) to remove live organisms, there is uncertainty about their efficacy in Arctic environments. We describe a collaborative study on the performance of ballast water management systems (BWMS) at an established Arctic port on northern Baffin Island, Nunavut, Canada. The study emphasizes co-development of research plans via community input and providing training for Inuit youth from affected northern communities to build local capacity for ballast sampling. Ballast water was filtered using a sampling device (Satake Ballast Catch) to collect large (≥ 50 µm) size class organisms, while additional unfiltered (raw) water was collected to enumerate the small (≥ 10 to < 50 µm) size class organisms from 30 ships over a period of 3 years. Additionally, samples were collected to assess water quality parameters (salinity, temperature, total residual oxidants) and for detailed taxonomic identification using microscope and molecular methods. Preliminary results will be shared to help inform discussions on future policy and monitoring efforts for preventing introduction and spread of marine NIS in Arctic ecosystems globally. The study provides the first evaluation of risk for NIS introduction via treated and exchanged ballast water discharge in the Canadian Arctic and evaluates new sampling methods that can be used for future ballast water monitoring in the region.

E5 - Rooting Out Trouble: Progress in Invasive Aquatic Plant Bio-Control

16 - The first biological control of two invasive plant species in the Netherlands

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The invasive aquatic plants *Crassula helmsii* and *Hydrocotyle ranunculoides*, together with *Fallopia japonica* on land, continue to cause major challenges in Dutch freshwater systems. Traditional control methods are often costly, disruptive and largely ineffective in the long term, especially in sensitive habitats. To address this, the Netherlands has taken steps to introduce classical biological control as a complementary management tool.

This contribution focuses on the process of obtaining approval to release biological control agents for invasive alien plants in the Netherlands. Using Japanese knotweed as an early example and comparing the pathways for *C. helmsii*, by using the gal forming mite *Aculus crassulae* (Eriophyidae) as a control agent, and *H. ranunculoides*, by using the weevil *Listronotus elongatus* (Curculionidae), we outline the regulatory requirements, the engagement with national authorities, and the collaborative role of Dutch waterboards and research institutes in shaping this process. Both biological control agents were released in the summer of 2025 at two separate infested sites in the Netherlands.

The Netherlands represents the first EU country to approve and implement the release of these biological control agents against invasive aquatic plants. Beyond the scientific basis of host-specificity testing and risk assessment, this effort demonstrates how cross-border knowledge exchange, stakeholder collaboration, and EU regulation (1143/2014) can be aligned to enable safe, nature-based solutions. Finally, we reflect on potential future targets, opportunities for wider European application, and the importance of international cooperation in addressing invasive alien species.

83 - Can weevils contribute to the sustainable control of floating pennywort in the UK and Europe?

Djamila Djeddour[1], Suzy Wood[1], Corin Pratt[1]

[1]CABI

Introduced through the ornamental aquatic trade in the 1980s, floating pennywort (*Hydrocotyle ranunculoides*, Araliaceae) was quickly found naturalised and has become one of the most rapidly spreading and costly aquatic weeds in the UK and Northwest Europe.

After a decade of safety testing, the Argentine weevil *Listronotus elongatus* (Curculionidae), a specialist natural enemy of floating pennywort, was granted ministerial approval for release in England in late 2021. Field trials have since been undertaken across 24 sites with varying habitats in England. In 2025, following further research, the Dutch regulatory authorities also approved release in the Netherlands and parallel field trials are being conducted at 2 sites, in collaboration with Dutch waterboards.

Seasonal monitoring at each site for weevil persistence, spread and impact, together with temperature analysis, is helping to build our knowledge of the weevil's establishment potential and climatic tolerance. Population persistence and growth year on year, ideally without the need for long term supplementation, is key to the sustained spread and impact of the weevils on floating pennywort infestations in the release areas and beyond. Successful overwintering and establishment have been achieved across many sites in the south of England and up to the Midlands, alongside significant damage. Establishment in the north of England is possible but more climatically challenging. An all-sector approach to the strategic management of floating

pennywort across affected catchments, including the use of biological control, is helping to coordinate efforts and share best practices. The results of the field trials are presented here and the opportunities for wider adoption in affected territories are discussed.

208 - Biocontrol across borders: the use of Aculus crassulae as a biocontrol agent against Crassula helmsii, from the UK to continental Europe

Sonal Varia[1], Suzy Wood[1], Corin Pratt[1], Janneke van der Loop[2], Elizabeth Pendlington[1]

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Classical biological control has been successfully implemented as a sustainable management tool for invasive plants for over a hundred years. Over the past decade, the UK has become a leader in utilising this method of control in Europe with four biological control agents released targeting four weeds including the invasive aquatic plant, *Crassula helmsii*.

Originally introduced to Europe in 1911 as a pond plant, *C. helmsii* is now naturalised in parts of Northwest Europe and is spreading. Following extensive safety testing, *Aculus crassulae,* a host specific, gall-forming mite from Australia, was approved for release as a biological control agent in England and Wales in 2018. Since then, the mite has been released across many sites, and the release strategy has been optimised so that populations have successfully overwintered and spread at the most suitable release sites. In 2025, Dutch authorities approved the release of *A. crassulae* at two trial sites in the Netherlands - the first time classical biological control has been used against *C. helmsii* outside of the UK. To support the application, supplementary research was carried out including host-range testing of additional species of Dutch importance, susceptibility testing and genetic analysis of local *C. helmsii* populations. The mites were finally released in September 2025 marking a major step forward in regional efforts to control *C. helmsii* using biological methods. A review of the progress made in the UK and the Netherlands will be presented here.

191 - First steps across the pond: initiating a biocontrol programme for the North American waterweeds (Elodea canadensis and E. nuttallii) in Great Britain

Suzy Wood[1], Norbert Maczey[1], Corin Pratt[1]

[1]CABI

The North American waterweeds *Elodea canadensis* and *E. nuttallii* are both problematic invasive non-native species in waterbodies across Britain and Ireland. Introduced as aquarium plants - *E. canadensis* in the mid-1800s, and later *E. nuttallii* in the mid-1900s - they have since become widespread and abundant across Europe. Their dense submerged mats can prevent

access to water for navigation and recreation and impede drainage. Ecologically they have been found to impact other freshwater plants, microalgae and invertebrate communities.

With physical removal being the only management option currently available, these *Elodea* species were identified during a stakeholder workshop as potential targets for biological control in Great Britain. Funding from Natural England has allowed CABI to investigate the feasibility of this management approach, including an exploration of the natural enemies found on the plants in the native range. Field surveys to Ontario, Canada have so far revealed relatively few natural enemies, but a stem-mining fly (*Hydrellia* sp.) has been discovered across multiple sites and is being held in CABI's quarantine facility in the UK for identification and testing. Natural enemy surveys to other climatically suitable parts of the native range of North America are planned, and may provide further potential towards the sustainable management of *Elodea* spp. The results of these surveys and any prospective biocontrol agent testing will be presented here, and scope for the future of the project discussed.

B5 - Crab Tracks: Managing Invasions from Pathways to Impacts

140 - Managing unknown pathways: Risk assessment of smuggled crabs in Norway

Gaute Velle[1], Paul Ragnar Berg[2], Johanna Järnegren[3], Martin Malmstrøm[4]

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Risk assessing non-native species is increasingly difficult as emerging pathways (live food and pet trade, transnational commerce, mixed cargo) and rapid environmental change expand import and establishment windows. Evidence is often sparse or biased, propagule pressure is uncertain, and species identifications can be wrong. Also, pathogen loads, hybridisation risks, and interspecific interactions are poorly known. These uncertainties complicate hazard identification, likelihood estimation, and the translation of science into policy.

We outline a practical approach that extends the Environmental Impact Classification for Alien Taxa (EICAT) with pathway-focused risk analysis, structured expert judgement, and confidence scoring. Key steps are to (i) trace feasible introduction routes from trade demand to release/escape; (ii) combine likelihood and impact magnitude under current and future climate scenarios; (iii) distinguish organism impacts from pathogen impacts; and (iv) make uncertainty transparent.

As a case study, we apply this framework to live-imported crabs intended for human consumption in Norway. Live crabs have beed confiscated at the Norwegian border after smuggled attempts, indicate market demand and a potential introduction pathway. The

assessment highlights elevated risk for mitten crabs (*Eriocheir* spp.) via competition, predation, and pathogen transmission, while other taxa range from medium to low risk depending on climate tolerance, life history, and trade volume. Outcomes depend as much on pathway feasibility and operational biosecurity as on species traits.

Safe introductions of live seafood should include: (1) environmental risk assessments, (2) pathway management (escape-proof transport/holding, cold storage, clear labelling, prohibition of release, rapid disposal protocols), (3) quarantine with pathogen screening, (4) monitoring and early detection around hotspots for introduction and consumption, and (4) adaptive risk management so measures can tighten or relax as evidence evolves.

196 - Watching Crabs with AI: Dial and Seasonal Behaviour and Abundance of the Invasive Percnon gibbesi on Mediterranean Rocky Shores

Silvia Paoletti[1], Hilmar Hinz[1], Sara Muñiz[1], Nuria Marbà[1], Andrea Anton[1]

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Invasive herbivore species pose a significant threat to marine ecosystems by overgrazing algae, competing with native species, and altering habitat structure, often leading to biodiversity loss. The invasive crab *Percnon gibbesi*, first recorded in the Mediterranean in 1999, has since spread across the basin. Despite its wide distribution, data on its density, ecology, and behaviour remain scarce. To address this gap, we developed a passive underwater monitoring system using time-lapse cameras to record *in situ P. gibbesi* activity and abundance without disturbance. Six camera systems were systematically deployed across a rocky shore bay throughout 2025, photographing standardized 1.5 m² plots for 24-hour cycles across seasons. Each deployment was paired with traditional visual surveys and the study area was 3D mapped using photogrammetry to link crab abundance to habitat features such as boulder size and algal cover. Crabs were automatically detected and counted in the images using a trained AI model, with abundances estimated as maximum number of individuals observed per frame over 30-minute intervals. These camera-based estimates were compared with the paired snorkelling visual counts, allowing the calculation of a conversion factor between methods. Our results revealed clear patterns of daily behaviour coupled to light intensity, temperature and algal cover seasonal fluctuations, and higher abundances than previously reported. This study demonstrates the value of AI-assisted, low-effort passive monitoring to track invasive species, improves the accuracy of density estimates and identifies peak activity times critical for survey design. Ultimately, these findings provide insights into the ecology of *P. gibbesi*, offering the first essential basis for future studies on its potential ecological impacts and paving the way toward informed management strategies across the Mediterranean.

71 - Hydrodynamic investigations to optimize trap design for the management of Chinese mitten crabs

Sengdavanh Thepphachanh[1], Torsten Heyer[1], Nick De Meersman[2]

[1]TUD Dresden University of Technology, [2]Flanders Environmental Agency

The Chinese mitten crab (*Eriocheir sinensis*) is among the most damaging aquatic invasive species in the world, with considerable ecological and economic impacts. As part of the EU-Interreg project “Clancy”, specially designed traps have been deployed in various water bodies of the North Sea region to both monitor and remove crab populations. To improve the efficiency of such traps, this study investigates their hydraulic performance using a combination of three-dimensional CFD modeling (OpenFOAM) and scaled physical flume experiments.

Both numerical simulations and physical experiments revealed that upstream-facing trap with its opening directed against the flow can create recirculating zones and eddies at the entrance. These conditions are likely to reduce catch efficiency. Building on these insights, modified trap configurations incorporating ramps to redirect the approach flow were tested. Preliminary results show that such adaptations improve flow distribution at the entrance, reducing backflow and creating conditions more favorable for crab entry.

By combining numerical and physical modeling, this research provides transferable design principles for optimizing hydraulic conditions in mitten crab traps. The findings offer guidance for improving trap implementation across diverse water bodies. This work illustrates how integrating hydraulic engineering and ecological management can advance the development of effective tools for mitigating the spread and impact of aquatic invasive species.

53 - What is the effect of Chinese mitten crab traps on the ecological integrity of small watercourses?

Pieter Boets[1], Machteld Bats[1], Heleen Keirsebelik[2], Jonas Schoelynck[2]

[1]Provincial Centre of Environmental Research, [2]University of Antwerp

The Chinese mitten crab (*Eriocheir sinensis*) is one of the world 100 most alien invasive species. For over 100 years it has been present in western Europe, but the last years its numbers have been increasing causing nuisance to people and affecting the environment. Within the EU-Interreg project “Clancy”, specially designed traps have been installed in various water bodies of the North Sea region to both monitor and stops migration of crabs. Since 2022 the Provincie of East-Flanders (Belgium) has started to implement Chinese mitten crab traps to stop upstream migration of the species and in this way interrupt in the life cycle of Chinese mitten crabs. In addition, the goal of the traps is to have pest free zones and consequently to improve the ecological water quality. In this respect, biological monitoring of macroinvertebrates and aquatic plants was performed to assess the effect of three traps. Since the installation, monitoring sites upstream of the trap were sampled to asses changes in community

composition over time. Additionally, historical data pre-trap installation is available. The first results indicate a positive effect on macroinvertebrate communities although several other aspects such as water quality and changing environmental conditions influence their occurrence. Long-term monitoring will be needed to deduct clear trends in community changes. Next to the monitoring of the ecological water quality an *in situ* experiment with caged Chinese mitten crabs was run to assess the effect of the crabs on the macroinvertebrates. Preliminary results indicate that certain crab density thresholds influence the occurrence and diversity of the macroinvertebrate community. The experiment will be expanded in the spring of 2026 to check the robustness of the results and determine the crab densities affecting macroinvertebrates.

103 - On the uncertainty of the economic costs caused by Chinese mitten crabs and how public awareness can help with the introduction of management systems

Björn Suckow[1], Mayleen Schlund[1]

[1]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI)

The Chinese mitten crab (*Eriocheir sinensis*) is a significant invasive species in Europe. First discovered in Germany's Aller River in 1912, it has since spread across several European countries, including all those bordering the North Sea. Its presence in various river systems has led to substantial economic costs, impacting fisheries, sport angling, infrastructure and biodiversity. Our research provides a comprehensive overview of the amount of these costs based on literature review, media screening and inquires made with authors of former studies and press articles up until May 2025. Our investigation shows that the data source is scarce. Only few, older estimates were found and data collection methods were not consistent. However, concrete and more recent figures would be highly valuable, especially in discussions about the introduction and design of management measures for this species in invaded regions, which is what the EU-Interreg project “Clancy” seeks to provide. Developing a standardized framework and the use of spatial mapping, could significantly improve the accuracy and comparability of damage costs in the future, benefiting the scientific understanding and guiding effective management and policy responses to mitigate the damage caused by this invasive species. In addition, this work shows how the power of images and public awareness in the absence of concrete numbers can help to engage local actors such as fishing clubs, environmental associations, as well as local authorities in the pursuit of testing and implementing management measures for this invasive species.

D5 - Special Session: Transcending Boundaries Between The Science and

Management of Ships' Ballast Water and Biofouling II

213 - Efficacy of Ballast Water Management Systems in Vessels that Ply the Laurentian Great Lakes

Matthew TenEyck[1], Christine Polkinghorne[1]

[1]University of Wisconsin-Superior, Lake Superior Research Institute

The Great Waters Research Collaborative (GWRC) has conducted paired ballast water uptake and discharge sampling on U.S. and Canadian Laker vessels operating within the Laurentian Great Lakes since 2022. The eight vessels within the study group utilize various type-approved ballast water management systems (BWMS), including 3 UV treatment systems and 1 chemical injection system. Vessels have been sampled multiple times during the duration of the project, allowing assessment of how vessel characteristics and water quality in uptake ports impact efficacy of ballast water treatment.

During ship visits the sample team quantifies uptake and discharge densities of organisms in the three USCG Environmental Technology Verification Program (ETV) organism size classes (≥50 µm in minimum dimension, ≥10 and <50 µm in minimum dimension, and <10 µm) and water quality parameters utilizing ETV methods. In addition, the vessels have been providing GWRC with BWMS autolog files as well as comments on how cargo operations were impacted by BWMS in each port. Furthermore, the vessel crew document the ultraviolet transmittance (UVT) of port water in each uptake port.

The efficacy data indicates that BWMS are decreasing organism densities in all organism size classes, and that the ≥50 µm size class is the most resilient class of organisms. Therefore, the use of BWMS, even when a discharge standard is not met, reduces the transfer of aquatic invasive species within the Laurentian Great Lakes. Water quality parameters such as UVT, DOC, and total suspended solids are good predictors of BWMS efficacy. Examining the documents provided by the vessel can provide additional indicators of whether or not a BWMS will meet discharge standards.

15 - Aquatic nuisance species transfer by ballast water: mesocosm technologies can be used to evaluate risk

Euan Reavie[1], Donn Branstrator[2], Abigail Latanich[1], Courtney Larson[3], Matthew Etterson[2], Malachi Granmo[1], Matthew TenEyck[4], Christine Polkinghorne[4]

[1]Natural Resources Research Institute, University of Minnesota, [2]University of Minnesota Duluth, [3]United States Environmental Protection Agency, [4]Lake Superior Research Institute, University of Wisconsin-Superior

Understanding the risk-release relationship (the relationship between density of organisms released and associated risk of establishment of a population) of aquatic nuisance species (ANS) is important for setting policy standards to protect natural water bodies from species spread through human-mediated vectors, in particular ballast discharge. To evaluate this relationship and simultaneously test the viability of an experimental and analytical approach to investigate this relationship, we conducted a set of mesocosm-based experiments at varying introduced densities of actual or simulated non-native protist and zooplankton organisms. These results detail four years of experimental activities that took place in June 2021 through October 2024. Experimental data were used to model the impact of various management strategies (simulated as various 'release' organism densities) on the risk of ANS transfer through Great Lakes ballast water. Primary questions we aimed to address through this work included: (1) Using mesocosms and a variety of freshwater taxonomic groups, can the impact of ANS reduction in Great Lakes ballast water be determined under a variety of scenarios? (2) How do findings compare to current discharge criteria (10 cells/mL for protists, 10 organisms/m^3 for zooplankton), and are there management implications? (3) Can environmental DNA measurements provide compliance information about ANS in ballast water?

128 - Scaling Up Hawaii's Ballast Water and Biofouling Program

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[1]Hawaii Division of Aquatic Resources

The State of Hawai‘i Division of Aquatic Resources (DAR) established its Ballast Water and Biofouling Program in 2007 in response to Hawaii Administrative Rules (HAR) §13-76. While designed to reduce the risk of invasive species introductions via commercial shipping, this program has historically been limited in scope and resources. Focused primarily on the collection and management of ballast water reporting data, vessel risk assessment, and pathway research, the program has faced challenges in ensuring compliance and in effectively assessing risks posed by vessel discharges.

Recognizing both the ecological stakes for Hawai‘i's marine ecosystems and the regulatory shifts anticipated under the federal Vessel Incidental Discharge Act (VIDA), DAR has embarked on a process to expand and modernize the program. Current efforts focus on three key areas: (1) increasing staff capacity to support enforcement, outreach, and scientific analysis; (2) building a structured inspection program to ensure vessel compliance with ballast water and biofouling management standards; and (3) modernizing ballast water data collection systems to improve efficiency, accuracy, and analytical capability. These initiatives are guided by the development of a new strategic plan that prioritizes risk-based management, program transparency, and coordination with federal and regional partners.

The expansion not only addresses immediate needs in compliance and invasive species prevention but also positions Hawai‘i to adapt effectively to forthcoming federal standards. By sharing lessons learned from this process—including challenges in staffing, funding, and system

modernization—this presentation highlights how state programs with limited beginnings can successfully scale to meet emerging policy and ecological demands.

A5 - Enhancing Proactive Responses to Aquatic Invasive Species

127 - A Decision Analytic Framework for Assessing Aquatic Invasive Species Status, Risk, and Biosecurity Measures for National Parks in the Southeastern United States

Avery Lettenberger[1], Kelly Robinson[1, 2], Wesley Daniel[3], Chuck Bargeron[4]

[1]Georgia Cooperative Fish and Wildlife Research Unit, Warnell School of Forestry and Natural Resources, University of Georgia, [2]US Geological Survey, [3]US Geological Survey - Wetland and Aquatic Research Center, [4]Center for Invasive Species and Ecosystem Health, Warnell School of Forestry and Natural Resources, University of Georgia

Aquatic invasive species (AIS) management poses significant challenges in decision making when there is a lack of detection capabilities and uncertainty in potential invasion threats. National Parks within the Southeastern United States in particular face significant challenges in the management of AIS due to their complex ecosystems and constrained resources for detection and control. In collaboration with Congaree National Park (South Carolina) and Horseshoe Bend National Military Park (Alabama), we are implementing structured decision making (SDM) processes to help identify and plan for current and future management efforts feasible for the Parks. SDM is a transparent, replicable, and deliberative process that allows groups to define the problem, set objectives, identify actions, evaluate consequences, and weigh trade-offs to support informed decisions. Through a series of in-person and virtual meetings we are developing long-term plans based in collaboration with park staff and local stakeholders to establish early detection and rapid response (EDRR) frameworks for the parks. These frameworks aim to develop and implement partnerships (*e.g.,* state and federal agencies and local interest groups), citizen science, and community outreach to evaluate AIS biosecurity within Park boundaries and their greater watersheds. In addition, we are using species distribution modeling to identify current and future invasions and ensure that these EDRR frameworks are tailored to the relevant species. Through the identification of priority AIS, clarifications of roles and responsibilities, and prioritization of feasible actions, these plans aim to prepare and improve coordination for AIS management. These frameworks include the cultural, recreational, and ecological values for each park, ensuring management actions support management and visitor engagement in the parks. Our approach can build agency capacity and shared understanding through providing a repeatable model for other parks and protected areas facing similar AIS threats across the region.

166 - The Marine Biodiversity Data Portal - NI as a tool for the identification and monitoring of marine non-native species.

Christine Morrow[1], Libby Keatley[1], Bernard Picton[1], Annika Clements[1], Jaimie Dick[1]

[1]Queen's University Belfast

The Marine Biodiversity Data Portal (MBDP-NI), is a five-year Department of Agriculture, Environment and Rural Affairs Environment Fund project based at Queen's University Marine Laboratory. The aim of the project is to build an innovative web-based portal for exploring Northern Ireland's marine biodiversity. The interactive website will incorporate recent as well as archive imagery and data from surveys in the 1980s to the present. The survey sites link through to site descriptions, photographs/video, biotopes and species lists. An important aspect of the project focusses on obtaining DNA barcodes from well curated specimens, accompanied by high quality photographs to help build identification resources. There is a particular focus on obtaining DNA barcodes and good quality images of non-native species, potential non-native species and species that could be confused with them. The availability of well curated DNA barcodes will facilitate future projects involving the monitoring of non-native species using environmental DNA.

183 - An automated establishment signal to seduce policy makers into action

Baudewijn Odé[1], Angelo Moerland[1], Michiel Verhofstad[1]

[1]FLORON - Plant Conservation Netherlands

Many new exotic species are found in the Netherlands every year. They are often introduced by humans, whether intentionally or unintentionally. Some of these species manage to maintain themselves in the Netherlands and even expand their ranges, sometimes through repeated introduction. Because species groups like vascular plants involve large numbers of species, this range expansion or increasing naturalization is not always detected in time. A timely response can be important when it comes to species that have significant effects on ecology or economy in the Netherlands.

To effectively detect developments in both expansion and naturalization of the populations of newly arrived species, an analysis tool has been developed with which a signal can be given per plant species if expansion or naturalization occurs to a certain extent. The tool is based on the data stored in the large and up-to-date Dutch National Database Flora and Fauna.

It is now being deployed to raise attention for species with a speedy increase of establishment, especially useful for policy and management organizations.

This tool works quite well and has already provided examples of species that attracted attention of policy makers and management organizations. Yet, the tool depends on the amount and quality of the data in the Database. It is therefore recommended that the results should always

be assessed by a species group specialist, so that effects of, for example, under- or overrepresentation of a species in the national data collection can be considered in a final assessment of the establishment status of the species. The tool may be especially relevant for the more species-rich species groups. In species-poor species groups, keeping track of developments of individual species is easier.

163 - Aquarium Release as a Rising Pathway for Aquatic Invasive Species: Lessons from Hawai‘i

Jesse Boord[1]

[1]Hawaii Division of Aquatic Resources

Aquarium release is a growing global pathway for aquatic invasive species (AIS), with impacts that cross ecological, taxonomic, and jurisdictional boundaries. The Hawai‘i Division of Aquatic Resources (DAR) AIS Team has responded to more than 20 non-native species detections linked to suspected aquarium introductions over the past four years. In Pearl Harbor, six species—*Unomia stolonifera*, *Capnella spicata*, *Anemonia manjano*, *Rhodactis* sp., *Euphyllia* sp., and *Apolemichthys xanthopunctatus*—have been linked to two distinct release events. *U. stolonifera* has expanded extensively, covering 82 acres of habitat under active removal by the U.S. Navy. In Kāne‘ohe Bay, DAR removed three non-native *Montipora* species in 2020 and continues to respond to new detections of *Montipora foliosa* as well as expanding *A. manjano* populations. On Kaua‘i and other islands, additional non-native corals, plants, and invertebrates have been detected and removed.

DAR has piloted innovative approaches that integrate rapid detection, site-specific control, and community engagement. Tools include custom tarping with controlled chemical applications, targeted physical removal, and a multi-jurisdiction *Unomia* survey database with an ArcGIS interface to track effort and detections across agencies, all supported by outreach that bridged technical interventions with community engagement through public awareness campaigns, targeted communication with local councils and civic groups, and facilitation of the first international *Unomia* learning exchange.

These responses highlight both innovations and systemic challenges. Rapid responses frequently encounter permitting delays, often requiring case-by-case exemptions. Lessons learned demonstrate the need for regional programmatic permits with agencies such as the Office of Conservation and Coastal Lands (OCCL) and the U.S. Army Corps of Engineers (USACE) to streamline action while ensuring environmental safeguards. By linking innovative tools, collaborative outreach, and forward-looking regulatory solutions, this work provides a transferable model for managing aquarium-release AIS in sensitive island ecosystems and other high-risk regions.

268 - Towards a more comprehensive invasive species monitoring programme across the island of Ireland.

Hannah Tidbury[1], John Kelly[2], Colette O'Flynn[2], Paul Stebbing[1]

[1]APEM Ltd, [2]National Biodiversity Data Centre

Effective monitoring is crucial to capture invasive species presence and abundance, track temporal and geographical changes, and assess compliance with legislation and progress towards management targets. However, invasive species monitoring is seemingly fragmented and patchy across the island of Ireland. In 2025, the National Biodiversity Data Centre commissioned a project aimed to support the design of a surveillance and monitoring system for invasive species across the terrestrial, freshwater and marine environments of the island of Ireland, which effectively and efficiently captures relevant invasive species data.

The project comprised a review of existing monitoring, and recommendations to improve invasive species monitoring into the future, based on gaps and opportunities identified. Outputs focussed on three key themes of monitoring: sampling approach, data collection and data flow and reporting. The delivery of the project included spatial analysis, technical assessment, theoretical modelling and stakeholder engagement.

The presentation will outline the approach and outputs of the project, focussing on the key recommendations and roadmap provided to guide the implementation of a more comprehensive, harmonized and resilient invasive species monitoring programme for the island of Ireland. Opportunities and challenges associated with this transboundary, cross-jurisdictional approach will be highlighted.

C5 - Special Session: Cross-system Comparisons and Knowledge Sharing for the Management of Invasive Salmonids V

124 - Two routes, two paces: invasion and distribution of alien pink salmon (Oncorhynchus gorbuscha) and bullhead (Cottus gobio) in a large subarctic catchment

Jaakko Erkinaro[1], Panu Orell[1]

[1]Natural Resources Institute Finland

Pink salmon (Oncorhynchus gorbuscha) was introduced from the Pacific area to the White Sea basin in the 1950s. It has gradually spread from the NW Russia to west, but in 2017, the invasion increased abruptly both in abundance and distribution across the North Atlantic. In the

Teno River on the border of northern Norway and Finland (70°N), the earlier small run sizes increased to 5000 fish in 2017, 50000 in 2021, 180000 in 2023 and 100000 in 2025, covering the mainstem and most tributaries of this large catchment.

Bullhead (Cottus gobio) was detected in a tributary of the Teno catchment, Utsjoki, in 1979, after an introduction that likely took place via live fish transportation from Finland to Norway. The species first occupied the Utsjoki system and most of its tributaries during the 1980s and 1990s, entered the Teno River mainstem in 2000, and has since distributed both downstream and upstream covering now a 170 km range of the mainstem and multiple tributaries.

Both species are monitored by several methods, including eDNA, but interactions between the alien and native species in the Teno system are poorly known. Variations in juvenile Atlantic salmon abundances have been difficult to link with the spread of bullhead, although Atlantic salmon populations are currently in a poor stage, mainly due to decreased marine survival. Similarly, the recent surge of pink salmon has not yet resulted in obvious effects on native salmonid species, especially on Atlantic salmon, which is a keystone species for the indigenous Sámi culture, local way of life and economy. A variety of potential mechanisms where invasive species may affect different life stages of native salmon are currently investigated. In addition, possible bilateral management measures on invasive and native species for balancing between mitigation, exploitation and conservation, are under discussion between Finland and Norway.

38 - Cross-analysis of integrated monitoring data through water temperature models reveals potential distribution of brook trout in southern Sweden

Mattias Larsson[1]

[1]University of Gothenburg

The introduction and spread of alien species are considered among the most significant human-induced threats to freshwater ecosystems. Brook trout (*Salvelinus fontinalis*), native to northeastern North America, has been widely introduced outside its natural range, primarily to enhance sport fisheries. In Sweden, brook trout was first introduced in the late 1800s and is now classified as an alien species with a high risk of becoming invasive due to its potential to compete with native salmonids for food and habitat, as well as its ability to hybridize.

Interactions between brook trout and brown trout (*Salmo trutta*) are well documented, with evidence showing that brown trout can displace brook trout from preferred habitats and prey on juveniles. However, some studies suggest that temperature-dependent competition may influence their distribution, with brook trout persisting at higher altitudes and cooler waters. Results from earlier research remain inconclusive, indicating the need for further investigation.

In Sweden, the distribution of brook trout has been shaped by both legal and illegal introductions. Existing monitoring programs primarily focus on native salmonids at lower stream altitudes, resulting in limited knowledge about brook trout populations, particularly in higher-altitude areas where the species might thrive.

This study aims to determine whether water temperature is a key factor influencing the success of brook trout introductions. By comparing historical stocking permissions with electrofishing monitoring data, we identify both successful and unsuccessful introductions of brook trout in southern Sweden. Understanding the relationship between water temperature and brook trout survival can help optimize monitoring efforts by narrowing the geographic focus, thereby reducing costs and improving the detection of undiscovered populations. Ultimately, this research provides insights into the ecological dynamics of brook trout in Swedish freshwater systems and supports more efficient management strategies to mitigate potential invasive impacts.

76 - Measures to control the invasion of pink salmon in Norway

Eirik Frøiland[1, 2]

[1]senior adviser, [2]head of National expert group for measures against pink salmon

Norway started an ambitious state funded program to control the invasive pink salmon in 2023 (Thorstad et al., 2025). The effort was doubled in 2025. This presentation presents the Norwegian strategy and the develoment from 2023 to 2025 in terms of occurence of pink salmon in different regions, increase in measures, results of the measures, and unsolved problems that stands in the way of reaching the goals. The presentation will also touch on the development of new tecnology to automate the species sorting by the use of image recognition and artificial intelligence, by which we aim to reduce handling and stress of native species. The presentation will partly be based on the evaluation report of the measures in 2025 by the National Expert Group for Measures Against Pink Salmon (not yet produced). Further, there is ongoing work to assess the unwanted side effects on native species due to the trapping of pink salmon. This will be included if ready.

153 - Sex-specific somatic growth in invasive pink salmon (Oncorhynchus gorbuscha) from two regions in northern Norway

Erlend Nes[1], August Gjestvang[1], Christian Selbach[1], Eva Thorstad[1, 2], Kenyon Mobley[1]

[1]Norwegian University of the Arctic, [2]Norwegian Institute for Nature Research

The recent invasion of pink salmon (*Oncorhynchus gorbuscha*) in northern Norway has raised significant ecological concerns. With the species expanding further west and south along the Norwegian coast, gaining a better understanding of regional differences in marine growth is an important step in evaluating their successful invasion in new environments. In this study, body size data and fish scale readings were used to identify differences in marine growth between

male and female pink salmon captured in northern Troms, and eastern Varanger in 2023. Results of the study showed that males from Varanger exhibited faster growth rates through marine phases than the other groups, which suggests that a combination of sex and location influence marine growth. The male pink salmon captured in the Varanger region appeared to have experienced more favorable marine growth conditions than pink salmon captured in Troms, which was reflected in the difference in growth during specific growth periods of the pink salmon. A sex-specific effect was also found in the body size of pink salmon at capture, where males from Varanger showed higher body weight, resulting in better body condition. This observation suggests that during good growth conditions, better body condition may be of more importance prior to spawning. The insights into the specific differences in marine growth and body size described here, emphasize the importance of taking local conditions into consideration in further assessing this invasive species expansive potential in Norway.

C6 - Something's Fishy: Tracking and Managing Invasive Fish Introduction and Spread I

78 - Rapid expansion and establishment of a small Asian fish species in Europe: a case study of the shimofuri goby Tridentiger bifasciatus Steindachner, 1881 in the Scheldt basin.

Hugo Verreycken[1], Rhea Maesele[1]

[1]Research Institute for Nature and Forest

The shimofuri goby (*Tridentiger bifasciatus*), a small gobiid fish native to East Asia, has recently established populations in Europe following earlier invasions in (non-native areas in) China and the United States. This study documents the species' first European occurrences, with initial specimens found in 2022 in the Netherlands and Belgium. Using data compiled from citizen science platforms (Observations.be, Observations.nl) and institutional records (INBO), we describe the species' rapid expansion across Flanders and the southwestern Netherlands since its first find. Systematic monitoring using electrofishing, fyke nets, and trawl nets confirmed presence at over 25 sites, with several hundreds of individuals captured. Nearly 300 individuals were caught at one location, although many sites only yielded one or two specimens. Observed size ranges (1.7-9.5 cm TL) and presence of juveniles suggest successful reproduction in the wild. The species was found in a wide range of environments—from freshwater canals to polyhaline waters (10-17 PSU) such as the Eastern Scheldt—indicating high ecological tolerance. Despite coexistence with the invasive round goby (*Neogobius melanostomus*), shimofuri goby populations appear to be establishing successfully, potentially by occupying

different ecological niches. The introduction pathway is likely ballast water exchange from shipping. The species' spread and adaptability raise concerns regarding its potential ecological impacts, particularly in terms of competition with native species. A UK risk assessment previously classified shimofuri goby as a medium invasion risk; however, recent evidence from the Scheldt basin suggests this may underestimate its true invasion potential. Ongoing monitoring and ecological assessments, including determining life-history traist, are essential to evaluate the long-term impacts on native biodiversity and inform management strategies. The shimofuri goby's broad environmental tolerance and reproductive success underscore its potential as an emerging invasive species in European waters.

152 - Genomic analysis of the spread and invasion pathways of Flathead Catfish (Pylodictis olivaris) in the Laurentian Great Lakes

Sarah Babaei[1, 2], Nicholas Mandrak[1], Nathan Lujan[1, 2]

[1]University of Toronto, [2]Royal Ontario Museum

Native to tributaries of the Gulf of Mexico and widely introduced across the United States, Flathead Catfish (FHC; *Pylodictis olivaris*) is a large, vagile predator known to significantly impact freshwater ecosystems. In recent decades, possibly due to climatic warming, FHC has expanded its northern range limit into the Laurentian Great Lakes, where its non-native status is commonly assumed but uncertain. In the Canadian Great Lakes, FHC is a growing threat to the Thames River, Ontario, where several at-risk aquatic species are potential prey and where FHC recently (2019) established its first reproducing population outside the United States and Mexico.

Using spatially extensive samples from across the native, invasive, and introduced ranges of FHC, a reduced-representation 3RAD genomic sequencing approach, and combinations of clustering and backward in time demographic analyses, we aimed to better understand the history of FHC in the Great Lakes as either a native or non-native species, and help guide future management strategies intended to slow the spread by mapping the species' population structure and estimating the timing, rate, sources, and pathways of its northward range expansion.

Preliminary results suggest that populations in Michigan are genomically distinct from those in the Maumee River, Sandusky River, Thames River, and Tennessee River. We detect an isolation-by-distance pattern extending from the Tennessee River to the Maumee River, to the Sandusky River, and ultimately to the Thames River, suggesting that the Thames River population originated as a northward expansion from the Sandusky River.

These findings are critical for assigning an invasive status to Flathead Catfish in the Great Lakes Basin to enable targeted management actions such as prohibiting introduction, transport, and release, raising public awareness, and implementing removal methods. Moreover,

identifying specific source populations and invasion pathways highlights priority areas for intervention and monitoring, such as implementing early detection programs.

234 - The trouble with Tench: sampling strategies and population characteristics of an invasive Canadian population.

Jaclyn Hill[1], Christophe Benjamin[1, 2], Trevor Avery[3], Sunčica Avlijaš[2, 4], Thaïs Bernos[5, 6], Philippe Brodeur[7], Annick Drouin[7], Paige Levangie[3], Nicholas E. Mandrak[6], Olivier Morissette[8], Nathalie Vachon[7], Anthony Ricciardi[2]

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Monitoring the occurrence and abundance of AIS is a challenge for managing freshwater ecosystems. Efficient sampling strategies are essential for early detection and accurate population assessments. The invasive Tench (*Tinca tinca*), became established in the St. Lawrence River (SLR) in the early 1990s and now represents the largest population of Tench in the western north hemisphere. Here, we identified the most effective methods and site-selection strategies for sampling Tench. A comparative analysis of four fishing methods indicated fyke and gill nets as the most effective gears for capturing Tench (abundance), whereas gill nets and electrofishing are the most effective for detection. Time of day had no effect on gear capture effectiveness. Vegetation was slightly correlated with Tench presence while substrate type was not, suggesting habitat preferences are more flexible than previously thought. Positive associations between Tench and native fish communities corroborate a preference for low-flow, vegetated areas, potentially informing site selection at the invasion front. We also measured key population characteristics of SLR Tench, to establish baseline data for comparison as the population continues to spread/potentially evolve. SLR growth rates were high at ages 1-2, showed gradual reductions between ages 2-5, and reached a near asymptote by age 9. Growth curves of populations reported elsewhere show that SLR Tench are larger than those of similar age elsewhere in the world. An abundance of high-quality habitat patches and their connectivity in the SLR may have permitted Tench to mature early, grow faster and larger than in their native European range. All population dynamic and gear capture data (except commercial fyke net data) will be made available on The Government of Canada's Open Government Portal. This information will inform mitigation plans in invaded areas and support early detection of Tench along the invasion front, with the ultimate goal of slowing secondary spread.

301 - Reproductive behavior and the genetic mating system of an invasive fish with alternative reproductive tactics

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Male alternative reproductive tactics (ARTs) are widespread in fishes, with some males defending a territory, attracting a mate, and then caring for young, while others use sneaking behaviors or female mimicry to access spawning females. In the invasive round goby (*Neogobius melanostomus*), males use either a territorial or sneaking tactic to reproduce. Territorial males then provide sole parental care for the developing eggs and larvae. Despite the large body of literature on the invasion of the round goby in the Laurentian Great Lakes and many parts of Europe, the behavioral interactions between guarder and sneaker males during spawning and the reproductive success of each tactic are unknown. We combined genetic analyses with a laboratory behavioral experiment to address these knowledge gaps. We collected guarder males and offspring from artificial nests deployed in Hamilton Harbour (Lake Ontario, Canada) and used DNA microsatellites to assign parentage. Guarder males sired on average 83% of offspring after excluding two presumed nest-takeovers, while sneaker males individually secured a smaller paternity share of about 10% on average. Behavioral analyses revealed that guarder males can detect sneaker males and respond aggressively to their presence in the tank. While guarder males remained in the nest throughout spawning, sneaker males spent an average of only 22 seconds in the nest, suggesting that sneaker males in this species use a fast “sneak” tactic rather than mimicking females. Overall, our findings highlight how behavioral adaptations associated with male reproductive tactics relate to reproductive outcomes in the round goby and contribute to the understanding of the evolution of alternative reproductive tactics in an invasive species. Understanding these reproductive dynamics provides insight into mechanisms that may drive the population growth and invasion success of round goby in invaded ecosystems.

B6 - Movers and Shakers: Understanding Invasion Pathways and Spread

209 - To Remove or Not to Remove: Native and non-native population responses to the deconstruction of anthropogenic riverine barriers

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Managing the multi-faceted threats posed by habitat degradation and biological invasion in freshwater ecosystems is an increasing priority for the conservation of native biodiversity. Thus, the removal of anthropogenic riverine barriers is a primary strategy to restoring river continuity to facilitate ecosystem recovery. However, there is compiling evidence that these initiatives could perversely promote the spread of non-native populations that thrive in more connected waters and erode well-intended conservation efforts. Our systematic review synthesises, for the first time, the patterns and trends in responses of native and non-native species to riverine barrier removals globally, while unveiling geographic, taxonomic and methodological biases, and knowledge gaps. We have shown that there is a disparity of knowledge regarding low-head barrier types (e.g., weirs and culverts), with dams being the most studied regarding population recovery after their removal. As expected, there is a publication bias towards the United States, which is likely explained by the campaign for barrier removals pioneering in North America. Research intentionally studying the response of populations of non-native species to barrier removals remains sparse in comparison to that of native species. Through a quantitative meta-analysis, we further compare the strength of responses to barrier removals between populations of native and non-native species, showing that removal efforts could disproportionately favour biological invasions. As river restoration efforts continue to gain traction globally, these outcomes will help to reconcile conservation quagmires around interacting global environmental changes, thereby improving long-term conservation outcomes.

148 - Investigating efficacy of mitigation options for reducing the risk of aquatic IAS within raw water transfers (RWT)

Zoe Cole[1], Alison Dunn[1], Steph Bradbeer[2], Ben Aston[2], Martin Tillotson[1]

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The dispersal of aquatic invasive alien species (IAS) is primarily driven by human-mediated pathways, with raw water transfers (RWT) representing a relatively under studied but key pathway for the introduction and spread of aquatic IAS. A single RWT is the movement of a volume of raw water (1-5 megalitres) from a source (reservoir, river) to a receptor (i.e. another reservoir or a water treatment works (WTW)) via a transfer pathway (i.e. pipe or open channel), these RWTS can form a network of transfers which can span different catchments. Yorkshire

Water (YW), a water company in England can move up to 200 megalitres per day within their RWT networks. The National Infrastructure Commission (NIC) in the UK have identified the need for a national transfer network in response to climate change which will lead to an increase of investment into new RWT networks. Movement of raw water has a high potential risk of spreading IAS around UK. This risk could also be increased during drought, which is becoming a more frequent event and can require the movement of water between catchments due to water resource management. In England, the Environment Agency (EA) requires water companies to assess and implement biosecurity mitigation measures to reduce the risk of IAS spread for existing and new RWTs. Currently there is a lack of biosecurity guidance and mitigation options applicable to the pathway of RWT.

New and novel technologies are currently being researched specifically for RWT. However, research into the suitability and efficacy of these technologies to manage IAS risks in RWTs is still in its early stages, reflecting a lack of evidence-based guidance for implementation. We present findings of investigations into efficacy of mechanical and chemical technologies for mitigating the risk of introduction and spread of aquatic IAS in RWTs.

249 - Hiding in plain sight? Vicennial changes in distribution and populations of 'non-established' red-eared sliders (Trachemys scripta elegans) in Singapore

Raynor R.B. Fong[1], Bryan Soh[1], Abigayle P.K. Ng[2], Ruth R.M. O'Riordan[3], Darren C.J. Yeo[1]

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The globally invasive North American red-eared slider, *Trachemys scripta elegans*, is one of only two terrapin species imported legally into Singapore for the aquarium/pet trade but is by far the more popular pet as evidenced by its ubiquity in local aquarium shops. Unsurprisingly, adult *T. s. elegans* are found in freshwater bodies throughout the country. Although long regarded as non-established in equatorial tropical Singapore owing to their native range being temperate to subtropical, and a lack of evidence of any self-sustaining breeding populations in the wild, recent reports of egg-laying and hatching now hint at potential establishment (despite a distinct absence of juveniles or subadults in the wild). To investigate the possibility of establishment and other changes in *T. s. elegans* populations and possible environmental correlates in rapidly changing Singapore, we conducted a visual survey throughout the island city-state, mirroring and in comparison, with a similar study from 2004, which had revealed that even in highly urbanised Singapore, greater *T. s. elegans* occurrence was associated with water bodies closer/more accessible to humans. This presentation provides updates on the distribution, density and structure of populations of *T. s. elegans* in Singapore two decades on since the last (and only) published ecological study of the species, and reports on the investigation and reassessment of its invasive status. We also examine possible drivers or predictors of *T. s. elegans* distribution and population structure and discuss factors that could be hiding or masking the species' establishment in Singapore or conversely affecting its ability to do so.

159 - KELLICOTTIA BOSTONIENSIS (ROUSSELET, 1908): A NON-NATIVE SPECIES PERSISTING IN A VERTICAL GRADIENT IN A TROPICAL RESERVOIR

Lucas Cesar Santos Cabral[1], Christina Wyss Castelo Branco[1], Raphael Ferreira Corrêa[1]

[1]Federal University of the State of Rio de Janeiro

The rotifer Kellicottia bostoniensis, a transcontinental invasive species, has exhibited notable dispersal and adaptability to tropical freshwater environments. In Brazil, at the Ribeirão das Lajes Reservoir, the non-native species is found mainly at the surface during winter. The present study analyzed 342 samples collected from 2004 to 2006 at 5-meter intervals from the surface to the bottom (40 meters of depth), measuring limnological variables “in situ”, and water samples for nutrient analyses. Additionally, 162 phytoplankton samples were collected for analysis. K. bostoniensis was detected at most depths, including anoxic zones, being most abundant between 5 and 25 meters. At 5 meters, it constituted approximately 33% of the rotifer community and 10% of the total zooplankton density. A negative correlation was observed between its density and electrical conductivity, as well as with micro cyanobacteria. Conversely, positive associations were found with chlorophyll-a, nano chlorophytes, and nano cryptophytes. These findings align with previous studies in temperate regions, where increases in K. bostoniensis populations are linked to nanoplankton biomass, consistent with its microfiltration feeding strategy targeting nanophytoplankton (<20 μm), bacteria, and detritus. Winter mixing in the reservoir likely enhances nutrient availability in the water column, promoting nanophytoplankton abundance increase and favoring K. bostoniensis. This study underscores the limitations of surface-only sampling, which may significantly underestimate the abundance and distribution of this invasive rotifer. Comprehensive vertical sampling is essential for accurately assessing its presence and ecological impact.

66 - The role of freshwater connectivity in facilitating the range expansion of invasive invertebrate species

Alisha Higgins[1], Paul Wood[1], Chris Gerrard[2], Kate Mathers[1]

[1]Loughborough University, [2]Anglian Water

Invasive non-native invertebrate species significantly threaten the diversity of freshwater ecosystems. Human activities such as fishing, aquaculture and boating have (un)intentionally introduced many invasive non-native invertebrates. The mechanism of successful establishment of these invertebrates will differ depending on their functional characteristics, however the connectivity of waterbodies is likely to facilitate their movement across the landscape. Anthropogenic waterbodies such as canals and reservoirs are highly invaded and may act as stepping stones for future expansion into adjacent, connected waterbodies. However, little

research has examined the role of waterbody connectivity in facilitating freshwater invasions and range expansion in the UK. Moreover, the role of barriers (e.g., weirs) and direct connections (e.g., locks) has been largely overlooked internationally but may influence the structure of macroinvertebrate communities. These knowledge gaps are being directly addressed as part of this research through studying two contrasting anthropogenic waterbody types: reservoirs and canals alongside their inflowing and outflowing waterbodies. Reservoirs and their connecting waterbodies within the Anglian Water region and a network of the Grand Union Canal and adjacent rivers within Leicestershire (UK) have been identified as the primary study sites and the composition of their macroinvertebrate communities are being characterised, alongside the presence of invasive species. These datasets will become available following publication of the results of the research. This presentation will provide evidence highlighting the role of waterbody connectivity in facilitating the range expansion of invasive invertebrate species.

D6 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations I

316 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations

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[1]Fisheries and Oceans Canada

This workshop, in combination with the Special Session on Transcending Boundaries Between the Science and Management of Ships' Ballast Water and Biofouling, aims to bridge the gap between research and policy, and to connect data needs and risk assessments with effective management and mitigation measures. Participants will be challenged to leverage and build on experience and lessons learned to improve the implementation of current ballast water management practices and advance new biofouling management policies.

A6 - Beyond Borders: Coordinated Approaches in Aquatic Invasion Science

12 - The Impacts of Biological Invasions

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Research on biological invasions has expanded rapidly over the past decades, yet the field remains fragmented across ecological, economic, and socio-cultural perspectives. Numerous studies have described invasion impacts, but no synthesis has previously compiled them or integrated these perspectives into a unified framework. This gap is particularly problematic for aquatic ecosystems, where biological invasions often cross political and habitat boundaries. Their impacts are severe yet inconsistently assessed, and socio-cultural consequences—such as effects on recreation or traditional resource use—remain underexplored and poorly quantified.

To address this gap, we conducted a global scoping review drawing on nearly a century of peer-reviewed studies, grey literature, and expert reports, supported by contributions from more than 40 researchers worldwide. From this compilation of over 700 references on invasion impacts, we developed a conceptual framework built on three interrelated pillars: (i) impact domains across ecological, economic, and socio-cultural spheres; (ii) methodological challenges such as research biases, data gaps, and difficulties in quantifying non-ecological impacts; and (iii) contextual subjectivity, reflecting how perceptions of what constitutes a significant impact vary across scales, regions, and cultural settings. By clarifying mechanisms of impact, exposing blind spots, and identifying fallacies in existing assessments, our review and the proposed framework provide means to generate more consistent and comparable evaluations across aquatic environments.

This work presents the first synthesis of invasion impacts that explicitly integrates ecological, economic, and socio-cultural dimensions, providing a foundation for interdisciplinary, standardized, and policy-relevant assessments. For aquatic ecosystems in particular, the framework highlights where impacts are consistently demonstrated, where socio-cultural dimensions remain poorly quantified, and how methodological inconsistencies limit comparability across studies. By exposing these patterns and blind spots, it offers a means to move beyond isolated case studies toward coordinated, evidence-based strategies for managing aquatic invasive species worldwide.

116 - Tools to support policies on alien species in Europe

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The European Alien Species Information Network (EASIN) has evolved in current years alongside the Joint Research Centre’s role in supporting biodiversity policies. It provides data and long-term established network of experts, linkages with Member States (MS) and organisations working on alien and invasive species (IAS) in Europe. It Supports the implementation of biodiversity-related objectives of the Biodiversity Strategy 2030, the IAS

Regulation (1143/2015) and other policies with a series of tools. Among these cross-sectorial tools, thematic maps combine of IAS spatial occurrence data and scientific-based assessments of IAS impacts. We aim to highlight three case studies of how these tools support specific indicators of European policies.

First, thematic maps are used for informing ecosystem assessments, such as the Mapping and Assessment of Ecosystems and their Services initiative (case study 1), which evaluates the state of ecosystems and their services in the European Union also considering IAS potential pressure. Second, thematic maps detect patterns of IAS distribution over time by analysing official data reports and notification of early detections from MS to the European Commission (case study 2). Finally, thematic maps track progress on Target 6 Rate of Introduction of the Convention of Biological Diversity and monitor trends in IAS introductions (case study 3).

The thematic tools and derived indicators are designed to support the implementation of EU policies, and to contribute to international biodiversity targets.

22 - A “Least Wanted” List to Protect the Great Lakes St. Lawrence River Basin from High-Risk Aquatic Invasive Species

Mike Piskur[1]

[1]Great Lakes St. Lawrence Governors & Premiers

The Great Lakes St. Lawrence River region of North America is home to 100+ million people, 21 percent of the world’s surface freshwater, and a $9.3 billion (US) economy. Regional collaboration and innovation are necessary to protect against aquatic invasive species (AIS). The Great Lakes St. Lawrence Governors & Premiers (GSGP), representing eight US States and two Canadian Provinces, work together to protect the system from AIS, especially invasive carp.

In 2013, GSGP created a list of 21 “least wanted” species that present a high risk of invasion or spread within the region. At the same time, the Governors and Premiers committed to prohibit their possession or transportation. The region’s States and Provinces, working through GSGP’s AIS Task Force, recently completed needed regulation, having taken more than 100 separate actions overall against these high-risk aquatic invaders. GSGP is now working with regional AIS and fisheries experts and leading researchers to identify new species to add to the “least wanted” list. Once selected following risk assessment and other research, these AIS will be prioritized for preemptive action to prevent their transfer and spread.

The actions taken because of the “least wanted” list drive real results. The Province of Ontario used the “least wanted” list to develop its Invasive Species Act of 2015. In 2022, the State of Wisconsin brought criminal charges against a wholesale fish dealer selling invasive carp. Additionally, the US federal government listed four “least wanted” AIS under the Lacey Act that prohibits interstate trade of species. Overall, the “least wanted” list is a powerful means to prevent the transfer and spread of AIS.

This presentation will discuss the process to develop and implement the “least wanted” list of AIS, and the potential use of this model for other environmental threats or in other regions of the world.

E6 - Mussel Mania: Dreissenids Among Us

24 - From physiological state to population structure: a dive into the life of Dreissena polymorpha

Chloe De Vernisy[1,2], Sandrine Pain Devin[1,3], Manon Bain[1,3], Claire Caillard[3], Simon Devin[1,3]

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The study of the population dynamics of an invasive species such as *Dreissena polymorpha* (zebra mussel) is essential to understand its spread, assess its impact on ecosystems, and characterise the influence of environmental factors on its development. Moreover, due to its reproductive strategy, wide distribution, and bioaccumulation capacity, *Dreissena polymorpha* is a relevant bioindicator in aquatic biomonitoring for assessing environmental pressures and knowing its population dynamics could help in interpreting the way it responds to these pressures.

Temporal monitoring of population size and abundance, based on growth, fecundity, and survival data obtained from repeated field sampling, provides the necessary data for the development of an annual matrix model. This kind of model is relevant for predicting population fluctuations and understanding their structuring into age classes. The model was built based on estimates of the age of individuals using Von Bertalanffy's individual growth model, which calculates the maximum growth rate over time. The constants of this model were used to infer the age of individuals from their size and to determine the parameters essential for building the matrix model.

The originality of this study is that the matrix model integrates the different phases of the annual reproductive cycle in order to account for the physiological state of the organisms. Energy allocation strategies between reproduction, maintenance of physiological functions, and stress adaptation vary according to individual size and age and remain poorly studied across different age classes. Here, we assessed these variations using chemical biomarkers indicative of energy metabolism, antitoxic and antioxidant defences, and cellular damage. The results explore the relationship between population structure and the physiological state of individuals. This innovative approach contributes to improving our understanding of population status and also to enhancing aquatic ecosystem management strategies.

85 - Understanding Zebra Mussels as a Novel Prey Resource for Lough Neagh Fishes

Liam Brennan[1], Sarah Helyar[1]

[1]Queen's University Belfast

Freshwater ecosystems face increasing threats from eutrophication, climate change, and invasive species, posing major risks to biodiversity and ecosystem services. Lough Neagh, the UK's largest freshwater lake, supports commercial fisheries and provides drinking water to approximately 40% of Northern Ireland's population. From 2023-2025, the lake experienced unprecedented cyanobacterial harmful algal blooms (HABs) in recent records, with some years dominated by the toxic cyanobacterium *Microcystis aeruginosa*. These blooms are associated with multiple environmental drivers, including the proliferation of the invasive zebra mussel (*Dreissena polymorpha*). Within Lough Neagh, zebra mussel densities increased substantially in 2022, approximately 17 years after their initial invasion.

This study investigates whether Lough Neagh fishes have begun to exploit zebra mussels as a newly abundant prey resource, and whether consumption differs between native species (eel, brown trout, and pollan) and non-native species (perch, bream, and roach). Visual microscopy-based stomach content analyses will quantify zebra mussel consumption across species. The abundance and size of consumed mussels will also be quantified, and potential explanatory factors underlying observed predation patterns will be explored.

By examining fish responses to an unusually delayed increase in an invasive prey population, this study aims to provide insight into the integration of invasive prey into Lough Neagh's food web and the potential for fishes to exert biotic resistance through predation. Understanding whether native and non-native fishes can exploit zebra mussels will provide important information for understanding and managing the changing Lough Neagh ecosystem. All supporting data will be archived in accordance with UKRI NERC data management policies and made publicly available in a recognised repository.

233 - Depth-dependent reproductive dynamics of the quagga mussel in a deep lake

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The quagga mussel (*Dreissena bugensis*) is a highly successful invasive freshwater bivalve that strongly alters nutrient cycling and food-web structure in invaded lakes. Its spread depends on the production and dispersal of planktonic larvae. In deep lakes, vertical gradients in temperature and food availability may generate depth-specific reproductive dynamics, with subpopulations contributing to larval production at different times.

We combined monthly monitoring of a littoral population with seasonal sampling at 5, 10, 30 and 45 m in Lake Bourget, a deep peri-alpine lake in France. Gonadal histology was used to characterize reproductive stages and calculate a Mean Gonad Index. These observations were

complemented by in situ growth monitoring and laboratory measurements of filtration, assimilation and respiration across gradients of food availability and temperature.

Histological analyses revealed a clear annual reproductive cycle in the littoral population, with progressive gonadal maturation during winter and spring followed by a major summer spawning event. However, reproductive dynamics were only partially synchronized across depths. Deeper populations showed delayed, contrasting or interrupted patterns of gametogenesis and gonadal depletion. The superposition of these depth-specific reproductive windows may extend the period of gamete release and larval presence at the whole-lake scale.

Physiological measurements and environmental forcing were integrated into a DEB-inspired reproductive model. The model reproduced the main littoral seasonal cycle and generated exploratory depth-specific predictions constrained by histological observations, temperature and food availability. This continuous depth-time reproductive field is intended to define biologically realistic larval source terms. Preliminary larval sampling also revealed a heterogeneous vertical distribution in the water column.

Ultimately, coupling this biological model with Delft3D hydrodynamic and particle-tracking models will allow the consequences of bathymetric reproductive asynchrony for larval transport and the vulnerability of sensitive lake areas to be assessed.

44 - Multinational initiatives to control ecological impacts of invasive dreissenid mussels in North America’s Great Lakes

Samantha Tank[1], Nichole Angell[1], Taaja Tucker-Silva[1], Autumn McGowan[1], Lindsay Chadderton[2], Tim Johnson[3], Bo Bunnell[4]

[1]Great Lakes Commission, [2]The Nature Conservancy, [3]Ontario Ministry of Natural Resources, [4]U.S. Geological Survey

Since first appearing in the Great Lakes region of North America in the late 1980s, invasive dreissenid (zebra and quagga) mussels have caused significant ecological and economic impacts. As mussel populations continued to expand both within and from the Great lakes, the need for effective control measures has grown. Synergies between two complementary initiatives, the Invasive Mussel Collaborative (IMC) and the Great Lakes Spawning Whitefish and Invasive Mussels (SWIM) project, are rapidly advancing planning and implementation of effective control techniques. In 2026, the IMC plans to release a research roadmap to prioritize and drive research and investment into invasive mussel control in the Great Lakes region. The IMC’s research roadmap will outline specific steps to achieve site level control of dreissenid mussels, with the long-term goal of developing effective regional control strategies. Informing this effort, the SWIM project is leading a 5-year experiment to explore how invasive mussels are negatively affecting lake whitefish reproductive success in lakes Michigan and Huron. The SWIM project team is currently in year 3 of project implementation which includes a reef-scale control effort in Lake Huron. The initiatives include multinational teams consisting of federal, state/provincial, and Tribal, First Nation governments, and academic and non-governmental partners. Broad representation of regional partners will ensure an integrated approach to

research and management that blends western science with Indigenous knowledge. The Great Lakes Commission provides administrative and technical support to both efforts. This presentation will provide an overview of both invasive mussel initiatives and share lessons learned from hosting multinational initiatives.

39 - Zebra mussels as catalysts of crisis: Their role in the UK and Ireland's largest Harmful Algal Blooms

Neil Reid[1], Marina Reyne[1], William O'Neill[1], Brett Greer[2], Qiqi He[1], Oliver Burdekin[3], John McGrath[1], Chris Elliott[1]

[1]Queen's University Belfast, [2]Agri-Food and Biosciences Institute, [3]burdGIS

*[Use this 2nd submission and ignore 1st submission - edited]

Invasive zebra mussels (*Dreissena polymorpha*) are implicated in the emergence of Harmful Algal Blooms (HABs) at the UK and Ireland's largest freshwater lake. Lough Neagh (392 km²) drains 43% of Northern Ireland, provides 40% of its drinking water, supports Europe's largest commercial eel (*Anguilla anguilla*) fishery, sustains the endangered pollan (*Coregonus autumnalis*), and is internationally important for biodiversity. Yet every summer since 2023, it has been engulfed by dramatic blooms of the blue-green cyanobacterium *Microcystis aeruginosa*, driven by phosphorus enrichment principally from agriculture, rising water temperatures due to climate change, and non-native mussel invasion. Zebra mussels filter feed on green algae and other phytoplankton, increasing water clarity and light penetration, while rejecting toxic cyanobacteria in pseudofaeces, thereby shifting phytoplankton dominance. Their excretion and biodeposits mobilize phosphorus and other nutrients in the benthic layer exploited by cyanobacteria. Similar persistent *Microcystis* blooms have followed zebra mussel invasion in Lake Erie (USA) and Lakes Balaton and Ijsselmeer (Europe). Whilst HABs can emerge when nutrient loading, increased temperatures, light, and calm conditions converge in the absence of zebra mussels (e.g. Lake Taihu, China), where mussels have established they act as a catalyst strongly reinforcing HABs post-invasion.

Plenary Presentation #3: Ana Nunes | Plenary Presentation #4: Tsungai Zengeya

298 - Tackling invasive alien species through policy support and stakeholder engagement

Ana Nunes[1]

[1]International Union for the Conservation of Nature

TBD

299 - Aquatic invasions in South Africa: Insights from national reports on the status of biological invasions and their management

Tsungai Zengeya[1]

[1]South African National Biodiversity Institute

TBD

D7 - Special Session: Transcending Boundaries Between The Science and Management of Ships' Ballast Water and Biofouling III

263 - Identifying potential mitigation strategies for reducing the spread of non-native marine species by ships' biofouling

Arjan Gittenberger[1], Marjan Bovers[2], Helena Keeler Perez[1], Marjolein Rensing[1]

[1]GiMaRIS, [2]Office for Risk Assessment & Research - Netherlands Food and Product Safety Authority

In the coming years, a legally-binding framework for the control and management of ships' biofouling is to be developed within IMO in a manner similar to the already established ballast water convention. We therefore present here our experiences in the Netherlands. Since 2009, heightened monitoring of non-native marine species has been conducted in marinas and ports. In addition to that, a number of biofouling assessments of commercial and naval vessels have been performed in dry docks. By merging data from these studies, we not only identified the primary ports and marinas where new introductions are initially detected but also revealed that by evaluating specific vessel types and selected niche areas, it is possible to make a reasonably accurate prediction of the total number of fouling species present. With this in mind, along with the vessel's past travel data, a protocol was developed to classify the risk level of a vessel as a low, medium, or high risk for spreading marine alien species. This allows management strategies to be targeted to the vessels with the highest risk. Likewise, the identification of

habitats in ports and marinas where new species are most often found, allows management to be targeted to settlement hotspots. Floating docks, for example, concern the main settlement hotspots of non-native fouling species in ports and marinas where they probably function as stepping stones in the further spread of these species. Additionally, taking into account an inventory of international and national laws, conventions and guidelines that directly and/or indirectly address the management of non-native marine species, allowed for an even better understanding of potential measures to mitigate non-native species spread through ships' biofouling.

277 - THE INFLUENCE OF MATERIAL PROPERTIES ON THE RECRUITMENT OF BIOFOULING COMMUNITIES AND NON-INDIGENOUS SPECIES (NIS)

Sebastiana Di Dio[1], Olga Bereznova[1], Greta Srėbalienė[1], Lina Vorotinskienė[2], Simas Račkauskas[3], Aine Antanavičė[2], Raminta Skvorčinskienė[2]

[1]Klaipeda University, [2]Lithuanian Energy Institute, [3]Kaunas university of technology

Biofouling is a widespread and persistent problem in the marine sector and is recognized as one of the main vectors for the spread of non-indigenous species (NIS). New technologies have been developed to address this issue more sustainably in line with the recently developed HELCOM measures and actions for achieving good environmental status of the sea. Surface topography and physico-chemical characteristic of materials play a significant role in larval settlement, influencing community composition. Exploring the effect of different materials properties in the development of fouling communities may provide a different approach to current biofouling and NIS management strategies.

This study aims to assess the performance of different artificial nano-structured materials in recruiting biofouling organisms in an anthropogenically impacted coastal area in Lithuania, considering also their resistance to settlement. Panels made of Polyvinyl Chloride (PVC), Aluminium (Al) and Copper (Cu), the latter two treated with five different physico-chemical surfaces modifications (Al+OTS; Al-NaOH+OTS; Al-NaOH+ZnO_{PMHS}; Al-NaOH, Al+ZnO_{PMHS}; Cu-$FeCl_3$; Cu+OTS; Cu+ZnO_{PMHS}; Cu-$FeCl_3$+ZnO_{PMHS}; Cu-$FeCl_3$+OTS), were tested as settlement substrates for biofouling communities over a six-month period. Sessile, mobile and NIS community composition, were then compared.

Results showed that PVC and Al panels recruited a greater number of species compared to Cu panels, which remained completely bare. Most of the species recruited by the panels were NIS, with a similar number recorded on both Al and PVC panels. The newly developed artificial surface-modified materials were tested for the first time under real marina conditions, and although the findings are promising, further analyses are needed to evaluate the surface properties and the efficiency of the new nano-structures.

257 - Integrating shipping growth and ballast water management to assess invasive species risks

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Maritime trade supports global economic development, but it also links distant marine ecosystems and can move organisms beyond their native ranges. A major pathway is ballast water, seawater carried by ships for stability and released during cargo operations. These discharges may contain viable organisms that can establish as non-indigenous species, with consequences for biodiversity, ecosystem services and coastal economies. International ballast water regulation has therefore required treatment systems that filter, disinfect or otherwise inactivate organisms before discharge. Yet the protection delivered by these systems may be challenged by future growth in shipping and by variation in treatment performance across vessel operations and environmental conditions. Here we assess whether ballast water management can keep pace with projected changes in maritime activity. We combine machine-learning projections of shipping under Shared Socioeconomic Pathways with a global introduction-risk model that explicitly represents compliance and treatment efficacy. We show that, even with widespread ballast water treatment, projected shipping growth can substantially increase future introduction risk unless treatment systems achieve consistently high efficacy. Across Shared Socioeconomic Pathways, future risk ranges from 94% to 900% of the 2018 baseline, depending on shipping growth trajectories, ballast water management efficacy and compliance. These results indicate that technology adoption alone may be insufficient to counteract the ecological consequences of expanding maritime trade. More adaptive ballast water governance, improved compliance, and sustained optimization of treatment performance will be needed to reduce future biological invasion risks in a rapidly intensifying global shipping system.

B7 - Beyond Ecosystems: Health and Welfare Implications of Aquatic Invasions

110 - A conceptual framework to classify impacts from invasive species on human health

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Ecological and economic impacts of invasive species are now well documented through established frameworks. These frameworks improve classifications and assessments, data collection, and interoperability, as well as communication, collaboration, and decision-making.

However, despite growing evidence that environmental and human health are deeply interlinked, as well as the emergence of integrative approaches such as OneHealth, no comprehensive framework currently exists for the health impacts of invasive species, resulting in a significant lack of harmonised data systems and awareness. Invasive species can affect human health in various ways, ranging from spreading pathogens, causing allergies, to altering resource availability or hampering mental health. The complexity of the public health risk posed by biological invasions is driven by the fact that: (1) a high diversity of species can harm human health via; (2) a wide range of mechanisms; and that (3) a single species can have impacts in various ways simultaneously.

We propose a conceptual framework for the impacts of biological invasions on human health and pioneer a typology to classify their effects. This includes a detailed characterisation and classification of the mechanisms by which invasive species directly and indirectly affect human health. It also identifies resulting impacts and provides an ordinal metric to scale their magnitude. After developing a first version based on a literature review, a consensus was reached by seeking feedback from invasion science and public health experts (academics and non-academics) in a Delphi survey. This conceptual framework provides a standard tool for interdisciplinary researchers and practitioners worldwide to assess and scale the human health impacts of biological invasions. It is applicable across all taxa, habitats, and regions, and represents a basis for developing global databases alongside more effective risk assessments, management interventions, and decision-making.

270 - The Lough Neagh Emergency: Development of New Hydrogen Peroxide based Treatments for Cyanobacterial Blooms and Toxins

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A combination of previous invasion, increased eutrophication and increased water temperatures have accelerated the growth of toxic cyanobacteria, also known as blue-green algae. Their decomposition produces cyanotoxins, which threaten the water supply and wildlife at Lough Neagh. Sixty percent of Belfast’s and forty percent of Northern Ireland’s water comes from Lough Neagh. Destruction of these cyanotoxins is difficult. Without the proper procedures in place to ensure removal of these cyanotoxins before the water reaches our tap, our access to clean water is under serious threat.

Hydrogen Peroxide (H_2O_2) is an effective treatment widely used for water purification in the Netherlands. H_2O_2 decomposes to water and oxygen. Conventional peroxide treatment is expensive and requires large volumes of peroxide, making it impractical for large bodies of water like Lough Neagh. A solution is to utilise catalysts which enhance peroxide effectiveness, producing similar or improved results with lower peroxide concentrations. TAML catalysts are biomimetic catalysts that resemble the active site of peroxidases. These catalysts are used in

ultra-dilute concentrations and are composed of solely biochemical elements, which enhances their environmental compatibility. TAMLs significantly increase the effect of H_2O_2, allowing larger volumes of water to be treated with small amounts of 'supercharged' peroxide. Recent studies have shown the effectiveness of Fe-TAML/H_2O_2 systems for water purification, and the removal of cyanotoxins and difficult pollutants. New Fe^{III}-TAML/H_2O_2 has been proven to completely degrade microcystin-RR in 10 minutes.

This project aims to investigate methods to catalytically supercharge peroxide treatment, focusing on optimising the Fe-TAML/H_2O_2 system to destroy cyanobacteria and cyanotoxins. Ecotoxicological analysis will be performed in parallel to understand the green design of this treatment, providing invaluable information on how this method should be used to treat badly impacted areas of the Lough.

73 - Non-native freshwater turtles as disease agents: An overlooked One Health risk

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Freshwater turtles are increasingly recognized as important actors in biological invasions. Their popularity in the pet trade and frequent release into the wild have led to the establishment of non-native populations worldwide. Beyond their well-documented ecological impacts, these turtles may also act as reservoirs and vectors of infectious pathogens—a dimension of their invasions that remains largely overlooked. To address this gap, we conducted a comprehensive review of published records on bacterial, viral, and fungal pathogens in freshwater turtles. Drawing from 163 peer-reviewed studies, we compiled 815 pathogen occurrences across 188 genera. The most frequently reported host species were *Trachemys scripta, Pelodiscus sinensis*, and *Emys orbicularis*. Notably, *T. scripta*, one of the world's most widespread invasive turtles, was strongly associated with zoonotic pathogens, particularly Salmonella. This finding underscores its dual significance: not only as an invasive species but also as a potential public health concern. Our analysis also revealed frequent pathogen sharing between native and introduced turtles, even across distantly related taxa. This suggests that shared environments and human activities facilitate cross-species transmission, amplifying risks for both ecosystems and public health. While bacterial pathogens dominated the records, viral data highlighted biogeographic links between Asia and North America, whereas fungal pathogens appeared more geographically restricted. Despite this, non-native species remain underrepresented in

disease monitoring and rarely feature in One Health or invasion management frameworks. In conclusion, our findings highlight the urgent need to explicitly integrate disease risk into invasion biology, aquatic biosecurity, and conservation strategies. Recognizing freshwater turtles, especially invasive species such as *T. scripta*, as vectors of pathogen transmission has far-reaching implications for biodiversity conservation, wildlife health, and public health policy.

A7 - Shifting Climates, Shifting Impacts: Understanding Invasion Impacts in a Warming World

117 - Seasonal and spatial variability in trophic web structure in a thermal freshwater ecosystem

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Invasive species pose several ecological impacts on the communities where they are introduced. Understanding the trophic interactions between co-occurring invasive species is thus crucial for understanding the mechanisms underlying their co-existence. Thermal waterbodies in temperate regions are peculiar ecosystems, where warmwater species from the aquarium trade are released by owners and can survive the winter conditions, thriving in these ecosystems. This results in very peculiar communities, composed of native species and species from disparate tropical and subtropical regions around the world, establishing entirely novel trophic relationships. We used C and N stable isotope analysis to investigate the trophic web of a peculiar freshwater community, composed of temperate and tropical species in a thermal locality in Hungary, along a thermal gradient of the Hévíz Lake outflow in two seasons, spring and autumn. We found that the trophic web structure changed along the gradient in both seasons. This study provides valuable information on how warmwater invasive species may interact with other co-occurring species, especially in light of climate change, since these species could eventually escape these thermal refugia and spread, should winters become less harsh.

204 - An integrative modeling framework to quantify and project the ecological impacts of invasive species under climate change

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Freshwater ecosystems are among the most vulnerable habitats in the face of climate change and invasive species. One such species is the European perch *Perca fluviatilis*, which has widely spread throughout reservoirs and natural lakes in its non-native range. Here, we aim to generate a novel integrative modeling framework to assess the ecological impact of perch on native fish populations under climate change. Our method integrates three complementary components. We first conducted stable isotope analyses to determine the dietary contributions of *Alburnus* species as the main prey target of perch, then to assess predation rates of perch we experimentally quantified functional responses under different thermal conditions and finally we used ecological niche models to capture niche overlaps between *Alburnus* and perch. By combining scores of these three components into a weighted average score, we obtained an ecological impact index of each site where *Alburnus* species occurs in the Anatolian peninsula (Türkiye). We developed spatially explicit ecological impact risk maps for perch predation on *Alburnus* under current and anticipated climatic conditions. Our results indicated that *Alburnus* populations are under tremendous predation pressure from perch across a variety of freshwater systems in Anatolia, with impacts being especially pronounced in reservoirs. Future projections predicted that the impact will escalate under future warming scenarios. We suggest this integrated framework as a cutting-edge tool for policymakers and environmental managers. It can help in determining conservation priorities, deciding management actions, and predicting upcoming ecological changes with clear and spatially resolved risk assessments. More generally, the method offers a template, which can be used to assess the impact of invasive species in other freshwater systems in the face of shifting climate conditions. All analyses will be supported by an openly available R script to facilitate reproducibility and data sharing.

25 - Lionfish in Hot Water: Responses to Coral Bleaching on Honduran Reefs

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This study examines temporal trends in lionfish (*Pterois volitans*) aggregations, abundance, and sex-based distribution across two reef systems across the north shore of mainland Honduras, La Ensenada and Banco Capiro, over three time periods (2014-2016, 2017-2019, and 2023-2024), which span multiple mass coral bleaching events. At La Ensenada, although the median

frequency of lionfish aggregations remained consistent, aggregation variability declined over time. Banco Capiro showed greater stability in aggregation patterns across periods, though statistical analysis detected significant changes over time ($p < 0.001$), indicating subtle but meaningful shifts in aggregation dynamics. Lionfish counts increased between 2014-2016 and 2017-2019 at both sites, followed by a sharp decline post-2023. Significant temporal changes in lionfish counts were found at La Ensenada ($p < 0.05$) and Banco Capiro ($p = 0.04$). Non-parametric tests confirmed a significant decline in lionfish abundance after the 2023 bleaching event at both La Ensenada ($U = 19.96$, $p < 0.001$, $r = 0.62$) and Banco Capiro ($U = 6.63$, $p < 0.001$, $r = 0.84$), with higher counts recorded prior to the event. Sex-based analysis showed that males were significantly more abundant than females at both sites. At La Ensenada, sex was a strong predictor of lionfish type ($p < 0.001$), while year had no significant effect. Conversely, both year and sex were significant predictors at Banco Capiro ($p < 0.001$), suggesting shifts in population structure over time. These findings highlight localised differences in lionfish dynamics and underscore the potential ecological impact of climate-driven bleaching events on invasive species behaviour and abundance.

36 - Invasive crayfish in warming waters: Predicting trophic impacts under climate change

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Predictive information on the trophic impacts of invasive consumers can be gained by experimentally measuring their functional response—the rate of prey consumption in relation to available prey density. However, a common gap in such information is how it varies with the consumer's reproductive state and thermal environment, particularly in environments where lower temperatures can act as physiological barriers to warm-adapted invaders. In laboratory experiments, we tested the functional responses of the red swamp crayfish (*Procambarus clarkii*) and the marbled crayfish (*Procambarus virginalis*)—congeneric invasive omnivores whose potential impacts in the Great Lakes basin and elsewhere in the world have generated concern. We used insect larvae (*Chironomus* bloodworms) and aquatic macrophytes (Eurasian milfoil *Myriophyllum spicatum*) as food resources to gain predictive information on crayfish per capita effects under present (18°C) and projected future (26°C) climate scenarios for the Great Lakes basin. The maximum feeding rate of *Procambarus virginalis* was higher at 18°C than at 26°C when presented with bloodworms, but it did not differ between temperatures when presented with macrophytes. By contrast, the feeding rate of *Procambarus clarkii* did not change with temperature for either food resource. Due to their larger mean size, *Procambarus clarkii* exhibited higher rates of resource (bloodworm and macrophyte) consumption than *Procambarus virginalis* at both temperatures. These results suggest that trophic impacts of *Procambarus virginalis* will dampen with increased warming, whereas *Procambarus clarkii* will sustain larger impacts irrespective of temperature within the range tested. However, warming alters the reproductive cycle of *Procambarus virginalis* by increasing the frequency and duration

of gravid states, leaving some uncertainty on which species may pose a greater threat to the Great Lakes basin and reinforcing the need to quantify per capita effects across life cycles and temperatures. Data collected during this work is available on Dryad.

C7 - Small Bodies, Big Behaviours: Ecological Roles and Impacts of Small Crustaceans

105 - Aggressive interactions in a global invader: intraspecific behavioural responses of the Japanese skeleton shrimp Caprella mutica

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The spread of marine invasive alien species (IAS) is an increasing threat to global ocean systems and is a major driver of biodiversity loss. IAS are often characterised by their ability to dominate over and displace native congeners, where aggression plays an important role. Crustaceans are a highly invasive sub-phyla which are recognised for displaying aggressive behaviours both inter- and intra-specifically. This in turn results in dominance over other individuals for space and resources, enhancing invasion success. In certain species, such behaviours can be manifested at the population level along with other behavioural traits which increase the likelihood of spread and establishment. Therefore, comparing individuals from different invasive populations can determine how widespread these behavioural differences are, especially in species with a global invasive range. The Japanese skeleton shrimp *Caprella mutica* is a highly invasive species across temperate regions with current populations distributed broadly across the West Coast of Scotland, having first been recorded in 2000. The species also has an extensive global invaded range which includes South Africa where it was first detected in 2015. The aim of this research will therefore be to examine aggressive behaviours of *C. mutica* across different invasive local populations from the greater Clyde estuary, on the West Coast of Scotland, through laboratory examinations considering male-male interactions. Findings will then be compared to data collected from South Africa, giving insight into local and global mechanisms of *C. mutica* invasion success. This research will improve our understanding of how the behavioural responses of a globally invasive species varies across populations and contexts, helping to explain competitive strategies and subsequent ecological impact.

265 - Armored invaders: How exoskeleton may drive amphipod competition and predator resistance?

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Invasive species often transcend ecological and biogeographical boundaries by outperforming native taxa in competition and predator avoidance. For aquatic arthropods, the exoskeleton provides both protection from predators and a potential advantage in interspecific interactions, yet its role in invasion success remains poorly understood. This project aims to test whether exoskeleton strength and armature contribute to the success of invasive Ponto-Caspian amphipods.

The project will address three hypotheses: (H1) species with stronger exoskeletons are less likely to be consumed by vertebrate predators; (H2) cuticular projections act as a deterrence mechanism against predation; and (H3) species with stronger exoskeletons are more aggressive and more likely to monopolize shelters in interspecific competition. To test these assumptions, there are planned three experiments on five native and five invasive amphipod species commonly co-occurring in Lithuanian waters. Firstly, amphipod palatability to European perch (*Perca fluviatilis*) will be correlated with cuticle strength across native and invasive species. Secondly, cuticular projections will be experimentally removed to test their role in predator deterrence. Thirdly, the outcomes of aggressive interactions between native and invasive species will be correlated with their cuticle strength. To achieve these objectives, the project will integrate behavioural experiments with morphological and histological analyses, providing a comprehensive approach to the role of exoskeleton strength in ecological advantage of invasive species.

By integrating predator-prey dynamics with interspecific competition, this project will provide novel insights into how morphological traits facilitate invasion success of Ponto-Caspian amphipods. The findings are expected to advance our understanding of the mechanisms enabling aquatic invaders to achieve ecological advantage over native species and to transcend ecological boundaries. All data generated during the project implementation will be openly shared upon project completion.

18 - Predicting the potential impact of the invasive terrestrial amphipod “Arcitilitrus dorrieni” using the Relative Impact Potential (RIP) metric in Northern Ireland

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Invasive species have become an increasingly important topic concerning environmental stability and conservation, with an increase in new locations requiring updated and highly predictive measures. Measures that can quantify the effects of invasive species in ecosystems and the possible increase in invasion due to biotic factors such as temperature, prey abundance or competition. Currently, there is no research into the impact A. dorrieni is having in Northern Ireland. This project aims to explain and quantify the impact by testing consumption rate and abundance in warm and cold environments. Sampling sites were chosen using the most recent sightings of A. dorrieni and were concentrated around the Ards Peninsula (Kircubbin and Mount Stewart). Sampling took place between October (2023) and January (2024), taking leaf litter from each site to collect A. dorrieni for consumption rate testing and abundance counting. Higher consumption rates were observed in warmer environments compared to cold environments; this is a similar trend concerning abundance, where a significantly larger abundance is observed in warmer climates.

The RIP metric uses the numerical (consumer abundance) and functional (consumption rate per capita) response of the invasive species and will be analysed in light of climate change. Using functional and numerical responses allows analysis of the impact of invaders and can be applied to any native analogue in the ecosystem or any population impacted by an IAS.

Assessing A. dorrieni in temperatures not typical of Northern Ireland indicates the invasive nature of this forager and emphasises the impact climate change and temperature increase can have on invasive species. Managing invasive species requires more effective pre-invasion measures, whereas post-invasion restoration is of higher interest. Further experimental research is needed concerning the RIP metric, where the impact of invasive species can be quantified and analysed in light of an ever-changing climate.

162 - Year-round monitoring of the Oriental river prawn in Germany: insights into an emerging Danube invader

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The Oriental river prawn *Macrobrachium nipponense* is an emerging invasive species in European freshwaters. In addition to its spread into the lower stretches of the Danube River in recent years, the species was recorded for the first time in Hungary and Germany in 2023, with further occurrences confirmed in several other countries, although not yet officially published. Native to East Asia, this large-bodied, long-lived decapod exhibits life-history traits typical of

successful invaders, such as rapid growth, early maturity and frequent reproduction, raising concerns about its potential ecological and socio-economic impacts. In 2025, year-round monitoring was conducted in the Racklau harbour (Passau), the site of its first record in Germany. Monthly sampling using baited traps was carried out at nine points along an ~800 m transect, providing the first insights into the seasonal activity patterns and life-history traits of the species under Central European conditions. The species was found to overwinter successfully and to reach considerable abundance and fecundity, even in the presence of competing invasive species such as the spiny-cheek crayfish *Faxonius limosus* and several gobiid species, such as the round goby *Neogobius melanostomus*. The Racklau harbour therefore likely functions as a source population from which the species can spread continuously, particularly downstream, facilitated by the dispersal of its drifting pelagic larvae.

C8 - Plural Voices: Bridging Perspectives and Knowledge Systems

223 - Bridging Indigenous and Western knowledge systems and perspectives: Sea lamprey in the Laurentian Great Lakes

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Sea lamprey (*Petromyzon marinus*; Ginebigomeg in Anishinaabemowin) control is an intensive 70 year invasive species management program credited with enabling the recovery of commercial, cultural, and recreational fisheries in the Laurentian Great Lakes (US and Canada). Despite the success of suppressing sea lamprey populations, Indigenous Peoples (both First Nations and Tribes) whose territories encompass the entire Great Lakes basin have often been excluded from decision making and applications of control measures. This presentation addresses that critical gap by centering Indigenous experiences and perspectives concerning sea lamprey and their control. Drawing on recent and ongoing research, the findings highlight that Indigenous Peoples hold diverse and nuanced understandings of sea lamprey and sea lamprey control. This input recognizes that invasive species management is not only an ecological challenge but a governance and political challenge that requires the bridging of knowledge systems for a shared and sustainable future. By incorporating Indigenous voices into invasive species management, programs like the sea lamprey control program can shift towards recognition of treaty rights and sovereignty while applying knowledge systems rooted in relationality and responsibility. By connecting Indigenous experiences and perspectives to ongoing policy discussions within the sea lamprey program and relevant governance bodies, this presentation contributes to the session theme of bridging research and policy.

205 - Invasion of alien pink salmon: ecological and sociocultural perspectives on niche construction at the Teno River, Finland

Jaakko Erkinaro[1], Juha Hiedanpää[1]

[1]Natural Research Institute Finland (Luke)

The recent, significant increase in abundance and distribution of invasive pink salmon (*Oncorhynchus gorbuscha*), native to the Pacific area, and introduced to the western European coast via stocking to the White Sea area, adds to the list of large-scale changes in North Atlantic salmon rivers, their native fish populations and connected sociocultures.

The recent decline of Atlantic salmon populations in the large Teno River system in northernmost Finland and Norway has led to a total ban on salmon fishing since 2021, with severe impacts on Indigenous Sámi communities.

The concept of niche construction can help understand the ecological effects of concrete physical changes the pink salmon create in the fluvial ecosystem through massive spawning nest excavation, which alters the physical habitat of juvenile salmon. The accumulation of carcasses after pink salmon spawning, with large-scale nutrient subsidies to the freshwater environment, has the potential to change the whole ecosystem, especially the growth potential and habitat characteristics of juvenile Atlantic salmon.

The Teno River also exemplifies how salmonid-related human niche construction—the evolution and development of human skills, languages, and practices—is entangled with the niche-constructive processes occurring in the river.

Human niche-constructive practices are now helping to recover from the ecosocial shock of the decline in Atlantic salmon populations spontaneous and deliberative modification of, e.g., emotional beliefs about the pink salmon (the species is not anymore considered disgusting), practical beliefs about its catch-value (no Atlantic salmon by-catch after Indigenous knowledge being applied in selection of fishing sites and adjustment of traditional Sámi fishing gear), and symbolic beliefs about the salmon-related future (new hope and other means for cultural recovery).

In intertwining the conceptions of niche construction and IPBES life-frames, help scrutinise how changes in beliefs—niche constructive practices—affect Indigenous and local people live in, with, from, and as the Teno River - and why.

14 - Territory-Wide Monitoring of Aquatic Invasive Species in Treaty #3: A Collaborative Approach to Whole-Ecosystem Stewardship

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[1]Grand Council Treaty #3

The Grand Council Treaty #3 Territorial Planning Unit (TPU), representing 28 Anishinaabe First Nations, leads the only large-scale aquatic invasive species (AIS) monitoring initiative across the Treaty #3 territory—a vast and ecologically diverse region spanning 140,000 km² of Ontario, Manitoba, and the Canada-USA border. Grounded in Anishinaabe cultural laws and relationships with the land, water and spirits, work is guided by principles of respect, reciprocity, and responsibility to future generations.

Treaty #3 is a largely unmonitored and data-deficient region, especially regarding aquatic ecosystems. The TPU's efforts help fill critical knowledge gaps, providing foundational data and leadership for collaborative management. Since 2023, the TPU has found novel detections of Zebra Mussels (*Dreissena polymorpha*) and *Phragmites australis* populations. These discoveries, including new detections along major transportation corridors and binational water bodies, emphasize the urgency of coordinated responses. The TPU is examining how the impacts of climate and water quality influence AIS spread across the territory.

Methodologies were designed to reflect cultural and scientific integrity. Ceremonies and offerings are ongoing throughout all projects. Sampling sites were chosen based on ecological risks and community significance. TPU followed strict decontamination protocols, and youth from Treaty #3 communities actively participated in fieldwork, fostering intergenerational stewardship.

Working alongside Treaty #3 communities, provincial and federal governments, and regional partners, the TPU is building a shared understanding of invasive species risks and responses. While respecting the Treaty #3 communities' data sovereignty, the TPU's data is accessible via self-published reports and public platforms (e.g. iNaturalist, EddMaps, DataStream). Management strategies include deployment of free public AIS decontamination units and establishment of a Treaty #3 Phragmites Management Area Working Group.

Through transboundary coordination, open data-sharing, and culturally informed stewardship, the TPU offers a pathway for how Indigenous-led science can guide ecosystem-wide strategies to protect freshwater environments across political and ecological boundaries.

145 - Development of adaptive management frameworks for Great Lakes coastal wetland restoration

Kelly Robinson[1], Brian Crawford[2], Katie O'Donnell[2], Danielle Fegan[3], Aimee Baier[3], Michael Castagne[3], Eric Clark[4]

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Coastal wetlands in the Great Lakes region of North America support diverse ecological communities and hold deep cultural importance for the Ojibwe peoples, expressed through practices like traditional harvest of manoomin (wild rice). Wetlands have been significantly altered from development, climate change, and invasive species, and are therefore a focus of stewardship efforts. Research and management activities conducted by multiple entities, including state, federal, and tribal agencies, non-governmental organizations, universities, and invasive species management areas have been ongoing in the wetlands of the St. Marys River system for many years, but these activities have not been coordinated among parties. In addition, making stewardship decisions in these complex systems requires grappling with multiple uncertainties. We conducted a collaborative decision analytic process that included identifying wetland restoration objectives, applying constructed value of information (CVoI) to identify and prioritize key uncertainties, and developing an adaptive management framework for wetland restoration in the St. Marys River. We found that many of the uncertainties articulated were related to invasive species removal (invasive narrow leaf cattail *Typha angustifolia* and hybrid cattail *T.* x *glauca*), including questions about patch size, distance to treated sites, and site history. The results of our CVoI exercise indicated that decision making for wetland restoration in the St. Marys River would benefit from reduction of uncertainties related to cattail removal. We therefore developed two adaptive management frameworks for wetland restoration, 1) active adaptive management focused on native vegetation restoration with cattail removal and supplemental actions, and 2) passive adaptive management to restore manoomin with seeding actions that account for invasion status and treatment history. We hope to implement these frameworks throughout the Obtawaing Biosphere Region of northern Michigan. Our results can aid partners in advancing collaboration, funding, and implementation of these frameworks to improve manoomin and native vegetation outcomes in coastal wetlands.

B8 - Many Tools, One Goal: Integrating Molecular Approaches into Surveillance and Management

222 - Finding Chinese Mitten Crabs in Sweden is like looking for a needle in a haystack - but multiple approaches might tackle the problem

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Sweden contains about 40,000 km^2 of inland waters - roughly 8-9% of the country´s total area - with approximately 96,000 lakes and 60,000 km of rivers. The Chinese mitten crab (*Eriocheir sinensis*), a catadromous species, spends most of its life in freshwater. Listed among the world’s

100 worst invasive alien species, for its severe ecological and economic impacts on freshwater systems, it was first recorded in Sweden in the early 20th century in the Baltic Sea and later in Lakes Mälaren and Vänern. To date, no juvenile stages have been detected, suggesting either that the population is not yet established or that current detection methods have gaps. However, in March 2025 the risk level was raised to 'very high' due to a) climate change leading to warmer, shorter winters and b) the potential introgression with the cold-tolerant Japanese mitten crab (*E. japonica*). Both risk factors enable further spread and permanent establishment.

In the EU Interreg North Sea funded CLANCY project (2023-2028) *we map the crab, we trap the crab and fill the gap* through international co-operations between Belgium, Germany, France and Sweden. While countries such as Belgium and Germany experience mass occurrences, France and Sweden still struggle with effective detection and eradication. This presentation outlines the current situation in Sweden and evaluates how combining multiple approaches - such as molecular tools (eDNA on water and sediment samples), digitally submitted citizen science records, a serious-game development by students, catches by fishermen and other trapping methods - can improve early detection and support stakeholders in enabling a rapid response.

235 - A collaborative approach to assessing the current extent and potential threat of Didemnum vexillum in Atlantic Canada.

Claire Goodwin[1], Anaïs Lacoursière-Roussel[2], Kelly Mackarous[3], Emily Blacklock[4], Alexa Meyer[5], Scott Pavey[6], Peter Lawton[2], Sarah Kingsbury[2], Claudio DiBacco[2], Melania Cristescu[7], Gregory Santangeli[7], Laura Teed[2], Brontë Thomas[5], Bex Goreham[5], Aidan McDiarmid[1], Julia Dupuis[1], Christina Carr[1], Zora McGinnis[3], Megan Burnett[3], Adena Peters[3]

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Didemnum vexillum, known colloquially as pancake batter tunicate or sea vomit is an emerging threat in Atlantic Canadian waters. This colonial ascidian can form large patches over both natural seabed and manmade structures presenting a threat to both native communities and economic activities such as aquaculture and fishing. It had recently become re-established around Deer Island (New Brunswick, Canada) but its wider distribution in the Bay of Fundy and off Nova Scotia was not known. We present results from a multi-partner project working to establish its distribution and invasion pathways in Atlantic Canada. A multi pronged approach combined surveillance using eDNA, eRNA, SCUBA surveys, ROV surveys, surface-deployed near-seabed drift camera systems, settlement plates, marina surveys, and records from fishers and citizen scientists. Invasion pathways were examined using SNPs. This project aims to generate a comprehensive picture of *D. vexillum*'s spread and to inform best practices for surveillance and management of this widespread invasive species.

220 - Unraveling the Great Mystery(snails): Insights from Genetic and Genomic Analyses

Adam Simpson[1], Samuel Nutile[1], Lynne Beaty[1]

[1]Penn State Erie

The Great Lakes watershed hosts diverse ecosystems that are frequently challenged by the introduction of non-native species. Asian “mystery snails,” a taxon of large-bodied viviparous gastropods, have become established in these ecosystems since their introduction in the 20th century. The two predominant species, *Cipangopaludina chinensis* and *C. japonica*, are morphologically similar with overlapping distributions in the Great Lakes and its surrounding waterbodies. The management of Asian mystery snails is impeded by the difficulty of species identification: shell morphology can be highly variable and genetic barcoding is not always conclusive, particularly for specimens that are nominally *C. chinensis*. This study aimed to provide clarity regarding the identification of Asian mystery snails and investigate the possibility of unreported species/sub-species. We employed low-throughput (genetic barcoding) and high-throughput (next-generation sequencing) approaches to process snails collected from waterbodies within the Lake Erie watershed. Genetic barcoding using universal primers (cytochrome oxidase I; COI) confirmed the identity of *C. japonica* among our samples, but also indicated the presence of three additional species, including one belonging to a different genus (*Margarya*). We used representative samples of each species to sequence and assemble whole genomes (150 bp paired-end sequencing; NextSeq 2000); the *C. japonica* sample was also prepared for long-read sequencing (PacBio Sequel IIe). Our analyses are still in progress, but we are excited to share our data with the scientific community: these will be the first whole-genomes available for Asian mystery snails in GenBank. Access to these datasets will aid our efforts to characterize the species complex and support the management of this taxon in the Great Lakes and abroad.

109 - Species Confirmation the Non-native Mystery Snails Cipangopaludina japonica and C. chinensis Within North America

Daya Hall-Stratton[1], Amy Fowler[1], April Blakeslee[2]

[1]George Mason University, [2]East Carolina University

Invasive species are an increasing concern worldwide as they disrupt native ecosystems and species. The Japanese mystery snail (*Cipangopaludina japonica*) and the Chinese mystery snail (*C. chinensis*), were intentionally transported from Asia to North America around 1900 to be cultivated for human consumption. Mystery snails are now found throughout North America with *C. chinensis* being the most widely and abundantly reported of the two species. However, the

two appear near identical morphologically, with overlapping features making identification difficult. Genetic sequencing is a more reliable method of species identification but has yet to be widely used in their invasive range. For this research mystery snails have been collected from 48 sites representing 14 States and three Canadian provinces. Demographic data (snail size, sex ratio, and embryo number) have been collected for all populations. Photographs were taken of snails to analyze morphometric differences between species. A subset of snails from each site were also selected for DNA sequencing using COI mitochondrial primers. Data so far has revealed low genetic diversity of *C. japonica* (4 NA vs. 18 native haplotypes N=230) and high diversity for *C. chinensis* (48 NA vs 25 native haplotypes N=104). Both species are widespread in North America, with *C. chinensis* being more common in Northern States and Canada and *C. japonica* being more common in the Mid-Atlantic states, with overlap in New England. *Cipangopaludina chinensis* appears to be absent from some extensively sampled regions where they were previously reported, suggesting misidentification. Morphometrics have supported the finding of overlap in shell characteristics. Uncertainty in species identity and inaccurate reporting can confuse ecological and biological differences between the two species, as studies conducted on one may have been of the other, so it is important to accurately identify each species and their range for effectiveness of future management.

D8 - Special Session: Transcending Boundaries Between The Science and Management of Ships' Ballast Water and Biofouling IV

142 - Quantifying vessel biofouling risk factors to support aquatic invasive species management

Farrah Chan[1], Tessa Brinklow[1], Robin Rozon[1], Laura Vrooman[1], Sean Yardley[1], Mariam Elmarsafy[1], Sarah Bailey[1]

[1]Fisheries and Oceans Canada

Vessel biofouling is a primary vector for the introduction of aquatic invasive species (AIS) into coastal ecosystems globally. Although several factors are known to influence biofouling levels on vessels, they are inconsistent across systems. In Canada, available data to examine vessel biofouling risk have been outdated. With new data from recent vessel surveys, we can now gain fresh insights into current vessel management practices and shipping trends. For example, the increased use of in-water hull cleaning may reduce biofouling risk (i.e., less biofouling per vessel), though this could be countered by increased shipping activity (i.e., more vessels, more biofouling overall). To better understand biofouling risk under current conditions, we aim to identify vessel management practices (e.g., time since last hull cleaning and antifouling paint

type) and other risk factors (e.g., vessel type and voyage history) that can be used to predict biofouling levels using recent survey data. From 2023 to 2025, we surveyed 40 international commercial vessels at the ports of Halifax (NS), Vancouver (BC), and Hamilton (ON). Each survey included biofouling sample collection to estimate species abundance and diversity, video footage of biofouling on the vessel to quantify percent cover, and background water samples to account for local species presence. Samples and footage were processed using established protocols to ensure comparability with historical studies. We will explore potential confounding factors and conduct multivariate analyses to identify key drivers of biofouling risk. Results will be shared during the conference presentation. Findings from this research will support the development of targeted management strategies, monitoring programs, and policies aimed at reducing the risk of AIS introductions via vessel biofouling.

267 - Characterizing biofouling communities for improved ship hull management practices

Ann Wassick[1, 2], Matthew First[2]

[1]Precise Systems, [2]U.S. Naval Research Laboratory

Vessel biofouling is one of the dominant vectors of marine non-indigenous species (NIS) worldwide and is primarily managed via fouling control coatings, especially biocidal antifouling coatings (AFC). There are concerns about the release of biocides from AFC, which may accumulate and cause environmental harm, leading to an increased interest in creating more environmentally sound solutions. The spatiotemporal variation in biofouling community recruitment and accrual rates must be considered when developing globally effective prevention methods. The United States Office of Naval Research Biofouling Program has maintained field sites that span a range of environmental conditions in California, Florida, Hawaii, and Singapore to help take biofouling community variation into account when testing experimental coatings. Since 2006, biofouling data have been collected in two-year test cycles on a variety of common and experimental fouling control coatings to examine efficacy across locations, while inert, biocide-free panels were included to characterize the monthly recruitment. An initial analysis of the first two test cycles generated baseline community data and indicated that some sites have a strong seasonal pattern. The goals of continued analysis of this long-term dataset are to clarify and characterize seasonal and interannual patterns in biofouling recruitment and determine if community variation is related to environmental conditions. Quantifying relationships between community variation and environmental conditions can be used to predict the biofouling pressure a ship may encounter along its route to determine if heightened management practices are needed. Additionally, understanding how coatings interact with different biofouling communities could provide data for a vessel to choose the most appropriate coating based on its areas of operation. Results of the study could aid more effective biofouling management practices, which in turn will reduce the risk of NIS introductions through ship hull biofouling.

59 - Ship Biofouling and Marine Invasive Species: A Marine Bioinvasion Super-Spreader and Debris Capture During Ship In-Water Cleaning

Mario Tamburri[1], Chris Scianni[2], Eugene Georgiades[3]

[1]University of Maryland Center for Environmental Science, [2]California State Lands Commission, [3]Environmental Protection Authority, New Zealand

The negative impacts of ship biofouling on vessel operations and its role in the spread of non-indigenous species are well documented. To manage biofouling on submerged ship surfaces, the maritime industry relies on two basic strategies (used separately or in combination): antifouling coatings (AFC) and in-water cleaning (IWC). While IWC with debris capture is increasingly promoted as a management strategy to minimize biosecurity and environmental contamination risks, key elements remain poorly defined, including which materials must be collected, an acceptable level of capture, and how capture can be quantified. Although the processing efficacy of collected debris can be assessed, because IWC itself occurs in an open, dynamic system, direct quantification of overall capture efficiency is not feasible. Furthermore, undefined ‘capture’ requirements risk inconsistent performance, unnecessary costs, and is likely to be a barrier to innovation. For IWC policies, regulations, and approvals to succeed, they should prioritize demonstrating no, or only acceptable levels of, environmental harm rather than mandating specific risk-mitigation methods that may or may not actually be effective or needed. Our presentation will provide clarity on the term 'capture' as it relates to the IWC of ship biofouling. We will also provide recommendations for IWC regulations, approvals, and related environmental policies to help avoid the pitfalls of enacting non-measurable, subjective requirements. IWC of ship biofouling has the potential to deliver mutual benefits for the maritime industry and the environment—provided that individual systems can be shown to be both safe and effective. An outcome-based regulatory approach would better ensure that IWC reduces biosecurity and environmental contamination risks while supporting ship operational efficiency.

156 - Navigating Complexity: Developing a Legally Binding Framework on Ships’ Biofouling

Colin Henein[1]

[1]Transport Canada

The development of a legally binding framework for the control and management of ships' biofouling presents a multifaceted policy challenge at the intersection of environmental protection, maritime operations, and international law. Biofouling management is increasingly recognized as essential to advancing the ocean-climate nexus, offering co-benefits such as reducing greenhouse gas emissions through improved vessel efficiency and mitigating underwater radiated noise (URN), which impacts marine biodiversity. This presentation will

explore considerations involved in transitioning from voluntary guidelines and guidance to enforceable legal instruments, including potential legal approaches for these new requirements, the integration of current scientific understanding of biofouling and its ecological impacts, and knowledge gaps that need to be addressed to enable effective regulation. Through this lens, the session will highlight the importance of cross-sectoral collaboration and evidence-based policymaking in shaping a robust and globally consistent response to biofouling.

A8 - Bad Fins Happen: Ecological Chaos from Aquatic Invaders

221 - Impacts of the invasive Indo-Pacific Lionfish (Pterois miles) on coastal fish communities in the Aegean Sea

Lasse Rauert[1]

[1]Universität Potsdam

Lionfish (Pterois sp.) are notorious marine invaders known for devastating Western Atlantic reef communities. Recently, Pterois miles arrived in the eastern Mediterranean Sea, posing an emerging threat to vulnerable local ecosystems. This study investigates the Lionfish's impact on coastal fish communities around the Islands of Samos and Lipsi in the Greek Aegean Sea.

We conducted a control-impact study over two years (2024-2025), systematically surveying fish diversity across 24 transects at six sites, three with and three without Lionfish. The data was compiled into a Darwin Core Biodiversity dataset for future GBIF publication. We analyzed species-level impacts using abundance patterns, co-occurrence, and alpha diversity metrics. We also evaluated community-level impacts by computing compositional dissimilarity between sites using beta diversity metrics.

Across 282 surveys, we recorded 107 unique species. Sites with Lionfish exhibited low densities of the invasive species. However, Lionfish presence significantly correlated with the occurrence or abundance of 31 species. Specifically, eight species showed negative correlations, while nine species, mostly other invasive, were positively correlated with Lionfish presence. Alpha diversity metrics revealed no significant impacts, but beta diversity showed marginal differences linked to Lionfish presence.

These findings indicate the Lionfish invasion at these surveyed Mediterranean locations is still in its initial stages, characterized by low abundance and marginal ecological impacts. However, growing local populations suggest the potential for severe detrimental impacts in the future. Consequently, this early stage provides a critical window of opportunity to implement meaningful mitigation measures to reduce or prevent devastating ecological consequences.

84 - Ramifying effects of goldfish invasions on pond ecosystems

Emma Schubert[1], Anthony Ricciardi[1]

[1]McGill University

Over the past century, the aquarium trade has facilitated goldfish (*Carassius auratus*) introductions to urban and natural waterways worldwide, resulting in an enormous number of invasions whose impacts are largely undocumented. The few impact studies that have been conducted to date suggest that goldfish can substantially alter wetland ecosystems, challenging a perception among policy makers and the public that the species is innocuous. By feeding on benthic resources, goldfish can uproot macrophytes and re-suspend fine sediments, thereby increasing turbidity—an effect that is accelerated at higher temperatures; in turn, suspended sediment could potentially affect water temperature by absorbing and radiating heat, creating a positive feedback with goldfish sediment disturbance. Furthermore, by cycling phosphorus, goldfish affect the availability of a limiting nutrient to primary producers. To experimentally test these impacts in concert, we quantified the effects of goldfish density on turbidity, water temperature, and algal growth in an outdoor mesocosm array over four weeks using individual fish from an established invasive population. We hypothesized that turbidity and water temperature would increase with goldfish density, whereas algal growth would be a modal function of goldfish density, owing to opposing effects of nutrient excretion and turbidity. Contrary to our hypothesis, algal growth increased linearly with goldfish density. Data will be made available in Dryad upon manuscript submission. Our results demonstrate the potential engineering impacts of goldfish invasions on pond ecosystems by showing that fish-generated turbidity exceeds that of natural forces (such as wind and rain). We suggest that expanding goldfish populations could exacerbate the effects of climate change on pond ecosystems.

64 - Poeciliids through space and time: how do their impacts vary?

James Hodson[1], Elizabeth Duncan[1], Josie South[1]

[1]University of Leeds

Poeciliids, such as mosquitofish or guppies, are a family of live bearing predatory fish with a widespread invasive distribution in which they are typically highly aggressive, driving declines or complete loss of native macro-invertebrates, fish and amphibians. Invasive species trophic interactions are influenced by spatial contexts e.g. temperature, flow rate and prey identity or temporal contexts such as time since invasion and consequently will vary across this wide distribution. We use a meta-analysis of recorded Poeciliid impacts under a range of different contexts, to explore context-dependency in impact trends, assessing which functional groups (fish, amphibians, invertebrates, zooplankton etc.) are particularly under threat, and under which circumstances this threat will be greatest. Additionally, we use temporal information from

studies, or density as proxy, to explore how impacts change over time, aiming to identify generalisable patterns in invasion-dynamics. This meta-analysis will provide the first global synthesis of Poeciliid impact and provide crucial evidence to support management and policy decisions about future introductions, or trade of the family. It will also provide a framework for investigating invasion dynamics and context-dependent variation in impact across other families of aquatic invasive species.

29 - How can we humanely deal with the flood of caught invasive fish?

Miloš BUŘIČ[1], Miroslav Strob[2], Anna Hovorková[1], Jan Čížek[2], Jan Kašpar[1]

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The regulation of invasive fish species is a matter of concern for many countries worldwide. Many techniques of eradication/regulation can harm the environment significantly, especially chemical treatments. However, the same problem arises when the capture methods are used, and you are dealing with units, tens, and hundreds of kilograms or even tons of live fish. Killing by suffocation in water or on dry land cannot be considered humane from a legal and moral point of view. The commonly recommended practice to humanely sacrifice fish is overdosing by anaesthetics, applying poisonous substances or applying carbon dioxide in the water. These methods are as much problematic as bigger is the number of fish treated due to contamination of big volume of water or technical constrains. The need for invasive fish species regulation is therefore limited by this point. Hence, we started development of the mobile device using electric current for stunning and killing of fish. Here we present the first results of work which should enable to sacrifice of fish *in-situ* (no transfer related risks), species and size specific regulation (to minimize suffering), and automatic conductivity optimization. The first results confirm the effectivity of the device for immediate stunning of fish and effective sacrification of them in the next step. Different species (*Pseudorasbora parva*, *Lepomis gibbosus*, *Ameiurus melas*) reacted differently to electric current and the protocol for device usage will be therefore reasonably different for different species. Another important point is that the device can work without being connected to the electrical distribution system. The device minimizes the risks associated with the transport and escape of live individuals similarly as unwanted suffering of fish. The implementation of the device (in at least two different capacities) in practice and the finalisation for final industrially protected solution is the next step.

D9 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations II

316 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations

Sarah Bailey[1]

[1]Fisheries and Oceans Canada

This workshop, in combination with the Special Session on Transcending Boundaries Between the Science and Management of Ships' Ballast Water and Biofouling, aims to bridge the gap between research and policy, and to connect data needs and risk assessments with effective management and mitigation measures. Participants will be challenged to leverage and build on experience and lessons learned to improve the implementation of current ballast water management practices and advance new biofouling management policies.

B9 - From Attitudes to Action: Social Drivers in Aquatic Invasive Species Management

91 - Turning audiences into advocates: science communication that resonates

Lauren Rogers[1]

[1]Invasive Species Centre

With the growing threat of aquatic invasive species, a coordinated response across diverse groups with varying levels of technical knowledge is essential for effective prevention and management. Achieving this requires meaningful engagement with a wide range of stakeholders, including government agencies, environmental organizations, Indigenous communities, industry leaders, recreational users, and the general public, and securing broad buy-in for behaviours that support shared goals. Because each group brings unique values, concerns, and knowledge, tailored communications are a cornerstone of success.

Well-established social science principles underscore this need. *Ethos* builds trust through credible sources, *Logos* demonstrates the measurable ecological and economic impacts of invasive species, and *Pathos* connects to shared values such as protecting lakes, rivers, and fisheries. Audience identification, values-based message development, and strategies for gaining commitment highlight the importance of campaigns centered on audience-driven messaging.

This presentation integrates both theory and practice. Drawing on established communications frameworks and original data collected by the Invasive Species Centre, including focus groups, surveys, and social media and website analytics, the presentation will examine the development, effectiveness, and outcomes of audience-driven strategies. Findings reveal which

messages resonate most strongly, which behaviours are most likely to shift, and what barriers to action persist.

Attendees will leave with practical tools for designing campaigns that engage stakeholders, foster meaningful behaviour change, and enhance invasive species prevention and management. By grounding efforts in audience-driven approaches, communications can motivate action and ultimately contribute to healthier, more resilient aquatic ecosystems.

273 - Transcending Geographic Attribution in Invasive Species Nomenclature: A Multi-Database Analysis Reveals Patterns, Alternatives, and Pathways for Inclusive Communication

Samuel Chan[1]

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Invasive species nomenclature serves critical communication functions across science, management, and public engagement, yet naming conventions may inadvertently associate ecological challenges with specific peoples, places, and cultures. We conducted a comprehensive analysis of both common names (16,491 database entries representing 13,377 unique species) and scientific names (14,132 unique species) across four U.S. federal and international databases (USGS US-RIIS, USGS NAS, USDA NISC, IUCN 100 Worst) to quantify geographic-cultural nomenclature patterns and identify effective alternatives.

We developed a systematic geographic-cultural reference dictionary (743 term variants representing 410+ base terms across six regional categories: Asian, European, African, American, Oceanian, and Middle Eastern) to classify nomenclature. Geographic-cultural references represent only 6.7% of common names and 7.6% of scientific names overall, demonstrating that over 90% of species successfully employ alternative approaches. Critically, educational and outreach databases show 4.5-fold higher geographic-cultural usage than technical databases (28.1% vs. 6.3%), presenting a strategic opportunity since these high-visibility materials receive disproportionate attention in public communication and policy discussions. Application patterns are highly selective: Asian-based names comprise 52% of common name geographic-cultural references and 32-53% of scientific name references, while database purpose predicts usage 2.5-4× more strongly than ecosystem type.

Analysis reveals proven alternatives already dominate: 4,778 species employ characteristic-based common names that describe observable features rather than origins (70.5% effectiveness in educational contexts), while 92.4% of scientific names avoid geographic-cultural attribution. These characteristic-based approaches enhance field identification while minimizing cultural attribution. Database analysis protocols and dictionaries available upon request.

These findings transcend traditional boundaries—geographic, cultural, and disciplinary—by demonstrating that inclusive nomenclature practices are not only achievable but already prevalent. We outline evidence-based pathways for community-driven nomenclature review,

particularly for high-visibility educational and outreach materials, and discuss how these approaches can enhance identification utility while fostering more equitable global collaboration in invasive species management.

102 - Identifying motivations and engagement typologies for successful invasive riparian plant management.

Clare Pitt[1], Thomas Bodey[1], Flurina Wartmann[1], Xavier Lambin[1]

[1]University of Aberdeen

The management of invasive riparian plants is resource-intensive, requiring consistent and repeated management over long periods of time. As a result, management regularly relies on the efforts of volunteers to reduce demands on limited finances and staff time in both the governmental and non-governmental sectors. The Scottish Invasive Species Initiative (SISI), a project established to provide a centralised focus for the strategic control of invasive riparian plants is one such example. SISI coordinates and supports targeted removal of species across multiple river catchments in Northern Scotland. SISI includes a range of active stakeholders but is grounded in volunteerism. However, little is known about *why* volunteers participate in invasive plant control, or what sociological or ecological benefits they accrue that empower them to continue their efforts across time or space. Similarly, the extent to which such benefits and motivations change as a result of top-down or bottom-up organisational approaches is poorly understood yet could be critical to retaining a reliable volunteer network.

In this study, we interviewed volunteers across multiple catchments about their motivations for volunteering with SISI, how they engage with SISI as an organisational structure itself, and their views on managing invasive non-native species generally. We also considered the wider context in which interviewees choose to volunteer, including the influences of demographics, multiplex relationships and place identity. We were able to identify multiple volunteer typologies within the broader SISI project, characterised by differing motivations and engagement. These typologies strongly influenced the effectiveness of top-down organisational support versus bottom-up volunteer-driven actions. This demonstrates the importance of understanding individual motivations, and what represents meaningful or beneficial participation for individuals, to ensure crucial volunteer participation can be maximised and effectively targeted. Our novel insights underscore the need to integrate volunteers into decision-making through reshaping long-term collaborative governance in invasive species control projects.

106 - Enhancing Baitfish Pathway Management: Developing a Regionally Coordinated Guide to Support Early Detection and Prevention of Aquatic Invasive Species in the Great Lakes

Sara Stahlman[1]

[1]Pennsylvania Sea Grant

Aquatic Invasive Species (AIS) pose ongoing ecological and economic threats to the Great Lakes, with the baitfish pathway remaining a persistent vector of spread. This presentation outlines a collaborative effort with the Great Lakes Commission and the Great Lakes Panel on Aquatic Invasive Species to develop a regionally coordinated bait identification guide. The goal of this resource is to support outreach across the bait industry and improve early detection and identification of AIS within baitfish supplies, strengthening prevention and interjurisdictional management efforts. To inform this effort, a content analysis of 18 bait and fish identification guides was conducted, coding for features such as species organization, visual aids, regulatory messaging, environmental context, and overall accessibility. Results indicate that while most guides utilize accessible language, family-level organization, and use supporting visuals, there are significant opportunities to improve visual clarity, regulatory and environmental messaging, and overall cohesiveness of prevention messages. Direct engagement of bait suppliers, dealers, and other industry partners is also critical to ensure that sector-specific needs and perceptions shape the relevance and practical application of the resource. By building on existing resources and integrating stakeholder perspectives, this initiative underscores the value of regional coordination and shared tools in advancing AIS prevention across the Great Lakes.

210 - Recreational Boater Movements as a Vector for AIS Spread in Eastern Canada

Andrew Guerin[1], Andréa Weise[1], Jaclyn Hill[1], Marc-André Plourde[1], Anne Allard-Duchêne[2], Matys Tessier[3], Ève Courtois[4]

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The stowaway pathway - translocation of aquatic invasive species (AIS) via recreational boating - is an important vector for the spread of AIS among waterbodies. Understanding this pathway is critical for managing freshwater AIS in Eastern Canada, particularly in the transboundary watersheds shared by the provinces of Quebec and New Brunswick, where zebra mussels (*Dreissena polymorpha*) have recently arrived, and information on boater movements is lacking.

Recreational boaters were surveyed at 24 sites in the Bas-Saint-Laurent region (eastern Quebec) and in New Brunswick. Boats were categorised by complexity, reflecting risk of AIS transport, and boaters listed sites they had visited or planned to visit during the 30 days before and after the survey, along with details of their cleaning practices. This collaborative effort involved staff from two Fisheries and Oceans Canada regions and multiple NGOs from both provinces.

Almost half of surveyed boaters (47%) reported visiting multiple waterbodies during the boating season, highlighting the potential for AIS transfer. This proportion varied with boat type; 37% of 'high risk' boat owners visited multiple sites compared to 68% of boaters with lower-risk, non-motorised craft. While more than 80% of boaters reported cleaning their boats between waterbodies, when asked about frequency, only 66% reported that they 'always' clean, drain, and dry their boats. Reported movements revealed a regional network of over 70 interconnected sites, along with 50 sites outside the region, which are potential sources of new AIS introductions.

Survey results and inter-lake connectivity data, which highlight those waterbodies at highest risk of AIS introduction, will be published in open-access articles and data repositories. This will inform management action, such as prioritizing high-connectivity sites for boat cleaning stations, and development of boat cleaning policies. These findings also provide insights into the habits of recreational boaters, which will help improve awareness campaigns.

E9 - Workshop: Bridging the Knowing-Doing Gap: Advancing eDNA Applications Beyond Presence/Absence in Invasion Science and Management

115 - Bridging the knowing-doing gap: Advancing eDNA applications beyond presence/absence in invasion science and management

Teun Everts[1], Rein Brys[1]

[1]Research Institute for Nature and Forest (INBO)

Nearly two decades after its introduction, the analysis of environmental DNA (eDNA) from aquatic samples has advanced considerably. eDNA-based detection techniques are now shifting from a methodological development phase to a pragmatic, application-oriented stage, increasingly informing ecology and conservation. In invasion science and management, eDNA holds promise as a coordinating and informative tool. Yet, its practical use often remains limited to detecting the mere species presence, while the technology can provide a wealth of complementary insights. Beyond presence/absence, eDNA can be used to track invasion fronts, identify breeding populations, reveal species phenology, quantify dispersal, investigate ecological interactions, and uncover hybridization events. This demonstrates the substantial, yet underutilized, potential of eDNA for advancing invasion science and improving management.

The aim of this GuardIAS workshop is to bridge the "knowing-doing gap" in applying eDNA beyond simple detection in invasion science and management. To achieve this, we will bring

together leading experts in eDNA with invasion scientists, managers, and policymakers at ICAIS 2026. The two-hour workshop will consist of three parts: (1) concise expert presentations (~5 minutes each; 45 minutes total) highlighting innovative applications of eDNA beyond presence/absenc; (2) a moderated discussion (~45 minutes) between experts and end-users to identify the main hurdles and concerns limiting broader adoption; and (3) a synthesis session (~30 minutes) to summarize barriers to implementation and draft the basis of a global questionnaire, to be disseminated after the workshop, aimed at further addressing the knowing-doing gap across research, practice, and policy. The specific objectives are threefold: (1) to inform end users about the potential of eDNA-based analyses; (2) to inform eDNA experts about the hurdles that end users face in moving beyond presence/absence; and (3) to draft a scientific paper synthesizing these insights to guide both the eDNA and invasion communities on overcoming barriers to broader application.

C9 - Guardians of the Coast: Integrating Monitoring with Management

225 - Working towards a standardised approach to detect and manage marine invasive species in understudied regions

Katie O'Shaughnessy[1, 2]

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The escalating threat of marine invasive species calls for prevention and monitoring approaches that cross geographic and habitat boundaries. Ports and marinas act as sentinels for invasions because high vessel traffic and propagule pressure make them hotspots. Although often considered “sacrificial” areas, invasive species can spill over from ports into protected and conservation-priority habitats. Focusing early detection on ports and marinas can therefore improve scientific understanding and adaptive management before invasives spread into sensitive areas. Opportunities to test similar hypotheses with standardised methods across different geographies, environmental conditions, and biological pressures should be pursued to improve early detection, track spread, and understand spatial trends. To this end, we deployed standardised settlement tiles in coastal Alabama (US) over two summers to test effects of manual scraping, exposure level (exposed, sheltered), salinity, duration, and seasonal timing on colonising communities. We identified 18 biofouling species, including two non-natives: the bay barnacle, *Amphibalanus reticulatus*, and the encrusting bryozoan, *Hippoporina indica*, both first records for Alabama. Exposure level, salinity, and scraping drove significant differences in community composition. The strength of this approach will lie in its reproducibility across geographic boundaries. A parallel study will be conducted in coastal South Africa, where ports adjacent to marine protected areas provide an ideal testing ground for invasion patterns. We hypothesize that despite biotic and abiotic differences between the US and South Africa, colonising communities will show similar biological response patterns. Given that both regions

remain understudied, these data are timely and critical for developing standardised monitoring approaches. Establishing ports and marinas as sentinel networks may offer early warning systems while providing the baseline information needed to manage marine invasives in both understudied and protected areas.

215 - The issues involved with producing accurate inventories of marine non-native species; case study of the United Kingdom

Phil Davison[1], co-authors to be confirmed[1]

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Accurate national or regional inventories of non-native species (NNS) are an important component of monitoring and management strategies, providing a baseline against which future developments can be assessed. With a group of marine NNS experts, we produced an updated baseline inventory of the marine non-native species in the United Kingdom of Great Britain and Northern Ireland, and categorised c. 108 species as being established in UK waters. This is approximately 50 more species than were identified in the last published UK inventory (from 2013), which demonstrates the continuing arrival and establishment of new NNS. Based on expert knowledge and published information, other species were assigned to categories of: non-established NNS; cryptogenic species for which non-native status is considered unproven; newly-arrived species for which establishment cannot yet be proven; and data-deficient species for which occurrence in the UK is uncertain.

A range of issues were encountered during production of the inventory, which will be common to similar projects undertaken elsewhere. These issues will be illustrated with examples from our project, and include: taxonomic and geographical recording bias which skews analyses based on the inventory; dealing with taxonomic uncertainty; determining threshold criteria for establishment based on a few records of a species or a new arrival; and deciding on non-native, cryptogenic or native status based on conflicting evidence. Increasingly, improved taxonomic resolution of species complexes will inform decisions on non-native status, and in this respect it is notable that over 10 % of the species assigned to the established NNS category have been scientifically described in the last 25 years. The overall recommendation is that national or regional NNS inventories should be reviewed regularly, both to incorporate newly-recorded species and to re-assess previously included (or discounted) species based on new evidence which better informs decisions on their non-native status.

51 - Mobilization and concerted action targeting aquatic invasive species in the Magdalen Islands

Noémie Pelletier[1]

[1]Comité ZIP des Îles-de-la-Madeleine

The Magdalen Islands, an archipelago in the Gulf of St. Lawrence (Canada), comprise five lagoons and are characterized by relatively warm, sheltered waters. Long-term monitoring by Fisheries and Oceans Canada has provided valuable data on species composition and population dynamics. Over the past two decades, species of greater concern have established themselves in local water bodies, raising critical issues for biodiversity conservation and the sustainability of fisheries. This context has underscored the need for structured, collaborative management responses.

To address these challenges, the Comité ZIP des Îles-de-la-Madeleine, has initiated a three-year project, funded by Fisheries and Oceans Canada's AIS Prevention Fund, focused on implementing targeted interventions and developing coordinated regional strategies for AIS management.

The project's first phase targets commercial and recreational boats as vector of AIS spread, through the installation of autonomous cleaning stations—among the first in Canada to be implemented in marine environments—and the acquisition of an underwater drone for removing AIS from submerged hulls fishing vessels

The second phase addresses the proliferation of the European green crab (*Carcinus maenas*) through intensified trapping efforts in key lagoon systems and the establishment of a broad, citizen-based detection network through awareness and training initiatives. The third phase focuses on an annual characterization of the vase tunicate (*Ciona intestinalis*) at selected ports and marinas, including manual removal from infrastructure by divers.

A fourth and final component emphasizes stakeholder coordination. A regional committee has been established to develop three action plans: (1) prevention of new species introductions, (2) management of established populations, and (3) rapid response protocols for newly detected species or site colonization.

This integrated, multi-pronged approach aims to enhance ecological resilience and inform best practices for AIS management in sensitive coastal ecosystems.

167 - 17 years of detection and assessment of non-native species in German coastal waters

Annika Cornelius[1], Christian Buschbaum[1]

[1]Alfred-Wegener Institut

Introduced marine organisms can substantially influence resident species, communities, and their interactions. Many nations are therefore investing considerable efforts in preventing or at least minimizing new introductions of non-native invasive species (NIS). A prerequisite for effective management is sound knowledge of the current invasion status in coastal areas. Reliable inventories of NIS and their temporal dynamics are essential, supported by standardized monitoring schemes that enable early detection of new arrivals and track the spread and distribution of already established species.

In Germany, a national survey and assessment program for non-native marine species has been established through close cooperation between governmental authorities and the scientific community. Since 2009, annual monitoring has been conducted along the German coast, combining Rapid Assessment Surveys (RAS) with the deployment of settlement panels at invasion hotspots. By 2024, a total of 159 introduced marine species had been recorded, most of them sessile organisms introduced via ship fouling or as associates of aquaculture species such as oysters. To date, these non-native species have not displaced native organisms and their effects on ecosystem functioning along the German coast appear negligible. Consequently, management efforts should continue to prioritize prevention of new introductions over eradication measures.

We will summarize 22 years of monitoring data from the German coasts, offering insights into temporal invasion dynamics, species-specific developments, and pathways of introduction. It will further explain how the German monitoring scheme was developed and is continuously operated in a process of *co-creation* between science and authorities. This joint approach has proven advantageous, ensuring methodological robustness, long-term continuity, and direct usability of the results for policy and management. By highlighting both ecological findings and governance lessons, the talk will inform future strategies for early detection, prevention, and sustainable management of marine NIS.

A9 - Wave After Wave: The Splashy Science of Fish Invasions

289 - Habitat preferences and seasonal dynamics of invasive suckermouth (Hypostomus plecostomus) armored catfish in spring ecosystems

Cora Mickey[1], Riley Taylor[1], Joey Perez[1], Robert Mullenhauer[2], Monica Mcgarrity[3], Matthew Troia[1]

[1]The University of Texas at San Antonio, [2]Washington Department of Fish & Wildlife, [3]Texas Parks & Wildlife Department

Suckermouth armored catfish (SAC) of the family Loricariidae are native to South America but are globally invasive. Tropical ecosystems are most vulnerable to SAC invasion but thermally buffered spring-fed streams in subtropical climates are also vulnerable. SAC degrade habitat, alter biogeochemical cycles, and compete with and potentially negatively impact native benthic fishes. Our objective was to quantify habitat preference of SAC in spring-fed streams and assess habitat niche overlap with native benthic fish. We quantified these responses seasonally to assess habitat use, including use of thermal refuges by cold-intolerant SAC during the winter. We conducted snorkel counts of SAC and imperiled Rio Grande darters (*Etheostoma grahami*) seasonally from January 2024 to January 2026 at 36 transects arrayed along a 3 km gradient of

spring influence in San Felipe Creek, Texas, USA. During each season, we monitored temperature regimes using *in situ* loggers and measured in-stream habitat variables (depth, velocity, substrate, etc.). First, we used the ordination technique, outlying mean index (OMI) analysis, to quantify multivariate niche dimensions of SAC and darters and assess niche overlap. Darters preferred higher velocities and coarser substrates in the midchannel, whereas SAC preferred bedrock substrates associated with undercut banks. Second, we fit occupancy models to evaluate variation in detection probability (p) and occurrence (Ψ). Occurrence was high in both channel margin (Ψ = 0.98) and midchannel (Ψ = 0.79) transects but was significantly lower in midchannel transects in spring (Ψ = 0.46)—a habitat shift potentially associated with seasonal burrow spawning behavior. In order to most effectively manage populations of SAC, understanding seasonal habitat preference is fundamental in subtropical climates. Further, this project will assess other spring-fed streams within Texas to establish if habitat preferences are consistent among similar ecosystems. This research may inform mitigation techniques for the SAC to prevent impacts on native species.

185 - Rainbow trout and Brown trout - two global invasive species in a UK and Irish context.

Ciara McGlade[1], Sarah Helyar[2], Jaimie Dick[2]

[1]The Rivers Trust, [2]Queen's University Belfast

Salmonids are amongst the most important invasive freshwater fish worldwide (Cucherousset 2011), with rainbow trout (*Onchorhynchus mykiss*) considered the most widely introduced fish species in the world (Stankovic 2015). In the UK and Ireland, the rainbow trout has limited success in establishing wild populations, with only a single self-sustaining population evident in the Wye River in England. Despite this, due to its status as a farmed fish it is still widespread throughout the UK and Ireland, with high farming densities leading to very high propagule pressures when escapes occur. Brown trout (*Salmo trutta*), although native to the UK and Ireland, is also a highly successful invader elsewhere, and so may provide biotic resistance to rainbow trout escapees or wild populations. This presentation will explore the dynamics between the two species, including the role of domestication, within a UK and Ireland context.

To analyse the potential impacts of these regular, and sometimes severe, escapes of rainbow trout in UK and Irish waters, a series of studies was conducted, including a controlled release into an Irish stream, an analysis of the persistence and success of feeding of farmed individuals following a mass escape in 2017, and an analysis of this mass escape on the potential impacts on the native brown trout population. Despite a low persistence of escapees, evidence was found for impacts of these escapes on the native brown trout population, as well as a shift towards feeding on natural prey with time since escape. The results suggest that despite a lack of self-sustaining populations, current practices with regards to the farming of this species and the subsequent risk of high density escapes puts native communities at risk of potentially significant impact.

206 - Behavioural shifts in invasive Ponto-Caspian gobies in response to predator and disturbance cues

Madelaine Picard[1], Veronica Groves[1], Anthony Ricciardi[1]

[1]McGill University

Many aquatic species use chemical cues to assess the level of predation risk in their environment and use the information to balance predator avoidance with resource acquisition. There is a lack of documented evidence for the use of chemical risk cues to inform such ecological trade-offs in invasive fishes, including the round goby (*Neogobius melanostomus*) and tubenose goby (*Proterorhinus semilunaris*). We experimentally examined how chemical risk cues that vary in their source and intensity can affect foraging and shelter use in gobies from invasive populations in the St Lawrence River. Firstly, we examined how round goby respond to risk cues of varying intensity by acutely exposing individuals to 1) a conspecific damage-released alarm cue, 2) the odour of a native predator, and 3) a water control. These results provide insight into the behaviour of invaders as potentially naïve prey in their new environment. Our second experiment examined the effect of cue source by investigating how round and tubenose gobies respond to both disturbed and undisturbed cues from conspecifics and from each other as heterospecific competitors. Although chemical cues are classically used in the context of predation, this experiment examined how these competitors respond to the undisturbed odour of one another. We predicted that both species would recognize one another's disturbance cues and exhibit similar antipredator behaviours, due to their shared evolutionary history and predator experience in their invaded range. The results provide insight into context-dependent differences in foraging behaviour between these two Ponto-Caspian fishes.

195 - Two decades of monitoring non-indigenous freshwater fishes in Flanders, Belgium: trends and distribution patterns

Rhea Maesele[1], Hugo Verreycken[1]

[1]Research Institute for Nature and Forest

Non-indigenous freshwater fishes are increasingly recognized as key drivers of ecological change in European aquatic ecosystems. They can affect the aquatic environment by modifying conditions such as altering the water quality and uprooting plants. They threaten the native species by competing for food and habitat, potential hybridization or by introducing new parasites or diseases.

Despite growing awareness, long-term regional assessments remain limited. Flanders (Belgium) provides a good case study, as its dense hydrological network and high connectivity to international waterways make is particularly vulnerable to freshwater fish invasions.

Over the past three decades, our freshwater fish monitoring programme has generated valuable data on the occurrence of non-indigenous aquatic species. We gathered over 4.3 million species observations in our dataset, which is openly available on GBIF. Of these, we selected the non-indigenous fish species data for our analysis. The number of non-native fish species increased sharply over the last decades and has now reached to 29 species of which at least 15 are established. We analysed the monitoring data to assess trends in species richness, establishment success, and spatial distribution of non-indigenous freshwater fishes in Flanders. This assessment sheds light on invasion dynamics in a highly managed river landscape and provides essential insights for future management and policy actions.

This presentation will highlight the temporospatial trends in some of the most recent non-indigenous fish species in Flanders (Belgium).

Plenary Presention #5: Tammy Robinson-Smythe

282 - Research in support of conservation: Managing invasions in South African marine protected areas

Tammy Robinson-Smythe[1]

[1]Stellenbosch University

Marine protected areas (MPAs) have a mandate to protect biodiversity, secure ecosystem services and support human health and well-being. Biological invasions undermine the ability of MPAs to meet these goals. Despite this recognition, the ability of South African conservation agencies to respond to invasions has been very limited. This has been addressed by developing a close working relationship with agencies that has included information sharing, training, collaboration and resource pooling. A prerequisite for evidence-based decision-making in alien species management, are complete species lists and routine monitoring. However, in a South African context, the resources available to meet these goals are limited. In response, field survey methodologies have been optimised and approaches have developed for unlocking high quality citizen science data - ultimately leading to the detection of eight species previously unreported from South Africa. Using a modelling approach to combine information on the environmental and habitat requirements of species and the pathways that link locations along the coast, a process has been developed for identifying MPAs that are at risk of invasion by newly recorded species. This will support MPAs in identifying taxa for which they need to develop site specific contingency plans, a key step in the pre-emptive management of impactful invaders. Strong interpersonal and interinstitutional relationships coupled with sound science have been key to developing an uncontested scientific basis for managing invasions in South African MPAs.

B10 - The Biology Beneath: Parasites and Pathogens in Aquatic Invasions

317 - PRESENTATION MOVED - EMPTY SLOT

N/A N/A[1]

[1]ICAIS

N/A

241 - Modeling growth and mortality relationships of an ecosystem engineer shrimp and its invasive parasite

Grace Roa[1], John Chapman[1], Brett Dumbauld[2], Mattias Johansson[3], Will White[1]

[1]Oregon State University, [2]US Department of Agriculture - Agricultural Research Service, [3]University of The Bahamas

Populations of the northeast Pacific blue mud shrimp (*Upogebia pugettensis*) are rapidly declining across their range in association with heavy infestations by the invasive parasitic Asian bopyrid isopod *Orthione griffenis*. This parasite effectively castrates female mud shrimp by extracting sufficient hemolymph to eliminate reproduction. Without refuge from the invasive parasite, long-term host resilience or coexistence is unlikely for these shrimp populations. Understanding the energetics and population dynamics of this system is critical for effective intervention, yet such knowledge is lacking for any marine bopyrid isopod-host association. Although host biomass can only decrease through isopod infestation, mud shrimp mass relative to length does not decrease with increasing parasite load, highlighting unresolved questions about the energetic basis of this interaction. Getting direct measurements of growth is also challenging, since it is nearly impossible to culture or manipulate the shrimp experimentally. Additionally, if mortality varies with size, size-dependent growth rates cannot be reliably inferred from population size distributions alone. To address these challenges, we developed size-based integral projection models that incorporate temporal variation in the size structure of both shrimp and parasites. Model analyses narrow the range of possible patterns of size-dependent growth, age, and mortality for infected and uninfected shrimp, yielding new testable hypotheses about the key drivers of population decline. Our results provide a mechanistic framework for understanding host-parasite energetics and demography, as well as represent a critical step toward predicting, and potentially mitigating, the continued collapse of *U. pugettensis* populations.

137 - Comparing Infection Parameters of the Invasive Nematode Parasite Anguillicola crassus Between Ecotypes of European Eel in Lough Erne, Northern Ireland

Niamh Heatley[1], Derek Evans[2], Jonathan Houghton[1], Jaimie Dick[1]

[1]School of Biological Sciences, Queen's University Belfast, [2]Agri-Food and Biosciences Institute

The haematophagic nematode parasite, *Anguillicola crassus*, is native to East Asia and was first described in the swimbladder of Japanese eels *Anguilla japonica*. Following accidental introduction to Germany through the aquaculture trade in the early 1980s, this introduced pathogen is now considered ubiquitous in European eel *Anguilla anguilla* habitat. *A. crassus* infection damages the swimbladder, and in swim tunnel experiments designed to replicate the European eel's transatlantic spawning migration, has been shown to reduce swimming efficiency and increase the energetic cost of transport. During their continental growth phase, in which they accumulate fat content to fuel this spawning migration, European eel are known to exist as one of two ecotypes: narrowhead or broadhead. Narrowhead individuals are primarily insectivorous, while broadhead individuals eat larger, or more hard-bodied prey resulting in an overdeveloped jaw musculature and low body fat. A comparative study looking at infection parameters of *Anguillicola crassus* in a sympatric population of narrow and broadhead individuals was carried out in Lower Lough Erne, Northern Ireland. The possible roles of paratenic hosts and definitive host ontogeny on infection parameters, and implications for reproductive fitness of European eel ecotypes, are discussed.

313 - A mixture of pheromone behavioral antagonists reduces invasive sea lamprey spawning activity in a natural stream

Anne Scott[1], Joseph Riedy[1], Sonam Tamrakar[1], Weiming Li[1]

[1]Michigan State University

The sea lamprey (*Petromyzon marinus*) is an invasive parasite in the Laurentian Great Lakes that contributed to the historic collapse of the native fish communities. Ongoing control efforts, including lampricides and migration barriers, are necessary to control sea lamprey. Our study evaluated an additional control strategy that targets pheromone communication in sea lamprey. Previous work identified petromyzonol sulfate (PZS) and petromyzonol tetrasulfate (3sPZS) as pheromone behavioral antagonists that reduced olfactory responses and female attraction to the male sex pheromone 3-keto petromyzonol sulfate (3kPZS) over short exposure periods. Here, we examined whether a mixture of PZS and 3sPZS reduces spawning activity over a longer timescale in a natural spawning ground. During 24-hour trials conducted across the spawning season, application of the antagonist mixture reduced the total number of spawning events by 53% compared to control trials. Visual surveys also indicated lower wild female abundance in

the system during antagonist treatments. Mature males and females tagged with passive integrated transponder (PIT) and released into the spawning stream spent, on average, 26% less time in the prime spawning zone when antagonists were applied than during control trials. These results demonstrate that behavioral antagonists can suppress spawning activity and may inform the development of additional tactics to supplement current control of invasive sea lamprey. This study was funded by the Great Lakes Fishery Commission.

D10 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations III

316 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations

Sarah Bailey[1]

[1]Fisheries and Oceans Canada

This workshop, in combination with the Special Session on Transcending Boundaries Between the Science and Management of Ships' Ballast Water and Biofouling, aims to bridge the gap between research and policy, and to connect data needs and risk assessments with effective management and mitigation measures. Participants will be challenged to leverage and build on experience and lessons learned to improve the implementation of current ballast water management practices and advance new biofouling management policies.

E10 - Watching the Waters: Ecological Drivers of Aquatic Invasive Species Success

242 - Computer vision assessment of life cycle dynamics in the invasive freshwater hydrozoan Craspedacusta sowerbii

Jonathan Zhu[1], Jensyn Langguth[1], Seyed Hossein Ghotbi[2], Muhammad Daffa Robani[2], Vivian Wong[2], Reza Aghla Ardyan[2], Nadine Rorem[1]

[1]Wheaton College, [2]AwanTunai

Prior research on the life cycle of the invasive freshwater hydrozoan *Craspedacusta sowerbii* relies primarily on manual observation performed at long intervals of a day or more. While it is known that *C. sowerbii* polyp colonies bud frustules which then transform into more polyp colonies, specific details about this process are still unknown, including the age at which polyps bud frustules, the time it takes for a frustule to transform into a polyp colony, and the time it

takes for a polyp colony to produce additional polyps. Shortening the interval between observations will allow researchers to gain more insight about the life cycle of *C. sowerbii*. More thorough and precise analysis is made available by highly accurate and automated computer vision models developed from frequent image capturing.

Based on preliminary data of *C. sowerbii* polyp colonies and frustules while exposed to different light durations, we automated a system to capture microscope images of polyp colonies and frustules every 15 minutes while exposed to constant light. We have currently observed several previously unobserved phenomena, including frustule movement and the transformation from frustule to polyp. We calculated preliminary estimates on the number of days for a frustule to transform into a polyp. After manual data labeling, we will implement an automated pipeline to extract insights into the life cycle dynamics from *C. sowerbii* microscope images using high-performance, open-source algorithms and libraries, including ResNet-34 for image recognition and the Python libraries pytorch and opencv for object detection. We plan to make all code and image data publicly available on GitHub and Google Drive, respectively, upon publication of this work. The results from these imaging data will provide a greater understanding about this invasive hydroid and will allow for potential predictions about colony development and perhaps even occurrences of jellyfish medusae.

251 - Evidence of the establishment process of an invasive species: The Cyclomorphosis Event of the Dinoflagellate Ceratium furcoides in a Tropical Reservoir (Santa Branca, SP - Brazil).

Raphael Corrêa[1], Rafael Macêdo[2], Vera Huszar[3], Christina Castelo Branco[1]

[1]Federal University of The State of Rio de Janeiro, [2]Institute of Biology, Freie Universität Berlin, [3]Laboratório de Ficologia, Departamento de Botânica, Universidade Federal do Rio de Janeiro/UFRJ, Museu Nacional

The non-native dinoflagellate *Ceratium furcoides* is spreading across South American freshwater reservoirs. We investigated aspects of its autecology during its recent invasion and establishment in an oligotrophic to mesotrophic reservoir in southeastern Brazil (Santa Branca, SP), aiming to identify population features in relation to environmental variables and the resident native biota. Plankton communities were sampled using two strategies: subsurface collections for phytoplankton and vertical hauls for zooplankton, conducted during both dry and rainy seasons from 2011 to 2014. Detection of *C. furcoides* by vertical hauls was delayed and yielded much lower densities, ranging from 0.38 to 1,280 ind. L^{-1}. In contrast, subsurface sampling recorded higher densities (up to 62,970 ind. L^{-1}), although it was less effective in detecting spatial and temporal patterns. Densities of *C. furcoides* were positively correlated with water temperature, dissolved oxygen, and electrical conductivity. Cyclomorphosis was observed and may have contributed to population persistence. Initially, individuals with three antapical horns and larger biovolume (71.10 μm^3) predominated in most samples in 2011. These were later

replaced by individuals with two horns and smaller biovolume (66.53 μm³) under water temperatures above 27 °C, as observed in 2014. Although species of the genus *Ceratium* are commonly associated with eutrophic environments, *C. furcoides* was also found in mesotrophic systems such as the Santa Branca Reservoir, where cyclomorphosis was likewise recorded. Examining the relationships between its populations and limnological variables provides insights into the dynamics of establishment of this invasive species in reservoirs.

138 - Bass With No Boundaries: Investigating the drivers of smallmouth bass (Micropterus dolomieu) invasion in the southwest Margaree River, Nova Scotia, Canada

Isabelle Tormasi[1], Kristen Cyr[1], Holly Mosco[1], Christina Semeniuk[1]

[1]University of Windsor

The link between individual behaviour traits and movement in fishes is being increasingly studied, particularly in terms of invasion potential. Behaviours such as boldness and exploration play a key role in facilitating how organisms interact with their ecosystems and can therefore be used to explain the movement and invasion success of non-native species. Smallmouth bass (*Micropterus dolomieu;* SMB) were introduced into Nova Scotia through legal introductions to bolster the fishing industry in the 1940s; and were first documented in Lake Ainslie, Cape Breton Island, in 2003. There are no physical barriers separating the lake from the southwest (SW) branch of the Margaree River and given the river presents ideal SMB habitat with areas of slow flow, vegetation, and warm temperatures, fish could readily occupy the river. Nonetheless, SMB riverine usage and drivers of movement in this region remain poorly understood. Our study investigates the role intrinsic factors have on SMB movement in the SW branch. To detect occupancy, directionality, and timing to reach farthest point downstream, 28 acoustic receivers were deployed in gates. Habitat characteristics such as flow, water temperature, and substrate were also recorded weekly from July to September 2025. We tagged 30 SMB with acoustic tags at three sites: two in the upstream portion of the river close to the lake, and one 21km downstream. Prior to tagging each fish, in-stream behavioural studies assessed behavioural types such as boldness and exploration through assays involving predator avoidance, shelter use, and acclimation to novelty. The resultant data was used to describe how behavioural types influence movement characteristics of SMB in the river. Our findings provide a characterization of SMB invasion potential and can be used to create effective management strategies such as tracking bold individuals to an aggregation on an invasion front that can then be effectively targeted for removal.

42 - Breaking In: Spreading and Habitat Flexibility of the Eastern Tubenose Goby in the Baltic Sea

Katariina Kurina[1], Imre Taal[1], Anu Albert[1], Aare Verliin[1], Roland Svirgsden[1], Martin Kesler[1], Lauri Saks[1, 2]

[1]Estonian Marine Institute University of Tartu, [2]Institute of Veterinary Medicine and Animal Sciencesof the Estonian University of Life Sciences

Non-indigenous species pose a major challenge to aquatic ecosystems, yet early documentation of their establishment and spread remains scarce. In 2020, the eastern tubenose goby *Proterorhinus semipellucidus* (Kessler, 1877) was first recorded in the Gulf of Finland (Truuverk et al. 2021). Since then, annual monitoring along the northern Estonian coast has offered a rare opportunity to study early invasion dynamics. Subsequent work confirmed the successful establishment of a population (Kurina et al. 2024), a prerequisite for further spread.

This study aimed to document the expansion of *P. semipellucidus*, characterize its habitat use, and assess its invasive potential in the Baltic Sea basin. Continuous monitoring, combining field surveys, molecular identification, and distribution mapping, revealed rapid westward dispersal averaging ~35 km per year. The species spreads both along coastal zones and upstream into rivers (Taal et al. 2024), occupying environments from brackish coastal waters to freshwater tributaries.

Although commonly found on gently sloping rip-rap habitats, *P. semipellucidus* also occurs on sandy and muddy substrates. Habitat preference was not statistically supported (Poisson GLMM: $\chi^2 = 5.46$, df = 6, p = 0.48), suggesting limited substrate-specific selection during early invasion stages. Algal cover at occupied sites ranged from 0% to >50%, and population densities varied from 1 to 41 individuals per 100 m², highlighting ecological flexibility and potential for locally high abundances.

This is the first study to demonstrate that *P. semipellucidus* combines rapid dispersal with broad habitat tolerance, underscoring its strong invasion potential. River systems may facilitate spread into continental Europe, while salinity gradients westward in the Baltic Sea may act as a barrier. These findings offer a valuable model for understanding early invasion dynamics in temperate aquatic ecosystems.

References

Kurina et al. (2024) doi: 10.1007/s10641-024-01604-4

Taal et al. (2024) doi: 10.3176/proc.2024.3.08

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A10 - Survival of the Fishiest: Traits That Tip the Scales I

96 - Does artificial light at night (ALAN) favour invasive species over natives? Responses of freshwater fish to chronic ALAN exposure

Mateusz Augustyniak[1], Łukasz Jermacz[1], Tibor Erős[2], Jarosław Kobak[1], Tomasz Kakareko[1], Bálint Preiszner[2], Magdalena Czarnecka[1]

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The artificial light at night (ALAN) significantly disrupts biological clocks and is now considered a human-mediated factor affecting biodiversity worldwide, alongside e.g. biological invasions. With ongoing globalisation, multiple invasive species are introduced into human-altered habitats, exposed to ALAN, and inland waters are among the most affected by both these phenomena. We tested experimentally how chronic exposure to ALAN affects the growth and physiology of nocturnal and diurnal freshwater fish, and whether the invasives are favoured over natives by their responses. Nocturnal species tested were the invasive racer goby (*Babka gymnotrachelus*) and ecologically similar native European bullhead (*Cottus gobio*). For diurnal species, we chose the invasive pumpkinseed (*Lepomis gibbosus*) and its native counterpart, perch (*Perca fluviatilis*). We exposed fish to ALAN (12L:12D cycle; nights illuminated with cool white LED light, 2 lux) for 8 weeks, feeding them *ad libitum* and monitoring their weight. At the end of the exposure, fish metabolic rates: maximum (MMR), standard (SMR), and the difference between them (aerobic scope, AS), were assessed. Control fish individuals were exposed simultaneously to an undisturbed (12L:12D cycle; dark nights) light cycle. Preliminary results showed no effects of ALAN exposure on nocturnal fish growth, but the racer goby exhibited decreased SMR, while the European bullhead decreased MMR and AS in response to ALAN. This indicates that ALAN exposure may reduce the physical capacity of the native species, but not the invasive one. Thus, invasive species, having greater energy resources for such activities as foraging, reproduction, or escaping from predators, could be favoured over natives in light-polluted areas with abundant food resources. ALAN can further modify the outcome of interspecific interactions, increasing the threat posed by invasive species to global biodiversity with rising light pollution worldwide. This research was supported by the National Science Centre, Poland, grant No. 2023/49/N/NZ8/01324

72 - Ecological modelling of the re-emergence of Pike as an apex piscivorous predator within the Lough Neagh aquatic ecosystem.

Jaimie T.A. Dick[1], Craig McCoubrey[1], Derek Evans[2]

[1]Queen's University Belfast (School of Biological Science), [2]Agri-Food and Biosciences Institute (Freshwater and Aquatic Ecosystems Branch)

Introduced invasive species are the second largest threat to global biodiversity loss. In particular, invasive apex predators can disrupt the balance of ecosystems by dominating the top of the food chain, negatively affecting native biodiversity at lower trophic levels. The Pike (*Esox lucius*) is an apex predatory fish species that inhabits freshwater ecosystems throughout the Holarctic region. Its piscivorous diet positions it at the top of the aquatic trophic chain, exerting top down pressure on prey fish assemblages. A non-native species to Ireland, studies suggest that Pike were introduced during the Bronze Age (~2000BCE) and the Middle Ages(~1400CE). Earliest recorded presence of Pike in the Lough Neagh system dates back to 1682. Pike rely on their excellent visual acuity and camouflage, which are well-suited to areas with dense macrophyte vegetation. Water-lowering events, which concluded in 1959, led to the destruction of any suitable spawning or refuge habitat, resulting in Lough Neagh being noted for its relatively absent Pike population. The introduction of the invasive Zebra Mussel (Dreissena polymorpha) in 2005 brought a suite of ecosystem engineering impacts to Lough Neagh. Through its filtration activity, the mussel has significantly increased water clarity and photic depth. This shift has facilitated the proliferation of invasive macrophytes, restoring habitat and creating conditions more conducive to Pike establishment and population growth. This PhD project explores the ecological implications of the re-emergence of pike as an apex piscivorous predator in Lough Neagh. Through a combination of field studies, laboratory analysis, and ecological modelling, the research will examine the ecological impacts linked to the re emergence of this introduced piscivorous predator.

238 - Trait-based mechanisms of invasion: Divergence in morpho-functional traits between the native and invasive Carassius species

Sakshi R. Tripathi[1, 2], Péter Takács[3], Pankaj A. Gorule[1], Kiran Thomas[1], Milan Gottwald[4], Marek Šmejkal[1, 2]

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Biological invasions threaten freshwater biodiversity, yet the functional mechanisms underlying invasive-native species dynamics remain underexplored. The widespread expansion of the invasive gibel carp (*Carassius gibelio*) across European freshwater systems has coincided with the decline of the native crucian carp (*Carassius carassius*). However, the specific ecological traits driving this displacement are poorly understood. This study investigates whether divergence in key morpho-functional traits confers a competitive advantage to *C. gibelio*. We collected specimens of both species from five sympatric pond systems in Czechia and measured fourteen standardized morphometric traits linked to feeding and locomotion. This

trait-based approach enabled a detailed comparison of ecological strategies under co-occurring conditions. Our analysis revealed that *C. gibelio* consistently exhibited longer gut length ratios and larger oral gape surfaces, indicative of enhanced trophic flexibility and the ability to process a broader spectrum of dietary resources, including detrital and plant material. Additionally, higher values for locomotory traits- particularly pectoral fin aspect ratio and fin surface area relative to body size- suggest improved maneuverability and access to diverse microhabitats. In contrast, traits such as eye position and body depth showed significant overlap, reflecting some shared ecological niches. These findings demonstrate that functional trait divergence underpins the ecological success of *C. gibelio*, facilitating its competitive dominance over native *C. carassius*. The data highlight how increased resource acquisition efficiency and locomotory performance may promote rapid invasive spread and intensify pressure on native populations. All trait data are archived and available upon request for meta-analytical use. This study underscores the value of trait-based frameworks in invasion ecology and supports urgent conservation efforts for *C. carassius*, a species now considered critically endangered in parts of its range.

114 - Seeing Spots: Eyespot Variation and Tributary Expansion of Invasive Round Goby in Lake Erie

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The round goby (*Neogobius melanostomus*) is one of the most ecologically disruptive invaders in the Great Lakes basin, where it competes with native benthic fishes, alters invertebrate communities, and reshapes food web dynamics. While the impacts and dispersal of round gobies are increasingly well-documented, few studies have examined the role of small-scale movements and morphological traits, such as eyespot size and color, in invasion success. We combined population monitoring, otolith elemental analysis, morphological assessments, and behavioral assays to investigate (1) the movement of round goby into and within tributaries of Lake Erie, (2) whether eyespot variation correlates with individual goby or habitat characteristics, and (3) how native fishes and other gobies respond to variation in eyespots. Our results show that goby populations are establishing persistent footholds in tributaries, with individuals exhibiting little within-stream movement and site-specific otolith signatures indicative of repeated use of these tributaries. Morphological analyses revealed significant variation in eyespot size and coloration across sites, suggesting potential plasticity or local selection pressures. These traits may influence predator-prey interactions and concealment strategies in novel habitats. By linking morphology to population ecology, this research highlights how subtle phenotypic and behavioral traits could facilitate the ongoing expansion of round goby in freshwater tributaries. These findings advance our understanding of invasion dynamics and have implications for predicting risk and developing management strategies in tributary systems.

C10 - Disease Vectors in Focus: Mosquito-borne Health Threats

146 - State of mosquito surveillance for native and non-native vectors in Northern Ireland

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Mosquito-borne disease emergence is a rapidly growing concern globally, influenced by factors such as climate change, habitat alteration and biological invasions by vectors and associated pathogens. For example, in England, West Nile virus vector *Culex modestus* is established, the tiger mosquito *Aedes albopictus* has been repeatedly detected, and Usutu and West Nile viruses have been introduced. Yet, to date, most surveillance in the UK is focused on England and Wales, with no assessments of mosquitoes in Northern Ireland having been published in over 30 years. Developing surveillance systems to analyse which species of mosquitoes are present is of great importance, as the ecologies, biting behaviours and vector competence vary greatly between species. It is also vital to confirm the absence of invasive mosquitoes, such as *Ae. albopictus*. This study aimed to fill this gap by surveying larval and adult mosquitoes across the six Northern Irish counties. Larvae and pupae were sampled through ‘larval dipping’ at suitable aquatic habitats. Adults were sampled using BG-Pro (Biogents) traps, fitted with dry ice and BG-Lure to attract blood-seeking females. Mosquitoes were identified to species/complex level through morphological methods. Here, we record the sampling of 951 adult mosquitoes, representing 17 taxa known to be native to Ireland, and report the current absence of any invasive vectors. Ongoing surveillance will be vital to monitor for the introduction and establishment of *Ae. albopictus* and other invasive mosquitoes into Northern Ireland and other temperate regions.

286 - Mosquitoes and associated pathogens along European anthropogenic land use gradients

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As urbanisation continues to expand as a global anthropogenic force, an understanding of its impact on both ecosystems and human health is essential. This interplay is seen when considering the effects of land use and climate on mosquitoes and their associated pathogens. Risks in urban settings may be exacerbated given interactions with climate via the urban heat island effect, alongside other anthropogenic stressors such as biological invasions. However, the links among mosquitoes, pathogens, and urban environments have lacked systematic integration. We examined the corpus of peer-reviewed literature related to the interactions among mosquitoes, mosquito-borne diseases, land use, and climate to clarify these trends of risk and the current state of research in Europe over recent decades. Analyses unveiled the relationships among settings, vectors, and pathogens, as well as the particular role of invasive *Aedes* mosquitoes. A total of 86 studies were included in the analysis, of which 66 (76.7%) discussed land use and 24 (27.9%) discussed climatic variables. Additionally, the networks of countries, vectors, and pathogens have grown more complex within the last decade, largely spurred on by the emergence of invasive *Aedes* and associated pathogens. Yet, research on invasive mosquitoes has remained distinct from research on native taxa, potentially hampering ecological understandings. Further disharmony was observed in land use comparator definitions, making direct comparisons of studies challenging. Together, these analyses highlight the complex interplays and evolution of the field as environments change and species invade and the need for more standardised environmental metrics for urban vector ecology in Europe.

F10 - Beyond Habitats: From Genes to Ecosystems

202 - Why and how to estimate residual invader population dynamics during long-term removal efforts

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Invasive mammalian predators are a major leading cause of global defaunation, contributing to over half of all recorded vertebrate extinctions. Eradication efforts of long-established invasive species over large areas are usually prohibitively expensive, leading to long-term population control strategies instead. These operate assuming that suppressing invader's residual populations below desirable thresholds will reduce their impact to negligible levels. However, to test such assumptions and optimise control strategies, reliable methods are needed to estimate how removal efforts change population residual abundances over time. Removal models have been historically used for these strategies, but classical formulations require strict assumptions (e.g. population closure) and can perform poorly under scenarios of high capture effort and

spatial heterogeneity. One of these scenarios is the long-term control of invasive American mink *Neogale vison* in Scotland, encompassing a wide range of habitats and patchy removal efforts.

By integrating recent developments in Bayesian removal models, we provide the first estimation of spatiotemporal residual population dynamics of the invasive American mink. We use data from 20 years of control with varying intensity led by citizen conservation efforts within a 29,000 km^2 area in Scotland. We estimated within- and between-year regional dynamics as a function of environmental factors while accounting for heterogeneous capture effort and probabilities, spatial biases, and missing data patterns common in citizen-science programmes. The results show how spatiotemporal patterns of abundance and capture rates vary along environmental gradients and control efforts as well as mink individual features. Additionally, we show how sex and age distributions of captured and residual invader populations change across time and space depending on habitat features and control effort. The modelling framework and results provide a blueprint tool to reliably estimate residual invader abundances under high environmental and effort heterogeneity and could serve to optimise ongoing and future large-scale invasive predator removal efforts.

184 - To what extent is genome size a mechanism for biological invasion?

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Why do some introduced species become established and others do not? What leads some biological invasions to have significant impacts while others have a limited or unreported impact? Do the underlying mechanisms behind invasion success and impact differ? Questions such as these cover a wide range of fundamental mechanisms of biological and applied relevance. The role of genome size as a mechanism behind biological invasions has received focus across plant species. However, the influence of genome size across animal species has yet to be explored. Variation in genome size has been alluded to be a mechanism behind the evolution of fitness-relevant traits, demographic stability and the adaptive ability of species. The proposed hypothesis within this study is that a larger genome size decreases a species' probability of becoming established, as well as having an influence over the subsequent stages of the invasion process, spread and impact probability. Here we investigate whether genome size influences 1) a species' probability of becoming established within a non-native range, 2) the spread of a non-native species (across regions and habitat types), and the 3) impact of an IAS. This study sets out to develop a *de novo* dataset consisting of invasion history, genome size and taxonomic data for tetrapod species (Reptilia, Aves, Mammalia and Amphibia). Our findings reveal multi-directional effects of genome size across invasion stages, with 1) strong evidence for a negative relationship between genome size and establishment probability, 2) weak evidence of a positive relationship between genome size and impact probability and 3) strong evidence for a positive relationship between genome size and the probability of having

an economic or ecological impact. Genome size variation within IAS profiling has potential to prioritize management and improve our collective understanding of the mechanism which underpins invasion success.

60 - The impact of invasive toads on the ecosystem services performed by native frogs in Madagascan rice fields.

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Invasive species are recognised as major drivers of ecological and socioeconomic harm, costing the global economy billions of dollars per annum. The vast majority of these costs come from losses in the benefits people receive from nature. Amphibians provide many such ecosystem services, including nutrient cycling, reducing sedimentation and crop pest regulation, which all affect the most commonly reported cost impact - reductions in food security.

Here, we examine the impacts of the Asian Black-Spined toad (*Duttaphrynus melanostictus*) on food security within rice fields, the principal food crop in Madagascar. This toad was accidentally introduced in 2010 and is both highly toxic and a large generalist predator. Its ongoing spread has been linked to declines in native species and impacts on subsistence farming practices such as honey production. We used nocturnal transect surveys along an invasion gradient of toad densities to assess impacts on the abundance of native frogs, finding a decline in several native species in areas with the longest invasion history. We used stomach flushing of captured individuals to compare diets among native frogs and invasive toads. We found significant differences in dietary preferences, with *D. melanostictus* consuming fewer pest species and showing a strong preference for beneficial insects from the order Hymenoptera. Our results show twin impacts from the invasion on the contribution of native amphibians to human well-being, with toads reducing the abundance of both amphibian and insect predators of crop pests. Such impacts are particularly acute in developing countries, where food losses for subsistence farmers are a key factor contributing to ongoing poverty.

310 - Assessing the composition of biological invasions across the island of Ireland

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National-scale syntheses of non-native species (NNS) are critical for understanding invasion dynamics and drivers, while informing management planning. This need is pronounced on islands, where invasion impacts can be disproportionately high and biosecurity interventions are essential. Despite substantial research interest and investment in invasion science, there has been no detailed analysis of documented NNS across Ireland. Here, we present the first comprehensive assessment of NNS in Ireland, integrating national biodiversity records and global datasets to evaluate taxonomic composition, temporal trends, introduction pathways, and ecological impacts. A total of 1,051 NNS have been recorded across Ireland's terrestrial, freshwater, and marine environments, with invasions particularly pervasive in terrestrial realms by vascular plants and arthropods. The accumulation of NNS in Ireland has accelerated over time, with long-established invasions tending to accumulate a greater number of occurrence records over the last century, indicating progressive spread. Of Irish NNS with documented ecological impacts (13% of all recorded NNS), high-impact classifications were particularly frequent among mammals (73%), birds (28%), and ascidians (28%). Freshwater habitats exhibited the highest proportion of high-impact species (63%), while semi-aquatic habitats were equally represented by medium- and high-impact classifications. Competition was the most frequently recorded impact mechanism (23%), followed by competition combined with biofouling (19%) and unknown mechanisms (16%). Comparisons with global NNS assemblages revealed pronounced taxonomic disharmony, with tracheophytes and vertebrates over-represented in Ireland relative to global expectations, whereas arthropods and several other invertebrate groups were under-represented. These patterns reflect the combined influence of ecological filtering, pathway bias, and historical contingency in shaping invasion outcomes in island systems. Together, these findings highlight the importance of pathway-focused management and habitat-specific monitoring for mitigating invasion risks, particularly in island contexts. This study provides a national benchmark for understanding biological invasions in Ireland and contributes to efforts to contextualise invasion patterns across island ecosystems.

A11 - Survival of the Fishiest: Traits That Tip the Scales II

13 - A global account of established non-native fish species

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Fish introductions have occurred for centuries, mediated by aquaculture, ornamental trade, fisheries enhancement, deliberate releases, and artificial corridors. Despite their ecological, economic, and cultural significance, there has been no comprehensive, standardized synthesis of established non-native fish species worldwide that simultaneously addresses their taxonomic diversity, distribution, pathways of introduction, and impacts. Here we present the *Global Fish Invasion Database* (GFID), the most complete resource to date on established non-native fishes

globally. Drawing on multiple international datasets, literature, and expert verification, GFID documents >1,500 established non-native fish species across 193 countries, spanning freshwater, marine, and estuarine systems.

Species richness was highest in families such as Leuciscidae, Cichlidae, Salmonidae, and Cyprinidae, with strong geographic concentration in North America, Asia, and parts of Europe. Temporal analyses revealed an accelerating accumulation of species reports since the 19th century, although annual first records have declined in recent decades, possibly reflecting improved regulation, reporting lags, or regional saturation. Introduction pathways differed between habitats: freshwater introductions were dominated by aquaculture and the aquarium trade, whereas marine introductions were strongly linked to corridors, most notably the Suez Canal. Pathway analysis also highlighted the predominance of intentional introductions, underscoring the strong role of human agency. Impact information was available for only a third of species, revealing major knowledge gaps. Where documented, ecological impacts were most often mediated by competition and predation, with additional economic and socio-cultural effects on fisheries, aquaculture, and traditional practices.

By integrating species identities, native ranges, distributions, pathways, and impact records, GFID provides the first standardized baseline for assessing and managing non-native fish globally. This database thus supports the identification of high-risk taxa and pathways, strengthens invasion risk assessments, and informs evidence-based management and biosecurity policies in freshwater, marine, and estuarine ecosystems.

132 - Global Ornamental Fish Traits Associated with Success Across Invasion Stages

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The global ornamental fish trade is one of the major pathways for fish invasions. This growing industry continues to introduce non-native species beyond their native ranges, with rates accelerating in an era of globalisation and widely unregulated markets. While species traits are recognised as key predictors for invasion success in many taxa, we lack understanding of the trait effects of ornamental fish, a species group filtered through this trade pathway and modified by domestication and human-mediated selection, across different invasion stages. We investigated seven categories of ornamental fish characteristics, including physiological, ecological, morphological, life-history, functional and reproduction, in relation to each of three key invasion stages (i.e. introduction, establishment, and impacts). We thus collated and analysed trait data for 3,718 ornamental species, of which 517 have a documented invasion history, alongside their origin and recipient regional flows. Our results suggested that ornamental fish with broad thermal tolerances are significantly more likely to be introduced, establish and become invasive (with impacts). These findings highlight the key traits associated with invasion success in ornamental fish and help better predict species invasiveness. This study also underscores the importance of management and regulations in the ornamental fish

trade industry in screening out high-invasion-risk species, as well as prominent origin regions, in order to help mitigate impacts on native ecosystems and socio-economies.

33 - Differentiation in feeding morphology is unrelated to geographical distribution in invasive Round goby (Neogobius melanostomus)

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[1]Wageningen University & Research

Round goby (*Neogobius melanostomus*), a Ponto-Caspian fish species, is a successful aquatic invader in Europe and North America. One aspect that likely contributes to the species' success is its capacity to exploit a broad spectrum of food types, which enables it to survive and thrive in widely different aquatic ecosystems, including freshwater lakes, rivers, and brackish coastal waters. As abundance and composition of food organisms varies between ecosystems, it is expected that established round goby populations will be optimised for the local food situation. Considering that prey capture and food processing are dependent on feeding-associated morphological traits, also differentiation in feeding-associated morphological traits is expected. Therefore, we studied the extent of morphological variation between and within 10 invasive populations of round goby from across Europe and Canada. We measured 39 external and internal morphological traits from 103 individuals and reconstructed their trophic potential based on established causal links between morphology and feeding capacity. In addition, we sequenced 2 mitochondrial genes, Cytochrome c oxidase subunit I (COXI) and Cytochrome B (CytB), from 2 individuals per population, to assess the spatial genetic structure among the study populations. In general, intra-population variation in trophic morphology was high, although some populations significantly differed in their average feeding morphologies and associated capacities, especially for particular food types, such as molluscs. Analyses of COXI and CytB did not reveal clear geographic differentiation among populations, likely reflecting the limited resolution of these mitochondrial markers at this spatial and temporal scale. Collectively, our results suggest that round goby has a high capacity to become rapidly optimised to local food organisms, supporting its invasive capacity. However, understanding to what extent spatial differentiation in feeding morphology is due to phenotypic plasticity or local adaptation, will require further in-depth study.

31 - Is the great morphological variability in common bleak the driving force for its invasive success?

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The common bleak, *Alburnus alburnus*, is a cyprinid species broadly distributed across Europe and Asia. Over the last few decades, it has been introduced to various regions, where it has started to act as an invasive species. The bleak is a markedly euryecious species. It exhibits inter-population plasticity in life-history traits - such as growth rate, age and size at maturity, reproductive investment, and body condition, which can flexibly change in response to habitats. Investigating morphological variation can reveal whether local populations are morphologically differentiated, potentially as an adaptation to heterogeneous conditions, or whether they retain a conserved body plan. Therefore, the study aimed to 1) analyse the bleak´s external morphology across the Danube River and its tributaries, and 2) to assess whether morphological differentiation helps the establishment of the species in non-native areas of occurrence.

The samples were collected during the Joint Danube Survey 4 river expedition from 28 different sites along the Danube River and its tributaries. To examine patterns of relative growth, 24 mensural characters were measured from digital photographs using TPSDig v. 2.64 software. Analysed populations showed a clear morphological separation, based on the discriminant functional analysis (DFA). Due to this evident distinction, we evaluated the two groups separately in all subsequent analyses. Four distinct morphotypes were identified within the Danube River main channel, as well as in tributaries. Overall results highlight the high degree of plasticity in the bleak´s morphology, which aids its ability to adapt to a wide variety of ecosystems. In connection with its invasive potential in the Iberian Peninsula, where it threatens endemic fish fauna, we can say that shifts in morphology can help the establishment under variable conditions. These findings confirm the high phenotypic plasticity, which leads to success in the invasive process.

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D11 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations IV

316 - Workshop: Assessing Risk to Inform Ballast Water and Biofouling Regulations

Sarah Bailey[1]

[1]Fisheries and Oceans Canada

This workshop, in combination with the Special Session on Transcending Boundaries Between the Science and Management of Ships' Ballast Water and Biofouling, aims to bridge the gap between research and policy, and to connect data needs and risk assessments with effective management and mitigation measures. Participants will be challenged to leverage and build on experience and lessons learned to improve the implementation of current ballast water management practices and advance new biofouling management policies.

C11 - Shell We Worry? Battling the Bivalve Boom

17 - Influence of macrophyte identity and fractal dimension on density and age structure of attached zebra mussels

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Macrophytes can support high abundances of juvenile mussels and thus facilitate the establishment and persistence of zebra mussels where suitable alternate substrates are scarce. Attachment to macrophytes can also facilitate mussel dispersal downstream via rafting and overland on trailered boats. Structurally complex macrophytes, defined as having finely dissected leaves, are reported to support greater densities of epiphytic invertebrates than structurally simple plants. To our knowledge, no study has examined zebra mussel settlement preferences with respect to macrophyte species identity and architectural complexity. In 2024, we tested 1) whether *Myriophyllum spicatum* (an invasive macrophyte in North America) is a preferred host; 2) if there is a preferred architecture amongst a range of macrophytes available for settlement; 3) how attachment varies among mussel size cohorts; and 4) if site and propagule pressure play a greater role than macrophyte traits in mediating zebra mussel density. Given that *M. spicatum* is structurally complex, exhibiting greater branching and dissected leaf morphology, we hypothesized that it facilitates zebra mussel settlement by providing increased surface area for attachment compared to structurally simple species. In 2025, we conducted an *in-situ* experiment by deploying identical plastic model plants of 'high' and 'low' complexity at our initial sampling sites, allowing a mussel settlement event to determine if site and propagule pressure play a greater role in mediating zebra mussel density than macrophyte traits. Observed differences in mussel densities on plant mimics are likely attributable to site characteristics (e.g., hydrology, or proximity to public boat launches). Our results can inform management regarding which macrophytes pose a greater risk of facilitating mussel population establishment and dispersal. They also demonstrate how ecological associations can influence local to regional invasion risk.

254 - Corbicula fluminea, understanding its impacts on a native freshwater mussel

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The invasive gold clam, *Corbicula fluminea,* was first recorded in New Zealand in 2023. Recognised for its rapid population growth and impacts within its invaded range elsewhere in

the world, a research programme has been established to understand its impacts in a New Zealand context. Of particular concern was the threat posed to the native freshwater mussel (*Echyridella menziesii*), which is in decline in a number of locations. In the reaches of the Waikato River, where corbicula has been found, there appears to be overlap with the occurrence of the native mussel, with both species present in littoral zone substrates from water depths of 1 to 15 metres in Lakes Karāpiro and Maraetai. Diver based surveys are being used to monitor changes in the abundance, distribution and population structure of these two species. In the two years since corbicula was discovered there has been ongoing recruitment (population growth) at the surveyed locations. Coupled with feeding and substrate preference trials for the two species, we address the question of whether potential impacts of the corbicula invasion on the native mussels are real or perceived.

253 - Corbicula fluminea, development of methods to reduce the spread, detect and manage populations

Deborah Hofstra[1], Michele Melchior[1]

[1]Earth Sciences Institute of New Zealand

The invasive gold clam, *Corbicula fluminea,* was first recorded in New Zealand in 2023. Recognised for its rapid population growth and impacts within its invaded range elsewhere in the world, a research programme has been established that includes the development of improved decontamination, surveillance and control methods.

With a primary goal to first reduce the risk of further spread, initial research has focussed on decontamination and improving the efficacy of surveillance methods. Decontamination has identified practical treatment options for in-field treatment of corbicula veliger-stage larvae on equipment. In addition drying, freezing and the use of detergents have been assessed to enhance boating and diving biosecurity protocols and reduce the risk of transferring invasive aquatic species during field operations.

To develop more effective and efficient surveillance and detection, comparisons have been made between a variety of methods including, the use of divers for transect based survey, boat operated sediment grabs, dredges and passive samplers. Passive samplers and plankton nets have also been assessed and timed for use when corbicula are known to be reproductive. The next phase (underway) is evaluating the utility of molecular methods (eg., eDNA) at a range of spatial scales, and known corbicula population densities.

67 - Second Generation Pseudomonas fluorescens CL145A to Control Invasive Zebra, Quagga and Golden Mussels

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Pseudomonas fluorescens CL145A was developed several years ago as a wettable powder formulation for zebra and quagga mussel control in pipes (power, industrial and irrigation). We have developed a second generation version that is a wettable dispersible granule formulation that is easier to use for pipe treatments than the wettable powder and a pellet/tablet for slow release larger open water applications. Both new formulations have been tested and show high level of activity against quagga and golden mussels in our lab tests. Fermentation productivity improvements and an increase in the active protein result in lower cost of production. 2026 Demonstrations are planned on zebra or quagga infested sites in parts of the Great Lakes (Lake Michigan). The Gen 2 slow release formulation is also designed for use as a new tool for rapid response to new detections and with lower environmental and non target risk than copper. Golden mussels have established in California, with nothing currently available for treatment in pipes or open waters. We have confirmed >85-100% activity against golden mussels in laboratory testing at dosages about 3X those used for zebra and quagga mussels. Field testing is planned in late 2025 and 2026. Bridging ecotoxicology studies are also planned to insure the effective higher dosages have similarly low risk to non-target organisms.

248 - Effect of extreme temperatures on the physiology of the invasive bivalve Limnoperna fortunei

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Generally, invasive species such as *Limnoperna fortunei* are considered to have broad environmental tolerances and the capacity of adaptation to colonize new environments, which helps these species to spread and increase their distributions and abundances. However, like other ectothermic organisms, environmental temperature may strongly affect the physiological performance of *L. fortunei*, especially when faced with very low or high values, changing respiration and standard metabolic rate. In order to assess variations in respiration and standard metabolic rate (SMR), as well as to evaluate the effect of extreme temperatures on metabolic oxidation mechanisms, *L. fortunei* individuals were collected from the Rio de la Plata estuary and gradually acclimated to different temperatures (from 2 to 31ºC). Our results showed that the SMR ranged from 3.64 ± 2.5 to 27.2 ± 11.94 µmol O_2 g_{AFDW}^{-1} h^{-1} changing significantly over a wide thermal range. Oxygen consumption appears to be regulated between 13-22°C, presumably through behavioral changes (e.g., filtration rate), thermal sensitivity (Q_{10}), and oxidative stress enzyme activities. When thermal coefficients and oxidative parameters were measured at extreme temperature values, the physiological responses suggest different adaptive mechanisms and antioxidant defenses, showing variable responses depending on temperature. Our data suggest a plastic response to thermal changes, which supports a high potential for colonizing new areas at both lower and higher temperatures than those currently found in its introduced distribution range.

Keywords: Invasive Mollusc, Thermal range, Ecophysiology, Standard Metabolic Rate, Oxidation Mechanisms

E11 - Ahead of the Spread: Innovations in Predicting and Managing Aquatic Invasive Species

305 - FWISE: global lessons for the world's first database of freshwater invasive species eradications

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Freshwater ecosystems cover less than 1% of Earth's surface yet account for 34% of extinct and 45% of threatened animals, with invasive species a leading driver of those extinctions. Decades of island conservation practice have shown that invasive animal eradication is an effective tool for the recovery of threatened native species, supported by a well-organized community and a centralized database of successful and failed attempts. Although freshwater native species recovery has been documented following invasive species eradication, no centralized database exists to drive freshwater restoration. To address this gap, we developed FWISE: the Freshwater Invasive Species Eradication Database. We compiled over 900 documented eradications across six continents, combining systematic review of peer-reviewed literature with snowball sampling of agencies and practitioners in the gray literature, using standardized fields for target species, outcomes, methods, waterbody characteristics, duration, and beneficiaries.

FWISE compiles eradication attempts for 208 invasive species across 34 countries, with 422 native and at-risk species recorded as intended beneficiaries. Across the compiled record, 79% of attempts were successful. The plant-based piscicide rotenone was the most frequently applied method, followed by netting/trapping, electrofishing, the antibiotic piscicide antimycin-A, and draining. Project duration ranged from less than one day for piscicide treatments to several years for physical removal. Using a binomial generalized linear mixed model on the ~70% of attempts with complete data, we found that eradication success was associated with lower local human population density, smaller water bodies, more recent attempts, and the use of rotenone rather than other methods.

By making this evidence openly available, FWISE provides practitioners with a reference for selecting methods, assessing feasibility, and benchmarking. The database is intended as a living infrastructure and will be made available in an easy-to-use app to catalyze a freshwater eradication movement comparable to the one transforming island restoration.

274 - RugOBSS: an Earth Observation monitoring tool to assess Rugulopteryx okamurae invasion

Mar Roca Mora[1], Maria João Borlido Oliveira Lima[2], Bede Ffinian Rowe Davies[3]

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Rugulopteryx okamurae is an Invasive Alien Species (IAS) first detected in 2015 in the Strait of Gibraltar, posing a significant threat to marine biodiversity and having a major impact on aquaculture, fisheries, and tourism in Spain, Portugal, Morocco, and beyond. Due to its aggressive invasive behaviour with continuous expansion over Mediterranean and Atlantic waters, and massive biomass arrival to beaches, Earth Observation techniques can be utilised to assess invasion trends and support biomass management. These data could provide key information from the last decade, which are essential to: 1) spatio-temporally understand the invasion success and the cumulative impacts on beaches; 2) better manage the local biomass and properly quantify the damages; 3) provide early detection of newly invaded areas; and 4) predict macroalgae biomass arrivals using ocean modelling. The **RugOBSS** tool (*Rugulopteryx okamurae* Observing Beachcast System from Space) was born out of necessity to understand the *R. okamurae* invasion at scale, create the first biomass and presence database on the invasion and to better manage the massive biomass arrival to the coast. This open-source platform provides insights on *R. okamurae* beached biomass and impacted area over time since 2015 using Sentinel-2 imagery at 10-meter spatial resolution in a cloud computing framework. The algorithm was validated using an independent dataset from fieldwork campaigns, including biomass sampling, percentage cover, beachcast height and presence/absence coordinates, which data will be made available under FAIR principles. The results provide the first complete view of the ecological and economic impact perspective on the *R. okamurae* invasion status, supporting better decision-making for up-to-date biomass removal, a 10-year historical series of beached macroalgae, and early detection alerts for rapid response of newly invaded locations. This study bridges the gap between research and policy, improving the management of this invasive species in a transboundary collaboration.

290 - Large scale application of thermo-responsive biocide technology in sun-coral control

Breno Pollo[1], Matheus Barbosa[1], Marcio Siqueira[2], Alexandre B. Villas-Boas[2], Daniela Batista[2], Ricardo Coutinho[2], Carlos Speglich[3], Edvaldo Sabadini[1]

[1]University of Campinas, [2]IEAPM - Instituto de Estudos do Mar Almirante Paulo Moreira, [3]Centro de Pesquisas, Desenvolvimento e Inovação Leopoldo Américo Miguez de Mello (CENPES)

The control of the *Tubastraea* species has involved inefficient and cumbersome methods. Most of the attempts in controlling the non-native organism had little effect or were not scalable. The conventional approach with divers for this job also imposes limitations on the remediation of infested areas such as ports and offshore platforms. It is noticeable the presence of the sun coral South America, particularly in Brazil, demanding large scale actions for immediate control as regulatory constraints start to emerge.

This study presents recent advances of our group in a large-scale *diverless* method to control invasive sun-coral species. This new hydrogel can be considered an evolution when compared to the previously patented alginate gel, despite not being directly related in composition. The remediation of a port area was done with a thermo-responsive hydrogel of basic characteristics in semi-industrial batches using a Remotely Operated Vehicle (ROV). Due to its thermo responsive properties, this product adheres firmly to the sun coral when in contact with the colder ocean water leading to a highly efficient biocide action with over 90% of the corals with their skeleton exposed.

Previously reported positive attributes of the use of hydrogel for sun coral control remain true even to this new formulation. The use of the hydrogel neutralizes the sun-coral with precision, restricting the biocide effect only on the areas covered by the hydrogel. The other components of the product are biodegradable, and commonly applied in the food industry. All of the components are readily and commercially available. Due to the absence of divers in the process, the invasive species control can be performed in risky environments, such as ports and open waters.

130 - Adaptive Management and Innovative Techniques for Large-Scale Removal of Invasive Marine Cnidarians

Kaitlyn Jacobs[1], Kevin Lino[1], Michelle Bejder[1]

[1]Naval Facilities Engineering Systems Command Pacific

Invasive marine cnidarian populations are transcending global boundaries at alarming rates over the last decade, with untenable coverage in places like Venezuela, Puerto Rico, the U.S. Virgin Islands, and Cuba. Hawaii, like many vulnerable island ecosystems, is no stranger to biological invasions. In recent years, Joint Base Pearl Harbor-Hickam has become a focal point for the introduction and establishment of several new invasive marine cnidarians, including *Unomia stolonifera,* which covers 80 acres of benthos.

The Navy tested and implemented a range of innovative techniques to address the large-scale removal effort, including desiccation, fresh-water submergence, smothering, shading, manual removal, and heated seawater treatments—all of which are ongoing. The most effective management was smothering for at least eight days, which consistently showed up to 100% mortality rates for *U. stolonifera.* Manual removal and shading using durable, opaque silt curtains achieved similar success. Superheated seawater treatments showed mortality across all species, with limits to application based on site, substrate and density. Efficacy varies among species, so each approach is evaluated based on effectiveness, cost, and labor intensity to

identify optimal strategies across environments. Early monitoring of re-recruitment rates indicate low recolonization rates in cleared areas, with benthic slope emerging as a key factor influencing settlement progression. These findings highlight the importance of incorporating environmental variables when designing targeted management strategies.

This work expands the toolkit available to resource managers, equipping them with diverse approaches to effectively respond to aquatic invasive species outbreaks and enhance rapid response efforts. Additionally, this research offers valuable insights into the ecological and biological dynamics of invasive marine cnidarians, highlights the need for integrating scientific research with adaptive management, and illustrate the necessity of transboundary agency collaboration to tackle the escalating threat of invasive species in valuable ecosystems.

B11 - Workshop: Overcoming Language Barriers to Improve Collaboration and Research on Aquatic Invasive Species

98 - Overcoming language barriers to improve collaboration and research on aquatic invasive species

Conrad James Pratt[1], Tatsuya Amano[1]

[1]University of Queensland

Since aquatic invasive species (AIS) are an inherently transboundary issue, global knowledge sharing and collaboration are particularly crucial in AIS research. However, language barriers can impede global collaboration and information transfer in aquatic invasion science. Although substantial amounts of literature on biological invasions are published in non-English languages, many studies and evidence syntheses on aquatic invasions (and in invasion science more generally) exclude non-English-language literature, ignoring potentially important evidence and biasing conclusions. Furthermore, the dominance of English as the common language of science and the related hegemony of high-income, Western countries in AIS research are likely stifling information exchange and collaboration with researchers from non-Anglophone, non-Western areas of the world.

We will therefore hold a workshop discussing language barriers in aquatic invasion science. Workshop leaders will be Conrad Pratt (interdisciplinary scientist, background in AIS research, currently studying language barriers in science in Japan) and Dr. Tatsuya Amano (Conrad's PhD supervisor, global leader in the study of language barriers in science). The workshop will begin with two short presentations delivered by the workshop leaders introducing language barriers in science (Dr. Amano) and aquatic invasion science (Conrad Pratt), respectively. These presentations will set the stage for a subsequent guided discussion period, where participants will discuss various aspects of language barriers in invasion science, their experiences with

language barriers in AIS research, and ideas for potential solutions to the way research and collaboration are conducted in the field. The results of the discussion will be collated after the workshop for future use and dissemination.

All ICAIS attendees are welcome at this workshop, as it will provide both an opportunity for anglophone/Western researchers to learn how to improve the inclusivity of their research and collaboration practices, and a platform for non-native English speakers from underrepresented regions to share their experiences and ideas.

Special Session: Conservation Detection Dogs - How Dogs Can Be Effectively Used as a Tool for Identifying Cryptic Aquatic INNS (Whitla Hall ONLY)

193 - Conservation Detection Dogs; How dogs can be effectively used as a tool for identifying cryptic aquatic INNS.

Caroline Finlay[1, 2], Holly Peek[2]

[1]Conservation Detection Dogs Northern Ireland, [2]Ecology Detection Dogs Britain and Ireland

Conservation detection dogs offer an efficient, underutilised tool for identifying cryptic aquatic invasive non-native species (INNS), particularly those that are difficult to identify/detect through conventional methods. This presentation and demonstration (special session) will explore the application of trained detection dogs in identifying cryptic aquatic INNS highlighting case studies including three priority aquatic INNS: *Eriocheir sinensis* (Chinese mitten crab), *Faxonius limosus* (American crayfish), and *Didemnum vexillum* (carpet sea squirt). These species pose significant ecological and economic threats, and early detection is critical for effective management and rapid response.

Drawing on the peer-reviewed work of McKeague et al. (2024), Conservation Detection Dogs: A Critical Review of Efficacy and Methodology, we will discuss potential best practices for deploying detection dogs in aquatic environments, including scent sample preparation, training protocols, and field validation.

Additionally, we will preview the forthcoming guidance document ‘Contracting a Detection Dog Team’ (expected August 2026), which provides practical advice for researchers and practitioners on contracting teams, and aligning project goals with detection dog capabilities.

Facilitated by Dr Caroline Finlay, Holly Peek, Dr Texa Sim and Lucy Wilde, we would like to present our findings followed by a live demonstration of detection dogs in action. Collectively, the facilitators bring extensive experience in training and handling conservation detection dogs across diverse projects, developing methodologies for licensing applications, publishing research on detection dog efficacy in conservation and working on aquatic INNS and biosecurity projects. All facilitators are current board members of the Ecology Detection Dog Working Group Britain and Ireland. The Ecology Detection Dog Working Group is committed to advancing knowledge and promoting responsible, evidence-based practices.

This session and presentation aims to inspire wider adoption of detection dogs in aquatic biosecurity and provide attendees with actionable insights for integrating conservation detection dog teams into INNS monitoring and management programmes.

Plenary Demonstration: Conservation Detection Dogs (Location Weather-Dependent: Outdoor Courtyard or Whitla Hall)

193 - Conservation Detection Dogs; How dogs can be effectively used as a tool for identifying cryptic aquatic INNS.

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