Contributed Papers

F1

Poaching in the Arctic – A Research Proposal

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Poaching is neither a new phenomenon in Norway, nor is it in other Arctic countries. However, how and why people perform illegal angling and harvest of fresh water and anadromous species has changed. Preliminary findings suggest that rangers and conservation officers still find poaching a substantial problem in Northern Norway. However, over the last few decades they describe the motives driving poachers as moving away from economic motives where the catch is part of subsistence economy.

In this proposed project we will focus on the changes of poaching in order to understand this phenomenon and its place in society today. This includes a focus on both changes and variation in poaching as practice and the changes in the underlying motives. We will do this through a comparative study in the arctic countries including Norway, Finland, Sweden, Iceland, Greenland, Ireland and Canada. We propose a mix method approach where we involve various governmental institutions, NGO's and selected local communities. This presentation will provide a detailed outline of the preliminary findings that provide the background for this proposed research.

F2

Pink Salmon and Ecosystem Fertilization Alter Life-Histories of Steelhead

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A key point in the life-cycle of migratory fish such as steelhead is when they transition from freshwater to the ocean as smolts. Different smolts may leave freshwaters at different sizes or ages and these individual characteristics have previously been found to influence their marine survival. Thus, freshwater conditions or management actions may influence smolts and their future survival. Here we examined whether adult pink salmon abundance and experimental fertilization alters steelhead smolt outmigration size, age, and abundance across four decades in the Keogh River, British Columbia, Canada. The age, size, and numbers of steelhead smolts were influenced by a combination of pink salmon abundance, artificial fertilization, and density-dependent processes. Higher abundances of pink salmon were associated with higher proportions of two-year-old smolts (rather than three-year-olds) and larger smolts, but not higher numbers of smolts. Similarly, artificial fertilization also increased smolt size and increased the proportion of two-year-old smolts but had no significant effect on numbers of smolts. Using a simple simulation model that accounts for size-selective survival in the ocean, we predict that high returns of pink salmon and artificial fertilization could be associated with small increases (<10%) in returning steelhead abundance. However, apparent extremely low marine survival of Keogh steelhead smolts has kept their population at a low level. Thus, species interactions and potential restoration actions can influence steelhead smolt characteristics.

F3

Informing the Great Fish Stocking Debate: An Australian Case Study

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Fish stocking is a commonly used fisheries management tool in developed countries aimed at improving recreational fish stocks and rebuilding threatened species populations. But fish stocking is contentious due to its high investment, limited scientific evaluation and typically divided opinion from key fisheries stakeholders. Debates over the efficacy and effects of fish stocking continue to occur, hampering its effective use as a fisheries management tool, and these debates often occur in the absence of key information including what stocking practices currently and historically occurred (spatial and temporal trends in numbers, species, sizes, waters) and how do stocking practices match up against the accepted responsible approach published in platform papers.

Consequently, in this study we present a framework for assessing fish stocking practices using both recent and historical fish stocking statistics and how fish stocking practices compare to the accepted responsible approach. We chose to assess Australia's fish stocking practices as a case study. Firstly, we benchmarked recent fish stocking practices by compiling inland fish stocking statistics from every state and territory in Australia. We found that over 84 million fish were stocked in Australia between 2009-2015 and recreational species, both native and salmonid, make up the majority of numbers and weight of fish stocked in Australia respectively. Secondly, we assessed historical trends in fish stocking over a 106-year period across one major jurisdiction and found significant changes in practices including a strong move towards native species, and a reduction in the number of salmonids stocked but an increase in size – consistent with international fish stocking trends towards improving fish survival and planting catchable sized fish for recreational anglers. Thirdly, we conducted a literature review and evaluated Australia's fish stocking practices and found that the majority of Australia's stocking practices could be considered responsible, however significant improvements could be made in most areas, in particular with respect to planning and goal setting of fish stocking. This study provides a valuable framework to assess fish stocking practices to result in improved understanding, more informed discussions and ultimately better outcomes from this popular fisheries management tool.

F4

The Nexus of Fun and Food Security: Recreational Fishing for Food

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Recreational fishing is a popular activity in aquatic ecosystems around the globe using a variety of gears including rod and reel and to a lesser extent spears, bow and arrow, traps and nets. Similar to the propensity to engage in voluntary catch-and-release, the propensity to harvest fishes strongly varies among cultures, locations, species, and fisheries. There is a misconception that because recreational fishing happens during non-work (i.e., leisure) time the nutritional motivation is negligible; therefore, the role of recreational fishing in food security at regional, national, or global scales is underappreciated. We consider the factors that influence whether fish will be harvested or released by examining the motives that underlie recreational fishing. Next, we provide an overview of the magnitude and role of recreational fishing harvest in supporting food security using regional case studies. Then we address issues such as contaminants and parasites that constrain the ability of fish harvested by recreational fishers. Although recreational fishing is foremost considered to be a leisure activity, the selective harvest of fish by recreational fishers has and will continue to contribute to food security by providing an accessible, affordable, and generally highly sustainable food source notwithstanding concerns about food safety and possibly overfishing. Attempts to better quantify the role of fish harvested by recreational fishers and the relative contribution to overall food security and nutrition will provide resource managers and policymakers the information needed to guide management activities and policy development.

F5

Influence of Habitat for Early Life Stages on Wild Rainbow Trout Population Dynamics: Implications for Recreational Fishery Management

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In fish populations, early life stages have a large impact on recruitment and population dynamics. The availability of spawning and juvenile-rearing habitat is a key factor regulating population abundance in wild rainbow trout (*Oncorhynchus mykiss*) populations. I developed a two-habitat age-structured population model based on empirical information. This model was used to explore the impact of the variability of early life stages habitat on wild rainbow trout populations. The model predictions were then compared to field data from over 30 wild rainbow trout populations in the interior of British Columbia. These populations inhabited small lakes spanning a large gradient in spawning habitat size and quality, productivity and recreational fishing effort. The information from these local scale recruitment dynamics can be used to generate estimates of fish production and improve management approaches.

F6

United States Saltwater Fisheries Allocation and Review Policy

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Allocation of fishery resources and fishing opportunities between resource users is one of the most difficult, contentious, and impactful issues with which fishery managers struggle. Under the U.S. Magnuson-Stevens Fishery Conservation and Management Act, federal fishery managers strive to provide equitable allocation of fish and fishing opportunities among all user groups. In the United States, fishery allocations traditionally have been based on historical catch levels using data from commercial and recreational fisheries. However, there are differences in how commercial and recreational data are collected. With the growth of saltwater recreational fisheries in recent decades, anglers voiced concerns over 1. the appropriateness of fishery allocations based on historical catch, and 2. the ability to have allocations reviewed and adjusted if appropriate. The U.S. National Oceanic and Atmospheric Administration's Fisheries Service (NOAA Fisheries) acknowledged the need to revisit the fishery allocation process and initiated a joint effort with the U.S. regional fisheries management councils to address constituent concerns. In August 2016, NOAA Fisheries and the regional fisheries management councils released a new policy intended to help ensure fisheries allocations are periodically evaluated to remain relevant to current conditions and clarify the factors that should be considered when making or updating an allocation decision. During this session, we will review the process of allocation policy reform and discuss in detail the new US saltwater fisheries allocation review policy.

F7

Memo to Legislators: Seafood Consumers are Primary Stakeholders Too

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As the title of this Session indicates, resource allocation is commonly considered in terms of recreational, commercial, aboriginal, subsistence and artisanal interests. However, where commercial harvesting is primarily directed towards supplying domestic markets, consumers warrant consideration alongside these traditional stakeholders. Too often, governments are prepared to terminate demonstrably sustainable commercial fisheries in favour of recreational fishing when the overall community benefits from both sectors are perfectly sustainable. Too often, commercial fishers are forced to accept publicly-funded compensation packages to quit sustainable fisheries. Why does this happen? The traditional contestants are usually well represented by vocal and effective advocacy groups who promote their interests, capturing media and political attention. Domestic consumers rarely have such direct representation and are totally unaware that their access to community-owned, i.e. their resource is being negotiated away through processes in which they have no part. In theory, their elected representatives should recognise and protect consumers' interests; in practice, governments respond to strident lobbying and consumers are quietly consigned to alternative seafood sources. Consumers are, thus, excluded from legitimate democratic processes. Typical of what is happening in Australian inshore fisheries, a 2014 decision to remove a proven sustainable commercial fishery in Victoria is disenfranchising five million consumers to benefit perhaps 100,000 regular anglers who already enjoy enviable fishing. The political decision process took no account of 20 years of state-funded stock assessments, nor did it explain why the community should not continue to enjoy the combined benefits from commercial and recreational fishing.

F8

The Challenge That Ecological Connectivity Poses to Conservation of Coastal Marine Recreational Fisheries

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The scales at which the social, cultural, economic and policy aspects of recreational fisheries conservation occur often do not match the ecology of the species that comprise the fisheries. This disconnect poses challenges to effective fisheries conservation. On the broad scale, for example, the recreational fishery for bonefish (*Albula vulpes*) in the Caribbean is managed exclusively as a local fishery by each nation state, even though the pelagic larval duration of bonefish (mean = 53 days) links spatially separate bonefish populations. This may confound local efforts in fisheries conservation if actions at distant locations impose strong effects. On a somewhat smaller scale, individuals of some species undergo migrations that effectively make them part of multiple fisheries, in that each fishery reflects local social, cultural, and policy influences, and is subject to different threats. Ongoing studies of tarpon (*Megalops atlanticus*) in the Gulf of Mexico and southeastern USA, permit (*Trachinotus falcatus*) in Florida, and bonefish in the Caribbean, Bahamas, and Central America are revealing such connections that pose challenges to local-level management. But even local-scale processes pose challenges. Management and conservation of the recreational fishery for snook (*Centropomus undecimalis*) in Florida, focus on stock assessments, discard mortality estimates, and catch and release education. Missing are management actions that consider the habitat mosaic required for snook ontogenetic connectivity. Granted, local efforts such as education and policy are critically important, but incorporating the ecological-scale factors into conservation strategies for coastal recreational fisheries is essential to ensuring sustainable fisheries.

F10

Changing Salmon Sport Fisheries - Implications for Landowner Based Management and Development of Angling Tourism

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Over the last 40 years we have seen a worldwide decline in the abundance of Atlantic salmon. So also in Norway which since 2010 has experienced many salmon rivers being closed to fishing, shortened seasons and stricter quotas introduced. In Norway and many other European countries landowners are key actors in salmon management and conservation as they own fishing rights, and thereby sell fishing permits to anglers, and co-manage stocks. In this paper we use landowner survey data from two Norwegian rivers (Orkla and Verdal) and two time periods (2008, 2013) to explore if there have been changes in landowner objectives about the fishing right, and attitudes towards management actions. Further, we look at consequences for landowner economic behavior. Over this time period there have been different changes in stock status and demand for angling in the two rivers. Survey response rate 60-61 %. Over time we find that for both rivers priorities about the fishing right have remained fairly stable, although with some changes. Landowner interest in influencing management of the fishery has declined. In the Orkla where stocks have not declined landowners gave less priority to offering (cheap) angling to locals. Some actions for securing stocks changed over time, as the acceptance of catch & release, and habitat improvements in tributaries grew in the Orkla River. Landowners somewhat pessimistic view on future stock status influences their willingness to invest in angling tourism, and is a concern for angling tourism development.

F11

Diamond Lake Angler Displacement: Where Did Anglers Go, What Did They Do and Did They Return?

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Diamond Lake is a highly-renowned trout fishing lake located in central Oregon, USA. The Gila Bicolor Pectinifer (the Tui Chub) was illegally introduced to the lake by anglers in the form of bait, and the lake trout population was decimated. The lake was drained and treated with Rotenone, then refilled with water and restocked with a hardier species of trout. This study was designed to measure visitors' visitation patterns prior to the closure of Diamond Lake, during the closure, and after the lake reopened. Respondents' measure of quality was determined both prior to and after the closure, and their primary activity as well as all of the activities in which they participated in on this trip. The respondents were also asked if their use at their primary recreation area increased, decreased or stayed the same after the lake reopened. Finally, the respondents were asked about their recreation participation patterns during the closure. A total of 405 surveys were conducted.

Results showed that a majority of users returned to Diamond Lake after the lake reopened and was re-stocked. Most users tended to recreation in other activities in the local area, rather than fish in other lakes. This suggests the displaced anglers were so attached to fishing at this particular lake that they were willing to "wait it out" rather than identify new and different fishing locations. Results will be discussed in additional detail.

F12

Offsetting Industrial Impacts to Recreational Fisheries: Food-Web Dynamics in the First Compensation Lake in the Oil Sands Region of Alberta, Canada

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When broad scale residual impacts to fish habitat cannot be mitigated, habitat offsets can be required to ensure no net loss in fisheries productivity. One approach for developing habitat offsets is through the creation of new lake ecosystems, called compensation lakes. However, compensation lakes are relatively new concept and there are many uncertainties regarding their design and management. Using a long-term (2008-2015) data set from Canada's first compensation lake in Canada's oil sands region, we find that the fish community is significantly changing through time, but there is no significant concordance between fish and benthic invertebrate communities (i.e., they are not changing in the same manner). Specifically, the fish community in the compensation lake has a mean trophic level that is significantly declining through time, which is related to increases in lower trophic level species and the absence of large-bodied predators. Additionally, we find that the assemblage and composition of fish species in the compensation lake is unique compared to other surveyed lakes within the region. Two competing management objectives, to maximize Arctic grayling (*Thymallus arcticus*) productivity and overall commercial, recreational and Aboriginal fisheries productivity (multiple species), have contributed to the current state of the fish community and will likely inhibit the compensation lake from resembling regional species pools or maximizing fisheries productivity. We highlight the need to for better regional data to assess fisheries productivity of boreal lakes and the need to create more diverse ecosystems to ensure long-term no net loss in fisheries productivity.

F13

Offshore Artificial Reefs, Design, Construction and Opportunities

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The installation of purpose designed artificial reefs for the purposes of recreational fishing has been demonstrated to provide multiple benefits to their communities and the environment.

Artificial reefs can be effectively designed to productively contribute to their environments through the restoration of degraded habitat, the enhancement of existing habitat and the provision of new and more complex habitat.

The company's unique experience across multiple industries is discussed, exploring the design, materials, community consultation, permitting and installation methods used to deploy large volume OARs.

Various case studies in Australia are presented along with the results of research into their stability, diversity, productivity and design life.

The speaker explores various funding models including opportunities for communities to partner with operators of offshore facilities to repurpose disused structures by integrating them into purpose built artificial reefs.

Opportunities to provide multipurpose reefs that mitigate coastal erosion processes through the provision of enhanced marine habitat are discussed.

F14

Three Major Eras (and/or Errors?) in British Columbia's Managing of Freshwater Recreational Fisheries

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Game Commission, Game Branch, Fish and Game Branch, Fish and Wildlife Branch, Fisheries Branch, Recreational Fisheries Branch, and Fisheries and Wildlife Branch (1958-1997)

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British Columbia, Canada easily gained world recognition for quality salmonid fisheries through early surpluses of famous Gerrard and Kamloops strains of rainbow trout. Prior to 1937, and going back to early1900's, there was little or no need for regulations as stocks were judged to be plentiful, use limited and enforcement was a sideline for police. In 1937 the federal government was getting out of the fish hatchery business and willingly signed over the infra-structure to the province. Thus begun a major function of a yet to be developed "Fisheries Program". It is notable the "trout paradise" was overseen by just three individuals until 1948 when the first fisheries biologist, renowned Dr. Peter Larkin, was hired. He set about hiring graduates from the Institute of Fisheries at U.B.C. as regional biologists and enjoined world-famous scientists as advisors. What a start! It was the passage basically from the 'country doctor approach' to 50 years of classic science and adaptive biology. But, all was not well in paradise! Major funding cuts and reductions of staff began in the 1970's and continued through three major recessions into the early 2000's. Political will placed all natural living resources, like fish, as sideline functions. A new paradigm was needed to salvage even the extremely efficient hatchery system. A private and non-profit fisheries service became the surrogate in 2003. Their ability to function and meet the needs of fish, fish habitat and fisheries will surely be severely tested by continuing, adaptive fisheries management and with proffered declining direct government involvement.