Session 1: Monitoring and Assessment of Recreational Fisheries

A1

Spatial and Temporal Reproductive Behaviors of *Cynoscion nebulosus* in an Aggregation Site: A Multiyear Telemetry Study

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Long term sustainability of fisheries requires understanding the relationship between reproductive output of a population and the resulting recruitment. Exploring how success at the individual level adheres to or deviates from the statistical models used to describe the recruitment process at the population level provides insight into the suitability of the statistical models used for fisheries management. We studied the fine scale reproductive behaviors of spotted seatrout (*Cynoscion nebulosus*) at an inlet spawning site in Tampa Bay, Florida through acoustic telemetry. The individual spatial and temporal reproductive patterns of 44 spotted seatrout (28 females, 16 males) were assessed over a period of three spawning seasons from 2007 to 2009. Movement in and out of the spawning ground was detected through an acoustic receiver array that was arranged for full detection of fish in the spawning ground and surrounding study area. Using this set up, four hypotheses were tested: (1) there is a large recruitment basin for the spawning site; (2) spawning frequency will differ with size and sex; (3) individual spawning seasonality will differ with fish size or sex; and (4) spotted seatrout exhibit inter-annual spawning site fidelity. The data analysis is ongoing; however, initial results suggest that the spawning frequency does differ with sex and there is evidence of inter-annual spawning site fidelity.

A2

Spatial and Temporal Patterns of Yellowtail (*Seriola dorsalis*) in the Southern California Bight as Inferred from Recreational Catch Data and Conventional Tag Returns

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In the Southern California Bight (SCB), yellowtail, (*Seriola dorsalis*) are valued gamefish targeted by recreational and commercial fishermen in since the late 19th century. State-mandated Commercial Passenger Fishing Vessel catch records indicate average take is approximately 70,500 fish per year, although catch has topped 500,000 fish during exceptionally warm years. The bulk of the catch is assumed to be comprised of fish seasonally migrating north into the SCB from Mexico. However, recreational anglers catch large yellowtail in select SCB inshore habitats during winter months; often when ocean temperatures are significantly below optimal. Despite angler interest, little is known about current yellowtail movements in California and no fisheries-independent data exist.

This study is the first to focus on SCB yellowtail in 60 years. Using a combination of recreational catch records and conventional tagging, we test hypotheses that yellowtail caught inshore are routinely larger than conspecifics caught offshore, that large fish are caught inshore during winter months in sub-optimal water temperatures and that yellowtail catch has distinct, seasonal, spatial patterning. Recreational catch indicates broad spatial and temporal trends exist in the SCB recreational yellowtail fishery. They are: (1) seasonal increases in juvenile fish offshore and larger, mature fish in select inshore areas. (2) Yellowtail "hotspots" with consistent, year-round, elevated catches as compared to surrounding areas. (3) Tag returns indicate that distinct seasonal catch increases are driven by angler effort, ocean temperature and large-scale environmental factors. This work is the first step in quantifying how these factors impact an iconic California gamefish.

A3

Sampling Rare, Diffuse and Episodic Fishing Events: Developing Methods for Optimal Survey Design

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Recreational fishing surveys that produce statistically robust outcomes require well thought out sampling designs, which include adequate coverage of the population being surveyed. However, it is often difficult to know how big the sample needs to be and the level of error that can be expected. This is especially true when trying to measure rare and episodic fishing events across vast areas, such as those which occur in some specialised fisheries. We were fortunate to have access to datasets from previous on-site stratified random access point surveys, as well as fishery specific information from expert angler surveys that allowed the construction of a simulated data set to test various sampling coverage rates and survey designs. Commercial catch data was also used to determine the likely presence or absence of the migratory target species in various areas throughout the year. We compared the results from these simulations against oversampled existing survey data. These simulations were then used to predict the error distribution of various sampling strategies and coverage rates. The outputs were invaluable in providing information on sampling coverage, cost and likely error of these scenarios and were used in designing a national recreational on-site survey for southern bluefin tuna in Australia. The methods used to develop an optimal survey design for estimating southern bluefin tuna catch in Australia have wider application for designing recreational angler surveys, especially when fishing activity is rare, diffuse and episodic.

A4

Approaches for the Inclusion of Recreational Data in Fisheries Stock Assessments Where Complete Time Series of Catches are Not Available

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Missing data on recreational fishery catches could potentially be a large source of bias in catch-based assessments of some marine fish species. Almost invariably these catches have to be estimated using surveys, often involving separate surveys to estimate fishing effort and catch per unit effort. Many European countries have commenced recreational fishery surveys to meet EU regulations, building on experiences in the USA and elsewhere. In addition to catch estimates, such surveys could yield trends in catch-per-unit-effort to inform stock assessments. However, in most cases full times series of recreational catches are not available for the entire period covered by the stock assessment, so assumptions need to be made about trends in recreational catches over time. In this paper, three examples of different approaches are outlined from different fisheries in the Seychelles and Europe. These cover recreational sea fisheries that are data poor (demersal fisheries of the Seychelles), have point estimates (northern stock of European seabass), and partial time series (Western Baltic cod). The implications of the different methods are discussed in the context of bias and outcomes of the stock assessment, and recommendations made for future stock assessments that include recreational fisheries.

A5

Use and Abuse of Recreational Fishery Harvest Regulations: Comparing the Intended Versus Realized Outcomes with Data and Simulation

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Recreational fishery regulations for a given management jurisdiction often include numerous pages of regional or waterbody specific adjustments to quotas, size limits, etc. (e.g. British Columbia regulation synopsis is 96 pages). The development of such regulations is a nebulous mix of science, stakeholder involvement, and individual manager preferences. Furthermore, there is often a lack of understanding of the origin of long held regulatory approaches, and/or whether the regulations are even manipulating the fishery towards some stated objective (i.e. sustainability or fishing quality). Recent analyses of Kokanee and Rainbow trout fisheries in British Columbia highlight several of the key considerations and processes influencing the outcomes from harvest regulations. A number of different studies have documented and quantified dynamic interactions between fish abundance, angler effort, angler efficiency, and fish growth and survival. In the case of Kokanee (*Oncorhynchus nerka*), simulation suggests that well thought out static regulations could be more robust to these dynamic processes and the variation in productivity between different lake fisheries. Incorporating a clear understanding of how harvest regulations actually influence different performance metrics would likely lead to substantial simplification and increased effectiveness of fishery regulations.

A6

Stock Assessment Model for Rainbow Trout in B.C. Small Lakes Based on Gillnet Sampling Data

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We developed a stock assessment model for Rainbow trout (*Oncorhynchus mykiss*) based on data obtained from gillnet sampling. Growth model included a formulation for density dependent change in growth. The priors for the component growth model were obtained from a Bayesian hierarchical analysis of growth data from 142 gill-net samples across the province. The model fits to gillnet sampling and angler effort data. Angler effort in the model is based on fishing mortality and our understanding of angler catchability and transfer rates of the Rainbow trout population between states vulnerable and invulnerable to anglers. The stock assessment model was applied to over 200 cases of gillnet sampling and angler effort data. The analysis was used to explore regional patterns in growth and fishing mortality. Following the analysis, we identified a need for a hierarchical analysis to explore the selectivity parameters and q and natural mortality.

A7

Assessing the Status of the Lower Fraser River White Sturgeon Population Using the Integrated Spatial and Age Mark Recapture Model

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The Integrated Spatial and Age Mark Recapture (ISAMR) model was developed for Habitat Conservation Trust Foundation (HCTF) to assess the status of the Lower Fraser River White Sturgeon population using data from the highly successful monitoring program run by the Fraser River Sturgeon Conservation Society (FRSCS). The FRSCS' monitoring program relies on trained volunteers to tag, record, and transfer data. As of January 2016, volunteers had conducted 134,679 sturgeon sampling events, tagged and released 64,565 sturgeon, and documented 63,990 recapture events. This incredibly rich data set presents several challenges including changes in gear selectivity with age and a heterogeneous distribution of sturgeon thorough out the study area. The ISAMR was created to explicitly handle these issues by combining a spatial mark-recapture model with age-structured population dynamics model. The age-structured population dynamics model allowed age-dependent gear selectivity to be modelled as a smooth function of age (a "flat-top" selectivity curve was used) and provided estimates of current and historical recruitment. The spatial component of the model was included to handle the uneven spatial distribution of sturgeon, as well as providing estimates of movement rates between study regions. The current analysis looks at captures and releases from 2000 through to 2015, across four study regions (i.e., A, B, C, and D) and 58 age classes.

A8

Evaluating Harvest Control Rules and Their Impacts on Ohio's Yellow Perch Quota Allocation Process

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Fishery management on Lake Erie occurs within an inter-jurisdictional setting composed of resource agencies from the states of Michigan, Ohio, Pennsylvania, and New York, along with the province of Ontario, and is guided by the lake's Fish-Community Goals and Objectives. Several objectives recognize the importance of Yellow Perch, which serve as a cornerstone to large-scale commercial and recreational fisheries, and call for the sustainable harvest of Yellow Perch across Lake Erie. Harvest policies for the lake's Yellow Perch fisheries are being revised through a stakeholder-centered process, along with input from management agencies. Such revisions are ultimately informed by conducting a management strategy evaluation to examine trade-offs achieved by alternative harvest policies and to assess the consequences of uncertainty for achieving management goals. Here, we help inform Ohio's fishery managers and stakeholders about the performance of potential harvest policies explored during the management strategy evaluation for Lake Erie's Yellow Perch fishery. Specifically, our objective was to evaluate performance of the current harvest policy relative to candidate alternatives, based on performance indicator trade-offs. We used modified assessment models to simulate Lake Erie's Yellow Perch population and associated fisheries, and summarized how candidate harvest policies affected sustainability, risk, and industry stability for a number of Ohio-specific performance indicators. This work will be used to help guide selection of a revised harvest policy to continue the sustainable management of Yellow Perch in Lake Erie.

A9

Estimating Fishing and Natural Mortality Rates for Piscivorous Rainbow Trout, Lake Trout and Bull Trout in Quesnel Lake

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Effective fisheries management requires a combination of sound science and social acceptance from a diverse angling community. We were asked by the angling public to review the current regulatory regime for Quesnel Lake. Quesnel Lake is a large lake, approximately 25,000 hectares in size, located in the interior of British Columbia and supports a diversity of anadromous and resident fish species. The primary recreational fish species are rainbow trout, lake trout and bull trout, with the majority of effort being focussed on the large piscivorous rainbow trout. The size and complexity of the Quesnel Lake system makes collecting informative scientific data challenging. A previous collapse in the rainbow trout population 20 years prior and subsequent implementation of restrictive angling regulations had also eroded trust in fisheries management. Therefore, review and successful implementation of new angling regulations had to address both the challenges of working within a large, complex lake ecosystem as well as renew social confidence in fisheries management. We used a combination of acoustic telemetry and high reward floy tagging to estimate natural and fishing mortality rates for all three key sport fish species. The requirement for anglers to contact a biologist for their reward provided an opportunity to disseminate relevant biological information to a diverse range of anglers. The use of acoustic telemetry combined with high reward floy tagging has proven to be an excellent method for obtaining the scientific data required to set angling regulations while also greatly improving social confidence in fisheries management.

A10

Can Individual-Based Models Provide Useful Insights into the Management of Recreational and Commercial Fisheries on the European Seabass (*Dicentrarchus labrax)?*

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The European seabass (*Dicentrarchus labrax*) is a high value fish with significant exploitation by both commercial and recreational fisheries. Scientific assessments of the northern stock have shown a rapid decline in the spawning stock biomass since 2006 attributed to a succession of weak year classes from 2008-2012 and increased fishing mortality. The stock exhibits substantial interannual variability in recruitment driven by environmental factors, and significant reductions in the harvest of seabass have been implemented by the European Commission to conserve stocks. Individual-based models (IBMs) are simulations that describe individual 'agents' of organisms that have been shown to be effective management tools in many systems, which have not been applied to seabass prior to this study. Here, an IBM of the pelagic phase of seabass was developed to assess the impact of environmental conditions on settlement that included both physical environment components (temperature and currents) and life history characteristics (growth and behaviour). The model was able to predict differences in strength of settlement in established poor and good settlement years regardless of larval behaviour, but larval behaviour was also an important factor in determining arrival at nursery grounds. Spatial IBMs were also developed for adults that take into account life history and exploitation by both commercial and recreational fishers. The outputs from both models are discussed in the context of seabass conservation and sustainable management of recreational and commercial fisheries.

A11

Use of Models of Intermediate Complexity (MICE) to Quantify Trophic Dynamics and Identify Triggers of Population Declines in Kootenay Lake's Trophy Trout Fishery

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In North America, large lakes (>10,000 hectares) support fisheries for trophy-sized rainbow trout (*Oncorhynchus mykiss*). Since the 1960s the Kootenay Lake fishery for the Gerrard strain of rainbow trout had attracted thousands of anglers from across North America and contributed $5-10 million annually to the regional economy. Giant rainbow trout (to 15 kg) increased to a 50-year historic high in 2012 and declined to historic lows in 2015 and 2016. The Gerrard's primary forage fish, kokanee (*O. nerka*), have concurrently dropped from about 1-2 million to 20,000 spawners. While uncertainty remains over the causes of these declines, managers have been trying to rebuild both species. We present a predator-prey-fishery dynamics model applied to Kootenay Lake which was formulated as a model of intermediate complexity (MICE), i.e., a two-species Bayesian statistical catch-at-age model. A model that explicitly incorporated interactions explained the data much better than models with no interactions. Model fitting suggested four potential triggers for the recent declines and projections allowed the ranking of the effectiveness of different management actions to rebuild the fishery. Stocking kokanee eggs and angler retention of age 2-3 Gerrards for the next 5 to 10 years brought about faster recovery than other measures. Angler release of large Gerrards would cause recovery delays of up to decades. Long-term instability would result if factors causing high recruitment rates of age 2 Gerrards persisted. This MICE model allows rapid assessment of population dynamics, yet its simplicity allows for effective communication and interpretation by managers and stakeholders.

A12

Use of Web Cameras to Monitor Long Term Trends in Dynamic Recreational Fisheries

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There is an increasing recognition that New Zealand's marine recreational fisheries are growing, substantial and dynamic. Although considerable progress has been made in developing reliable methods of surveying recreational fisheries in recent years, these surveys are usually conducted infrequently, because of the cost involved. Recreational harvesting can vary considerably between surveys, however, as fishing effort fluctuates and in response to changes in localised abundance. We describe a cost-effective means of continuously monitoring levels of recreational fishing effort over the long term, based on web camera technology. Web cameras have been used to continuously monitor trends in recreational effort on the northeast coast of the North Island since 2005, and the west coast since 2006. The indices of effort provided by these data have given us unprecedented insight into the temporal dynamics of New Zealand's largest recreational fisheries. Although the resources required to operate these systems are relatively low, the effort required to interpret the imagery collected can still be appreciable, and strategies have, and are, being developed to substantially reduce costs and to extend the utility of the information provided.

A13

An Adaptive Management Experiment to Test the Effectiveness of Size-Based Fishing Regulations and Stocking to Address High Exploitation Rates on Lake Trout Populations in Ontario, Canada

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Size-based fishing regulations and supplemental stocking of hatchery-reared fish on wild lake trout stocks are two commonly employed management technics to address high fishing pressure and excessive harvest. Size regulations attempt to prevent recruitment over-fishing while stocking attempts to compensate for high fishing demand by artificially enhancing abundance. We tested the effectiveness of these techniques by manipulating slot-size harvest regulations and stocking a local, native strain lake trout in four study lakes having similar area, morphometry, water quality and fishery histories in the Haliburton Highlands of south-central Ontario. We used extensive roving creel surveys and volunteer anglers to track fishing effort, catch, harvest, body size and otolith age of wild and hatchery lake trout in winter recreational fisheries two years prior to and ten years after manipulation. A 40-55 cm slot-size regulation protected lake trout of spawning ages and allowed sustainable harvests. Removal of this regulation resulted in a dramatic increase in fishing effort and harvest, decline in body size and shifting age structure. Seven years of stocking had a transient, relatively minor effect on effort, made a highly variable contribution to harvest and appears to have negatively affected natural recruitment. We discuss the ecological and fisheries implications and how this project pioneered new resource management partnerships which contributed to public participation, science transfer and positive community involvement.

A14

Effects of Harvest Regulation on Population Dynamics of Freshwater Salmonids

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Recreational fishing has the potential to alter fish populations, both in size and structure. This is especially true in many freshwater systems where recreational fishing might impose a substantial effect on fish mortality. Fishing areas are thus often under regulations to mitigate the possible negative population effect of fishing, but also to optimize the structure of the population for the fishers which have preferences regarding fish size and yield. The different types of harvest regulations thus often involve restrictions on fishing effort (e.g. numbers of fishers), fishing mortality (e.g. bag-limit, C&R) and fish size (e.g. minimum/maximum size). However, although some studies exist there are relatively few examples in the scientific literature on how the different regulations affect freshwater fish populations in the long term. It might thus be challenging for right holders and managers to decide on the optimal regulation plan for the specific system. In our project we aimed to develop a model-framework that might work as a management tool to assess the long-term population effect of variations in harvest regulations. We used data from different river systems in Norway obtained both from scientific surveys and catch records from fisher to parametrize the different elements in the model. The river systems are popular recreational fishing areas, and represent a range of different harvest regulations. Although our model remains a simplification of the natural systems, we are confident that the results can provide important guidelines for freshwater managers on the effect of various harvest regulations in salmonid river systems.

A15

Using Remote Cameras to Monitor the Recreational Atlantic Salmon Trolling Fishery in the Baltic Sea

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Monitoring marine recreational fisheries is often challenging due to large geographic areas that have to be covered, but useful survey methodologies have been developed in the past. However, those survey methodologies are often inadequate to obtain representative data from small, specialized angler populations, e.g. trolling anglers. Such hard-to-reach angler populations may account for a substantial fraction of the total catch for certain target species that needs to be included in stock assessments ensuring sustainable fisheries managements. A nationwide telephone-diary survey was conducted to collect representative data on effort, catch, and socio-economic parameters for the German marine recreational fishery. However, this survey resulted in very low numbers of panelists for some small and specialized, but - in terms of stock exploitation - potentially important recreational fisheries. Using the German recreational Atlantic salmon (*Salmo salar*) trolling fishery in the Baltic Sea as a case study, we tested the long-term use of remote cameras in harbors to monitor trolling boat fishing effort. On-site interviews complemented the camera monitoring to estimate catch-per-unit-effort, and to collect biological catch data and socio-economic information. Preliminary results revealed that German recreational salmon trolling catches are substantial and must be taken into account in the Baltic salmon stock assessment. Furthermore, remote cameras proved to be a cost-efficient method providing fishing effort estimates with little bias. The results help to increase the accuracy of the Baltic salmon stock assessment and the methodology can also be used to monitor other recreational boat fisheries.

A16

Monitoring and Managing Recreational Fishing on Hatchery Salmon in Puget Sound

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Fishery managers have been challenged to find a balance between providing highly valued recreational salmon fishing opportunity and ensuring that the conservation objectives of wild salmon are met. Declining abundance of wild Puget Sound Chinook (*Oncorhynchus tshawytscha)* salmon populations resulted in threatened status under the Endangered Species Act (1999), resulting in severe restriction of virtually all marine and freshwater fisheries in the Puget Sound region that take wild Chinook salmon directly or as incidental catch while pursuing other species or stocks. Innovation with physical identification techniques with hatchery produced Chinook salmon, coupled with results of scientific studies that showed low mortality rates for released, sport-caught Chinook salmon, presented the opportunity to restore lost recreational fishing opportunity. Since 2003, closed Puget Sound and Strait of Juan de Fuca sport fisheries have been carefully re-opened under mark-selective regulations – release of unmarked wild Chinook salmon while allowing retention of marked hatchery Chinook salmon stocks. Intensive sampling of these new fisheries, including on-water as well as shore-based methods, was implemented to account for stock-specific impacts. With over a decade of practical experience and data for evaluation, the mark-selective fishery sampling strategies have been continuously improved to ensure statistically sound estimation of critical management parameters. Although incidental mortalities of wild Chinook salmon associated with mark-selective fisheries are relatively low, they are significant and accurate accounting is vital to sustainability of these fishery. Virtually all Puget Sound sport fisheries are currently managed under this mark-selective regulation regime and high angler participation levels indicate success with this relatively new approach to providing meaningful recreational fisheries. Acceptance of mark-selective fishing across the broader sport, commercial and tribal fishing community is challenging given the diversity of value perspectives.

A17

Estimation of Abundance, Observer Efficiency, and Residence Time for Englishman River Winter Steelhead Using a Combination of Radio Telemetry and Snorkel Surveys, 2012 – 2014

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The Englishman River drains a watershed area of 324 km2 from the central east coast of Vancouver Island B.C. providing a mainstem anadromous length of 15 km. The relative abundance of winter steelhead has been evaluated annually since 1982 through snorkel surveys and used as an indicator of winter steelhead stock status for Vancouver Island east coast streams. Area-under-the-curve (AUC) population estimates have been derived for several survey years since 2002, although key parameters including residence time and observer efficiency were estimated with no local validation. In the spring periods of 2012-2014, we marked 77 steelhead with visual streamer tags and monitored their distribution and movements using radio-telemetry, during which time eleven snorkel surveys were completed. The unadjusted mean residence time from date of tagging to emigration or mortality was 40.6 days with no significant differences between years or sexes. Snorkel survey observer efficiency varied significantly from 0.2 to 1.0 but was strongly related to both stream discharge and survey-day. A number of escapement estimation approaches were explored including trapezoidal-AUC with bootstrapping and maximum likelihood estimation under different model assumptions and constraints. Escapement estimates were generally between 100-300 fish per year and near levels of conservation concern, but with some considerable differences in estimates and precision resulting from the different approaches.

A18

Harvest in Remote Headwater Streams Alters Native Brook Trout Populations

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Native Brook Trout *Salvelinus fontinalis* populations in streams experience declines in adults overwinter leading to speculation that low energy reserves following spawning may lead to mortality. In central Appalachia, lowest body energy occurs in December following spawning, but condition rebounds in January. In small (1st & 2nd order) streams anglers begin targeting Brook Trout in late January. We hypothesized angling may contribute to declines in abundance of larger fish. Due to the remoteness of streams and infrequency of angling traditional creel survey methods were impractical to estimate harvest. To evaluate harvest impacts on Brook Trout we conducted angler surveys to gain information on numbers and minimum sizes of fish retained and placed motion activated cameras on six streams to estimate angling effort. Anglers harvesting Brook Trout traveled shorter distances than catch-release anglers. Catch-keep anglers caught an average of 4.5 fish per day and fished on 2.6 streams per trip. They reported the minimum size fish kept was 182 mm. Coupling angling effort (from cameras) with the mean catch from angler surveys we estimate overwinter declines in fish could be accounted for by harvest. Despite high catch rates on a reference (catch and release) stream, populations of larger fish did not decline over winter. Our results suggest harvest may structure Brook Trout populations in remote, headwater streams and such streams may require more restrictive regulations than larger systems.

A19

The Use of a Large-Scale Tagging Study to Evaluate and Improve Statewide Hatchery Catchable Trout Fisheries

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Increases in hatchery rearing and transport costs coupled with stagnant or declining funding has often resulted in reduced numbers of hatchery fish stocked in public waters. This has intensified the need to better understand how to maximize return-to-creel rates of hatchery trout by identifying factors contributing to better post-stocking performance. From 2011 through 2015, we T-bar anchor tagged over 150,000 catchable-sized hatchery Rainbow Trout (*Oncorhynchus mykiss*) and stocked them into 139 different waters across 586 individual stocking events. Angler tag returns were used to generate water-specific estimates of angler return rates and average days-at-large of angled fish. In addition to monitoring trends in water specific catch and harvest over time, these data were used to evaluate numerous factors that might influence angler catch, from hatchery rearing techniques and stocking conditions, to environmental factors specific to each water. Angler catch rate, within one year of stocking, across all study years averaged 26% and ranged from 0% to 76% for individual stocking events. Variation in angler returns was best explained by mean fish length at stocking, water size, rearing hatchery, and water elevation. Average days-at-large for angled fish in individual waters varied from a low of 10 d to a high of 297 d, and this variation was best explained by water size and season of stocking. These results have helped the state of Idaho understand factors that lead to better angler returns of hatchery catchable trout and initiate efforts to enhance returns.

A20

Pilot Surveys to Improve Monitoring of Marine Recreational Fisheries in Hawaii

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Marine recreational fishing from shore and by private boats in Hawaii is monitored by the Hawaii Marine Recreational Fishing Survey (HMRFS), an access point survey to collect catch information, and the Coastal Household Telephone Survey to collect fishing effort data. In response to recommendations from a recent HMRFS review, roving surveys of shoreline fishing effort and catch, an aerial fishing effort survey, and a mail effort survey were tested in combination and compared with the current HMRFS approach for producing shoreline fishing estimates on one of the main Hawaiian Islands (O'ahu). A pilot access point survey of private boat anglers was conducted on the same island, using a design created by the NOAA Fisheries' Marine Recreational Information Program (MRIP). The for-hire fisheries sector in Hawaii is dominated by the charter boat industry, for which catch and effort reporting is required via DLNR's commercial marine fisheries reporting system. Through another project funded by MRIP, the commercial fishing reports for charter fishing were compared with fishing activity observed by surveyors at four major charter boat harbors. Based on the results from these pilot studies, we will provide recommendations for improving the current surveys of marine recreational fishing activities in Hawaii.

A21

From the Bar to the Bedroom: Using Knowledge of Sex-Specific Reproductive Behavior to Inform Management of Lake Erie Walleye

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Lake Erie's walleye population is supported by a number of discrete spawning aggregations in the western and eastern basins, largest of which occurs on an open-water reef complex in Ohio. Recreational anglers are allowed to harvest four fish per day during the spawning period, although some anglers feel that recruitment may be hampered through harvest of spawning females. We combined acoustic telemetry, in situ egg collections, and creel surveys to test hypotheses concerning sex-specific differences in walleye reproductive behavior on Lake Erie's largest open-water reef complex, with the goal of learning how these differences influence vulnerability to exploitation during the spawning period. While temperature appeared to initiate spawning for both sexes, males and females showed consistent dimorphic behavior patterns across multiple years. Both acoustic telemetry and creel data suggested that males arrived earlier and remained on reefs longer than females, which appeared to stage on the periphery of the reef complex and entered for a relatively short duration. This translated to female walleye having lower vulnerability than males to recreational angling harvest. Additional work is needed to fully inform management actions suggested by recreational anglers (e.g., length-based regulations aimed at reducing harvest of females) to protect walleye recruitment.

A22

Norwegian Marine Recreational Fisheries - A Pre-Study in the Oslofjord

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Marine recreational fishing is popular in Norway, but little is known about catches, socio-economic impacts, or human dimensions on a national level. Norway's marine recreational fishery is diverse, and anyone (i.e. residents and tourists) can fish without a license along Norway's 25 000 km coastline. To test different on- and off-site survey sampling techniques, three methods were used to obtain data on recreational fishing in the Oslofjord during June, July and August 2016; i) a telephone screening survey, ii) diarists with telephone contact (memory jogger approach) and iii) a roving creel survey with on-site face-to-face interviews of fishers. We found diaries can provide high quality data, but follow-up of diarists needs improvement to increase response rate. The screening survey revealed that 339 000 (20%) of the surrounding 1.7 million people informed to have fished in the Oslofjord at least once the last year. Importantly, there was a discrepancy in estimates of proportion of persons born in other countries between the telephone screening survey (8 %) and the roving creel survey (54 %). This indicates potential bias in off-site surveys, and the need for complemented surveys. Mackerel was the fish most caught in summer, with few Atlantic cod and other species. Knowledge about regulations was low, for example, with only 20% knowing the minimum size limit for Atlantic cod. This study provided information and methodological inputs towards developing effective and sustainable fisheries management in the Oslofjord, and contributed to a larger scale national survey on marine recreational fisheries in Norway.

A23

Tracking the World's Most Elusive Gamefish – The Permit

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Permit (*Trachinotus falcatus*) are a popular gamefish in the tropical western Atlantic Ocean, Caribbean Sea and Gulf of Mexico. Hooking or landing a permit with a fly rod by sightfishing on nearshore flats is considered by many as the pinnacle of sportfishing experiences. However, the same elusiveness that makes this species attractive to anglers also poses major challenges to scientists studying their ecology. There are fewer than ten scientific publications on this species, none of which studied live adults. Hence, there are major knowledge gaps in the natural history and ecology of this species relevant to their conservation. Here I will discuss an ongoing acoustic telemetry study in the Florida Keys conducted in partnership with the angling community and resource managers. We are addressing questions related to permit habitat use, the scale of their regional movements, and connectivity between nearshore flats, coral reefs, and shipwrecks. This talk will reveal the spatial ecology of one of the world's most elusive gamefish species, and the challenges of undertaking such a project.

A24

Case for Lake Erie Walleye as a Cultural Keystone Species

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Plant or animal species whose existence and symbolic value are essential to the stability of a given culture through time are known as cultural keystone species. We propose that Lake Erie Walleye provides an example of one such species. Walleye supports large-scale commercial and recreational fisheries across Lake Erie, is featured prominently in annual festivals and ceremonies held by local communities, and those whose livelihoods depend on Walleye fisheries have developed a unique vernacular. Further, the complex life history of Walleye makes it unlikely to be replaced by other native fishes within the cultural fabric of Lake Erie should it become extirpated. Ultimately, because of the cultural and economic significance of Walleye, a premium has been placed on effective, sustainable fisheries management, which empowers agencies and stakeholders to commit fiscal resources to maintaining this species in the context of cultural continuity. Additional system-wide benefits from this commitment include stakeholder advocacy on a wide range of ecosystem issues, interagency investments in assessments that characterize the status of other native fishes, including threatened and endangered species, a focus on large-scale habitat enhancement projects that benefit ecosystem function, and a recognition, through commercial fishery certification, that sustainable fisheries are critical to cultural stability.

A25

Sea Angling 2016 – A Survey of Catches and Expenditure by Recreational Sea Anglers in the UK

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Recreational sea angling is a popular and high value activity in the UK with catches of some species significant. However, in many cases recreational catches are not included in stock assessments affecting our ability to manage fish stock sustainably. In Europe, mandatory annual reporting of recreational catches is required for certain species as part of the data collection programme that underpins the Common Fisheries Policy. To fulfil this requirement, the Sea Angling research programme was instigated in the UK in 2016 (www.substance.net/seaangling2016). A combined approach with a population survey and diary panel was developed to estimate the expenditure and catches of all species by recreational sea anglers. The national survey provided estimates of the numbers of sea anglers by region across the UK and their avidity. A diary panel of almost 500 anglers reported catches monthly using a bespoke online system developed for the project (www.seaangling2016.org). The estimates catches and expenditure were raised to the total population accounting for avidity and location, then partitioned to provide estimates at the regional sea level. The results of the 2016 survey are compared to estimates from 2012 to assess the effect of different survey design - as well as other factors such as regulations on catches of some species - and discussed in the context of the methods for data collection from sea anglers and management of recreational sea angling in the UK.

A26

Regulating Fisheries by an App

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In the Netherlands fishing rights are rented by angling associations. The renting organizations are responsible for the fish stock in the rented waters. However, Waterboards and the ministry who rent out the fishing rights are also responsible for the quality of the water systems including fish stocks. Sportvisserij Nederland developed an App called VISplanner where every rented water can be found, including the fishing rules. By entering membership number (VISpasnumber) every member of an angling club can easily see where he is allowed to fish. Before, this information was in paperback sized booklet. Since 2015 the App is officially a legal part of the license, together with the VISpas, replacing the booklet. This presentation shows the App, the working, the data collection system and maintenance of the app but also angler behaviour concerning the change from paper to app, distribution issues, usage etc. For the near future this app can be used to collect data about the usage and importance of waters since over 100.000 sports fishermen have downloaded this App.

A27

A Membership Survey as Guidance for Future Areas of Focus

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In 2016 there were 577.000 active and registered anglers in The Netherlands. In that year a large survey was held among all these registered anglers, asking various questions about their behaviour, such as the types of angling, species fished for, frequency and duration of trips etc.. In this survey we also asked when anglers first started angling, how they first got in touch with angling and why they stopped or resumed their fishing activities. Also wishes of anglers as well as their willingness to assist someone else with their angling are monitored in this survey. In total 12.915 people completed the survey. The presentation shows responses to various questions asked and discusses the results and associated biases. Results will be compared with former survey results. The results are used to define the current needs of the anglers and to shift the areas of focus for angling in The Netherlands. Not only for our own organization but also in different national boards, where the importance of fisheries and needs and wishes of our anglers for the near future are being discussed.

A28

Integrated Survey Methods to Estimate Harvest by Marine Recreational Fishers in New Zealand

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Fishing is a popular and productive pastime in New Zealand. Several iterations of large scale fisher diary surveys were undertaken in the 1990s to estimate recreational harvests. Slight changes in survey method produced uncertain and at times implausible results. Focus turned to more direct measures of fishing effort and harvest using aerial counts of boats, combined with all day creel surveys at high traffic access points. In 2011-12 three concurrent surveys were conducted independently using different methods: A random sample of 7000 panel diarists were recruited using a face-to-face household survey and contacted regularly by SMS and telephone to collect information; an aerial-access survey of boat based fishing; and a complete census survey of access points in a sub-region to estimate the harvest by specialist fishers targeting scallop and rock lobster. The results and methods were reviewed by an international expert panel. The offsite survey relied on average weight data for each fish stock, provided by the access point surveys, to convert estimates of numbers of fish caught to weight. The aerial-access survey and access point census survey relied on the proportion of land-based harvest estimated by the offsite survey, to derive total regional harvest estimates. The final snapper (*Pagrus auratus*) harvest estimates where of a very similar magnitude. These were incorporated into the stock assessment and management review, which led to a lively public and political debate about new management controls in 2013. High quality recreational harvest estimates are important to support management changes in high profile fisheries.

A30

Improving Catch Monitoring and Assessment of Guides, Lodges and Charters on the West Coast of Vancouver Island

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The tidal waters recreational fishery in BC involves over 300,000 participants, and takes place in some very remote locations. Time and area fishery strata are monitored through a combination of creel surveys, guide and lodge logs, and angler logs. In this report we describe the assignment of fishery risk to each stratum, and the resulting allocation of creel survey effort. A significant portion of the BC tidal water fishery originates with lodges, guides and charter operations. We explore the extent of this component of the fishery. We also describe collaboration with fishing lodges, guides, and charter operations to address catch reporting in remote areas, in obtaining high resolution biological sampling, and in the potential use of this consistent data source as an index of abundance.

In 2016 DFO and the SFI collaborated on improving the participation rate of guides in catch reporting and biological sampling along the west coast Vancouver Island. We describe the work, including getting buy-in for sharing responsibility for fishery monitoring, for improving the efficiency of the reporting and sampling process, for improving tools and adapting procedures, and improving the education and awareness.

Guides generally agreed that lack of resolution of most fishery data was leading to reduced fishing opportunities. Therefore, improved spatial and temporal resolution of the catch, stock and biological composition, and subsequent utility for refining fishery management actions was an important consideration in gaining support. We will describe how lessons from the 2016 experience will influence the development of a strategic plan for improving the participation of guides and lodges in catch reporting and biological sampling throughout the BC coast.

A31

Angler Use of New Zealand Lake and River Fisheries: Results from Two Decades of National Angling Surveys

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The 2014-15 National Angling Survey was the fourth in a series of surveys conducted since 1995 to estimate annual angling effort for all river and lake fisheries under Fish & Game New Zealand (FGNZ) jurisdiction. Data on angling locations and effort during the 2014/2015 angling season were collected via bimonthly telephone surveys of randomly selected fishing licence holders.

Total annual effort from 1995-2015 ranged from 1.110 million angler-days in 2014/15 to 1.202 million angler-days in 2007/08, but shows no consistent long-term trend. Long-term trends are more apparent at regional level, with significant declines in Auckland/Waikato, Eastern, Wellington, and weaker declines in Nelson/Marlborough and Southland. Significant increases have occurred in Central South Island, and on the West Coast. Consistent long-term trends are also apparent with respect to River Environment Classification (REC) source-of-flow and land cover class, for which total annual effort has declined by 48% for lowland river fisheries, and by 30% for fisheries in catchments dominated by pasture or cropland.

This dataset, which now spans two decades, is one of the few available sources of quantitative data on long-term trends in New Zealand freshwater environments. It is valued not only by FGNZ, but is now recognised as a robust and credible data source, widely used to inform resource management and policy development.

A32

Angler Apps as a Source of Recreational Fisheries Data: Opportunities, Challenges and Proposed Standards

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Recreational fisheries surveys are limited in time and place, which limits scientific understanding and sustainable management. Smartphone applications (apps) allow anglers to record fishing trips and catches. In this presentation, we describe the opportunities and challenges associated with angler apps as a source of data, and propose minimum standards for their use in data collection. Angler apps are a potentially valuable source of conventional and novel data that are both frequent and extensive, and an opportunity to engage anglers through data sharing and citizen science. To realize this potential, we must challenges related to angler recruitment and retention, data quality and bias, and integration with existing fisheries programmes. We propose solutions to each of these challenges. Given that the angler app market is diverse, competitive and unpredictable, we emphasize minimum standards for data collection as a way to ensure large and reliable data sets that can be compared and integrated across apps. These standards relate to trips and catches, and angler demographics and behaviour, and should be supported through consultation and research. Angler apps have the potential to fundamentally change how anglers interact with the resource and with management.

A33

Appy Days on the Horizon: Preliminary Results from a Nationwide Smartphone App for Collecting Recreational Fisheries Data

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Smartphone applications (apps) that allow anglers and other recreational fishers to record the details of their fishing trips and catches have emerged in recent years. When designed properly, such apps can be a valuable and low-cost source of data that can feed into the future management of recreational fisheries. This includes traditional fisheries-dependent data related catch (harvest and release) as well as novel data that reveal how anglers interact with management and the resource. Clearly, there are multiple challenges related to angler apps, and future research should be directed at understanding the weakness and limitations as well as the strengths and benefits. This study presents preliminary data from the app "Fangstjournalen", which was developed by DTU Aqua, Technical University of Denmark, to generate quality data for research and management. The platform, which also includes a browser version, is primarily financed by the Danish national fishing license and since it was launched in 2016 has received support from ministries as well as fishing clubs. The number of users is steadily growing. Here, I present patterns of user demography and compare this with non-app user demography to explore potential patterns of user bias. To further explore weaknesses and limitations of apps in general, I present data on retention time (i.e. how long the anglers use the app) and explain why some anglers stop using the app. As examples of strengths and benefits, I will give examples of data that can be generated from the app, such as traditional recreational fisheries data (e.g. species-specific catch rates, release rates and size distributions) and more novel data such as the interplay between angler avidity, motivations and satisfaction.

A34

Determining the Utility of Electronic, Self-Reported Recreational Data for Fisheries Stock Assessment

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To supplement current sampling programs, fisheries professionals are turning to electronic, self-reporting platforms. The hope is that such platforms will be effective at filling data gaps and enhance fisheries assessment. We assess the utility of the iAngler smartphone "app" data, one such sampling program in Florida, for recreational fisheries stock assessment by characterizing the dataset and comparing specific metrics to those of NOAA's Marine Recreational Information Program (MRIP). These metrics were spatial distribution of trips by county, frequency of catch for the ten most commonly reported species, and species-specific catch rates. We conducted "catch frequency", catch rate, and length frequency of discard comparisons for different spatial designations in Florida, and catch rate comparisons for different fishing modes. Data from iAngler exhibits a strong spatial bias toward southeast Florida and a bias toward three common inshore species: Common Snook (*Centropomus undecimalis*), Spotted Seatrout (*Cynoscion nebulosus),* and Red Drum *(Sciaenops ocellatus).* However, iAngler catch rates for these three species were similar to MRIP. Because most trips reported to iAngler came from a relatively small number of anglers, we used a simulation to develop a proper weighting for angler avidity. Using a geometric mean that accounted for zero-catch fishing trips and angler avidity, we recalculated catch rates for Common Snook, Spotted Seatrout, and Red Drum and found avidity to have a variable yet noticeable impact on catch rates. This study shows the potential for electronic, self-reporting programs to provide reliable recreational fisheries data, if spatial and demographic coverage is sufficient and avidity is accounted for.

A35

A Review of Creel Survey Monitoring of Recreational Fisheries in British Columbia Tidal Waters

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A significant recreational fishery has occurred in southern British Columbia tidal waters since the 1940's; with more than 300,000 licenced anglers currently. This fishery primarily targets Pacific salmon, although groundfish – such as halibut (*Hippoglossus stenolepis*) – and shellfish are also targeted. Fisheries and Oceans Canada has monitored tidal water recreational fisheries using a creel survey since 1980. The creel survey was developed as a paired aerial-access point design. Over time, the survey has expanded and contracted in scope in response to changes in the spatial extent of the fishery and to changing budgets; it remains one of the primary sources of information on recreational catch and effort information for domestic and international fisheries management. This presentation will briefly summarize development of the recreational fishery from a monitoring perspective and review the history of the creel survey from its initial development to today, highlighting changes in methods, design and objectives as well as future directions.

A36

An Internet-Based Survey of Recreational Anglers to Estimate Effort and Catch on Canada's Pacific Coast

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Since July 2012, Fisheries and Oceans Canada has conducted an internet-based survey of tidal water recreational licence holders to estimate effort and catch. The objective of this survey is to provide reasonable quality estimates of effort and catch across all legal harvesting methods for all species, areas and months. The survey is delivered, via an email with a personal survey link, to a random selection of valid licence holders each month. Currently, more than one in three licence holders are invited to provide fishing activity information via the survey; more than 100,000 licence holders per year. We first present a summary of the survey and analytical methods to estimate catch from these fisher-dependent fishing records. We also present a summary of telephone interviews conducted with licencees who failed to complete the internet survey to evaluate the potential effects of a 'non-response' bias. We then describe how, for boat-based angling effort and catch estimates, we use concurrent estimates from a comprehensive creel survey to bias-correct our internet survey-based results. We conclude by describing recent progress towards full implementation of the results into recreational fishery management processes as well as future research.

A37

Communicating Regulatory Information for Compliance in the Recreational Fishery

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Recreational fishing in British Columbia is a popular endeavour and a significant economic contributor to the province. More than 300,000 tidal waters licences are issued by DFO each year, and the sector supports 7,700 jobs with an annual fishery value of approximately $500 million.

Over the past three decades, management of recreational fisheries has increased in complexity, as resource management approaches strive to find a balance between fishing opportunities and ecological requirements. A significant challenge for a regulatory agency such as Fisheries and Oceans Canada is communicating ongoing fishery management measures (openings, closures, restrictions) to the public in a manner that is timely, accurate and enforceable. DFO in Pacific Region has been involved in a project to modernize recreational fishery communication for the past two years, with components of that supported by a partnership with the Sport Fishing Institute and the Pacific Salmon Foundation.

The primary focus of the Recreational Fishery Information Transformation project has been the development of infrastructure and tools required to maintain a central repository of Pacific recreational fishery information - a singular source of information for all distribution channels. This repository (the Fishery Regulation Information System) is nearing completion and will ensure that DFO's Recreational Fishery Website, the Sport Fishing App and any other distribution channels will share dynamically-generated real-time regulatory changes to fishery clients.

In addition to the FRIS database, the Department has embarked on a number of other improvements to its website and other communications to improve readability (plain language), support branding around client-responsibility (Catch Counts!), and move towards a fully electronic fishing licence with an online repository for catch data. The development of these tools is intended to both enhance the experience and ease-of-use for sport fishing anglers in BC as well as support the effective management of the resource.

A38

National Marine Recreational Fishing Expenditure Survey

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U.S. law mandates NOAA's National Marine Fisheries Service (NMFS) to enumerate the economic impacts of the policies it implements. Additionally, NMFS is responsible for estimating the economic importance of marine recreational fishing to the nation. In order to gather economic data related to marine recreational angling, NMFS conducts surveys of recreational anglers to gather anglers' expenditures on recreational fishing trip expenditures. The primary objectives of the 2016/2017 National Marine Recreational Fishing Expenditure Survey are to profile the most recent marine recreational fishing trip in terms of mode (for-hire, private boat, shore fishing), number of days fished, species targeted, reason for trip, location of trip, etc.), collect a set of trip expenditures for the most recent marine recreational fishing trip, and collect limited demographic information. The survey was conducted to cover angler marine fishing activities that occurred from January 2016 to December 2016 in Alabama, Florida, Mississippi, Louisiana, Texas, California, Oregon, Washington and Alaska. Additionally, surveys were sent to holders of the recreational Highly Migratory Species permit along the Atlantic and Gulf coasts. In 2017, the states from Maine to Georgia, and Hawaii will be surveyed. This presentation will focus on project goals and methodologies.

A39

Recreational Sea Fishing in Europe – Participation Rates, Fishing Effort and Expenditure in a Global Context

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Marine recreational fishing (MRF) is a high-participation activity with large economic value and social benefits globally, with separate catch allocations for commercial and recreational fisheries common in some countries. Although reporting of recreational catches has been a European legislative requirement since 2002, robust estimates of MRF are only available for some countries. In this study, the numbers of anglers, participation rates, days fished, expenditures and catches of two key species were synthesised to provide estimates of MRF in Europe. National data were collated by local experts and, where surveys did not exist, combined with extrapolations from donor countries corrected for population size or GDP. We estimated that there were 8.7 million European recreational sea fishers and a participation rate of 1.6%. Each year, 77.6 million days were fished and direct expenditure was €5.9 billion. Higher participation, numbers of fishers, days fished, effort, and expenditure was found in the Atlantic than in the Mediterranean region. Comparisons with other regions globally showed that MRF participation rates were higher in Oceania and the U.S., but expenditure was lower than the U.S. In contrast, participation rates, days fished and expenditure were higher in Europe than South America and Africa. Removals by MRF represented 27% of the total removals for European sea bass and western Baltic cod. These estimates highlight the importance of the European MRF and the need for collection of MRF data that can be used for stock assessment and fisheries management, leading to sustainable use of European marine fishery resources.

A40

Defining Bonefish, *Albula vulpes*, Migration Corridors and Spawning Aggregation Sites on Eleuthera, the Bahamas

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Marine fish species that employ the reproductive strategy of broadcast spawning frequently migrate from their typical home ranges to spawning aggregation (SA) sites. Fidelity to SA sites and migration corridors may expose these species to both natural and anthropogenic threats, such as predation and coastal development. In the Bahamas, bonefish, *Albula vulpes*, are a popular sportfish, supporting a catch-and-release flyfishing industry estimated to generate $141 million USD annually for the Bahamian economy. Acoustic telemetry studies on bonefish have determined that these fish use nearshore flats and mangrove creeks for feeding followed by monthly migrations to deeper water to form SAs. Previous studies identified multiple migration corridors and SA sites on Grand Bahama, but currently there is limited and incomplete knowledge of these critical locations on Eleuthera. Between 2015-2017, using a broad-scale acoustic telemetry array, fish were tracked moving between foraging grounds and SAs at five locations around Eleuthera. Bonefish tagged in each of these locations were not detected in another region, indicating that these populations likely do not mix at spawning sites. Telemetry data indicates five spawning migrations corridors utilized between December and June, with migration distances between 1 km and 25 km from foraging grounds to SA sites. To conserve this recreational fishery, natural resource managers should consider incorporating bonefish migration corridors and SAs into management plans, specifically the design of marine reserves.

A41

A Framework for Science-Based Management of Marine Recreational Fisheries in Norway

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This talk introduces and presents the first results of an interdisciplinary three-year project which aims to provide knowledge of the extent and development of marine recreational fisheries (MRF) in Norway, as well as of the ecosystem services provided by the sector. Norwegian MRF are an important part of the blue economy, but may threaten the sustainability of coastal fish stocks. Resource managers presently lack science-based knowledge to evaluate MRF' economic importance and impact on fish stocks relative to other potentially conflicting coastal activities. MRF in Norway are open access, and there is neither a comprehensive registry database of recreational fishers nor a complete registry of recreational boats available. The Norwegian telephone registry provides excellent coverage of the domestic population and is

used as sampling frame for a telephone-diary survey to characterize this segment of MRF. On-site surveys are required for non-resident marine recreational fishers, and to collect biological data. This is challenging because MRF are widely spread out in time and space and the heterogeneous population of fishers cannot be representatively sampled from a finite list of access-points along the coast. Therefore, a framework for cost-effective probability-based survey sampling that can minimize biases and provide robust national estimates of recreational effort, catches, and the ecosystem services provided from MRF is developed. This includes innovative statistical methods that combine complementary probabilistic survey methods which are tested during 2017. This project will provide guidelines of sampling efforts to reliably quantify and characterize Norway's diverse and extensive MRF.

A42

The Silver King Acoustic Telemetry Network: Tracking Atlantic Tarpon Across the Gulf of Mexico and the Western Atlantic

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The recreational fishery for Atlantic tarpon (*Megalops atlanticus*) has rapidly expanded since the fishery's origin in Charlotte Harbor in 1885. This fishery, worth billions of dollars per year, now encompasses the Chesapeake Bay, Gulf of Mexico, and the Caribbean. Given the economic importance of the tarpon fishery across regions, a better understanding of tarpon movements and habitat use across life history stages is needed to develop and implement a strong tarpon management plan. Although acoustic telemetry provides a means to track tarpon movements across local and regional scales, the wide geographic range and variable migratory behaviors of tarpon require multi-institutional collaboration. We report on the Silver King Acoustic Telemetry Network, an extensive collaboration of agencies, institutions, guides and anglers who have joined together to establish an acoustic telemetry monitoring network stretching from the Gulf of Mexico to the east Atlantic Coast, including the iTAG, FACT, and ACT networks. This collaborative provides us the ability to determine the extent of connectivity between regional tarpon populations; if tarpon use the same spawning sites each year; the effects of freshwater flows on tarpon movements; and the movement patterns and habitat use of tarpon. We also report on the important roles of stakeholder engagement for guiding tarpon research and conservation priorities. We provide preliminary results on the diverse movement strategies of tarpon across size classes.

A43

Describing Growth of Stocked Rainbow Trout Based on Stocking Densities and Landscape Characteristics

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We developed a growth model for Rainbow trout (*Oncorhynchus mykiss*) based on a Bayesian hierarchical analysis of growth data from 142 gill-net assessments across the province. The growth equation was defined as a von Bertalanffy function and the environmental and stocking covariates were applied to L∞ or K parameters of the function. Considerable improvement in prediction of growth was obtained by calculating the time in terms of growing degree days experienced by fish in the lake. On average, fish stocked as yearlings have an approximately 17% higher K than those stocked as fry. Key factors defining growth for the most parsimonious model were calculating time spent in lake based on growing degree days, the life-stage at stocking, stocking density, and the strain of stocking.

A44

Characterizing Angling Effort Responses to Stocking of Triploid Rainbow Trout in B.C. Lakes in a Meta-Analysis of Long-Term Records of Aerial Surveys of Angling Effort

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An increasing number of small lakes in western North America have been stocked with all-female, triploid rainbow trout (AF3n). AF3ns survive beyond the ages at maturity for diploid (2n) fish and are not subject to the loss of flesh quality and appearance that occur with maturation. Performance evaluations of 2n versus AF3n trout have focussed on growth, survival and return to creel rather than angler effort. Measuring an effort response is difficult because high temporal variance in angler counts causes low statistical power. To address this issue, our analysis uses a large data set consisting of 63,139 aerial boat counts from 512 B.C. lakes collected between 1989, prior to any AF3n stocking, and 2014, when about 50% of stocked rainbow trout were AF3n. We present a meta-analysis to test hypotheses about angler effort response to AF3n stocking and coincident changes in other management policies.   We found significant common-shared interannual variation in effort across all observed lakes, i.e., interannual changes averaging about 15% per year, common to all observed lakes. When these "common year effects" were accounted for, significant positive effort responses to AF3n stocking and other management methods were found. Angling effort increased by about 20% following AF3n stocking. Other factors that were found to significantly impact angling effort on B.C. small lakes include stocking density, regulation intensity, the game fish species stocked and region. The meta-analysis of angler count data on numerous lakes was critical to detecting angler responses to different management methods and thereby testing their effectiveness.

A45

Use of a Modified Delphi Method to Develop Recreational Blueline Tilefish Catch Estimates

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Recent increases in the harvest of blueline tilefish (*Caulolatilus microps*) by fishermen from the states of New York through Virginia required the development of management measures by the Mid-Atlantic Fishery Management Council (Council) to control harvest. Council management in U.S. Federal waters includes the specification of an Acceptable Biological Catch (ABC) by the Council's Scientific and Statistical Committee (SSC). In order to develop an ABC for blueline tilefish, the SSC required a time series of catch estimates. Commercial catch estimates were available but given the rare-event nature of private recreational blueline tilefish catches in the Mid-Atlantic as well as underreporting in the for-hire segment of the fishery, reliable catch estimates for the recreational fishery did not exist. As such, the Council used a modified Delphi Method to develop recreational blueline tilefish catch estimates. The method included iterative surveys in online and workshop formats to solicit input from fishermen who had expert knowledge of the blueline tilefish recreational fishery. The recreational catch estimates developed by this modified Delphi Method were used by the Council's SSC to develop an ABC recommendation and are currently being used in an ongoing blueline tilefish stock assessment.