Plenary sessions

Invited Plenary Speaker: Mark Saunders, DFO
A future for Pacific Salmon under Canada's Wild Salmon Policy
Division Head, Salmon and Freshwater Ecosystems Division, Pacific Biological Station, Nanaimo, BC.
In 2005 DFO's Wild Salmon Policy (WSP) was adopted. The WSP provides a framework for the management of salmon using principles of sustainable development. I highlight the progress made to date in particular the identification of units of salmon biodiversity and habitat indicators and I examine the challenges and opportunities associated with WSP implementation.

Long-term research and monitoring for Pacific salmon (Oncorhynchus spp.) in the North Pacific Ocean ... an international consensus.
B. E. Riddell. President, Pacific Salmon Foundation, Vancouver, B.C.
The North Pacific Anadromous Fish Commission has recently published this plan following two years of discussions and planning. This talk provides an overview of the process and plan, much of which will provide greater understanding of pink and chum salmon production in the North Pacific countries. Each of the Pacific salmon producing countries conducts research and monitors its salmon fisheries to protect and utilize a resource that provides food and economic opportunities. But while each country can study Pacific salmon within their own jurisdiction; international cooperation is needed to understand the spatial and temporal scope and processes that control Pacific salmon on the high seas; particularly with the increasing evidence of climate change impacts.
This “Long-term Research and Monitoring Plan” represents a consensus of a large group of researchers from all Pacific salmon producing countries that the approaches identified in the plan will improve the ability of each country to understand how their salmon populations will respond to changing environments. The participants agree that it is now possible to use new technologies and a new spirit of international cooperation to identify the processes that influence Pacific salmon survival in the ocean. International cooperation is always a challenge, but the North Pacific Anadromous Fish Commission has proven that it can provide the framework for this cooperation.

Pink and Chum sessions
Session Fisheries Management 1:10 – 2:50

Presentation Title: Pink and Chum Keynote: Applying genetic variation to fisheries management, assessment, and enforcement
Presenter: Terry Beacham
Author: Terry Beacham, Department of Fisheries and Oceans.
The application of genetics and biotechnology is integral to the management and assessment of fishery resources. In Fisheries and Oceans Canada (DFO), the application of genetics and biotechnology is becoming part of the way that DFO conducts business in fisheries science, management, enforcement, and conservation. In stock identification applications, examples are outlined in which genetic variation has been instrumental in providing rapid estimates of stock composition, and has been used to shape fisheries to avoid stocks of conservation concern. Migration routes of juvenile salmon from specific

stocks have also been identified, and these can be related to subsequent survival. In enforcement, genetic variation has been used as a tool to aid in prosecutions of those individuals who choose to contravene fisheries regulations in both salmon and abalone. Evaluation of gene expression, and the subsequent application of biomarkers for expression of specific genes, can provide predictability of natural survival of individual fish, with potential implications for fisheries management. The application of genetics in evaluation of brood stocks, whether in use in aquaculture or hatchery environments, can lead to more cost effective methods of development and assessment than previously possible. Possible future applications of genetics and biotechnology to fisheries management and assessment are outlined, with the expectation that applications will become increasingly more cost effective and form a wider foundation in Departmental activities.

Presentation Title: Pink Salmon Forecasting
Presenter: Micheal Folkes
Authors: Micheal Folkes, Department of Fisheries and Oceans
The odd year returns of Pink Salmon to the Fraser system are considered a single Conservation Unit (CU) within Canada's Wild Salomn Policy. This CU has seen continuously increasing recruitments during the last several cycles. The downstream fry numbers and timing are evaluated against other key biological drivers of the stock's dynamics. Uncertainty, due to limited survey programs, plays a large role in conclusions drawn from the state of the CU.

Presentation Title: Didson counters Pink/Glendale
Presenter: Pieter VanWill, Department of Fisheries and Oceans
Authors: Pieter Van Will
Adult salmon escapements have been measured/estimated in various Knight Inlet rivers since the early 1950's during which the methods and effort have varied greatly, thus affecting confidence in the absolute numerical estimates as currently reported in the Fisheries and Oceans Salmon Escapement Database. At best, there are trends (rather than numbers) over time for the 1953-2009 periods. Most of the estimates of escapement for these systems are derived by frequent visual monitoring either by helicopter or stream walks. In some of the key systems, observations are highly frequent and lend themselves to Area Under the Curve analyses. In order to calibrate these visual estimates and more accurately quantify adult pink escapements, Fisheries & Oceans Canada (DFO) in collaboration with the BC Pacific Salmon Forum initiated a multi year study to deploy an imaging sonar system to enumerate the pink salmon in one of main producers in that area, Glendale Creek. In 2007 and 2008 the DIDSON imaging system was installed and the feasibility of that system to enumerated migrating pink salmon was assessed. Estimates of abundance for those 2 years were determined from the data collected by the imaging sonar and compared back to the escapement estimate derived from the visual surveys. Further evaluation of the precision of the DIDSON estimates is still required, but the results to date look promising and will likely provide a reasonable tool for calibration of visual counts.

Presentation Title: Recent volatility related to chum salmon abundance (*Onchorhynchus keta*) in Western Alaska: Today's residents' perspectives
Presenter: Karen Gillis
Authors: Karen Gillis and Chris Stark, Bearing Sea Fisherman's Association, Anchorage Alaska

Pacific salmon (Oncorhynchus spp.) returns to the Arctic, Yukon and Kuskokwim regions of Alaska have been wildly inconsistent. A series of poor returns of chum salmon to the Yukon River, Kuskokwim River, and rivers draining into Norton Sound in the late 1990s and early 2000s prompted a total of fifteen disaster declarations by the Governor of Alaska and federal agencies. Some of these stocks have been in a decline for more than a decade and a half, leading to severe restrictions on commercial and subsistence fisheries and creating numerous hardships for the people and communities that depend heavily on the salmon fishery. Being Sea Fishermen's Association maintains the honor of serving the Arctic, Yukon, Kuskokwim and Bristol Bay regions of Alaska. This area covers more than 75% of the landmass of the State of Alaska and maintains an approximate population of over 150,000 residents. The communities within rely on both subsistence and commercial fisheries where there is little separation between commercial and subsistence activities. In many areas of these regions, restrictions to commercial activities result in impacts to subsistence harvests. The reliance on fisheries not only represents the cultural foundation of the residents it is the primary component of their food supply. In addition, access to commercial fisheries can provide a dose of cash into these extremely cash-poor regions. What are the residents saying? How do the residents manage in years of low abundance with restrictions to both their commercial and subsistence activities? What impacts are felt by those whose spiritual and daily livelihoods depend on this resource?

Presentation title: Cascades Fish Passage – Quinsam River – Pretty in Pinks?
Presenter: David Ewart
Authors: David Ewart and Shannon Anderson, Department of Fisheries and Oceans.
For over 70 years a series of bedrock cascades on the Quinsam River was identified by Fisheries personnel as a barrier to upstream adult migration during periods of low flow, especially impacting adult Pink salmon. A Technical Committee was formed to investigate the quality of habitat upstream if passage was improved. Reconnaissance surveys of habitat, and potential for fishways was done in 2004 and 2 fishways constructed in 2005. The health of the Quinsam River Pink run is key to the Georgia Strait Pink CU (both even and odd years) – as most other systems have poor returns.
Since 2005 30-40,000 Pinks migrate through the Cascades fishways, with fry outmigration doubling and quadrupling historical levels. In 2009 rotary screw and incline plane traps were installed at the lowest fishway in conjunction with the hatchery fence counts to quantify the production from upstream of the cascades and compare to fence counts. 2009 Pink adult estimate to the Quinsam River is in excess of 850,000, a historically high return. Outmigration timing, ocean conditions and reduced fisheries exploitation likely added to returns. Density of the fish in the river has created a number of new issues to consider.

Session Conservation biology/genetics 3:30 – 5:30

Presentation Title: Hood Canal Summer chum salmon – interm genetic analysis of subpopulation structure in a metapopulation receiving supplementation.
Presenter: Maureen Small
Authors: Maureen Small, Washington Department of Fish and Game
For over 15 years, the endangered Hood Canal summer chum salmon ESU has been the focus of an intensive recovery effort designed by the Summer Chum Salmon Conservation Initiative. Supplementation with in-river broodstock was implemented in several tributaries with extant populations and fry from three supplementation broodstocks were additionally released in tributaries where populations had gone extinct. We present genetic profiles of

summer chum salmon before and during supplementation and compare genetic profiles of supplemented and unsupplemented subpopulations.

Presentation Title: Stock identification of Fraser River Pink salmon using microsatellite data.

Presenter: Bruce White

Author: Bruce White, Pacific Salmon Commission, Vancouver

The Pacific Salmon Commission (PSC) has used genetic stock identification (GSI) to identify the proportion of Fraser River pink salmon (*Oncorhynchus gorbuscha*) caught in mixed-stock fisheries in odd-numbered years since 1987. The GSI estimates have been used by the Fraser River Panel of the PSC to help achieve fisheries management goals, including escapement and catch allocation goals for Fraser River pink salmon by user group in Canada and the United States. From 1987 to 2005 the PSC used allozyme-based GSI techniques and in 2007 and 2009, microsatellite DNA techniques were used. The results of stock identification analyses in 2009 indicated that Fraser River pink salmon contributions to mixed-stock fisheries during their peak marine migration period were lower than normal. This was not a result of weakness in the return abundance of Fraser River pink salmon but rather of the strong return of pink salmon to several other non-Fraser pink salmon stocks in southern B.C. and Puget Sound. In addition to helping achieve catch allocation and escapement goals for Fraser River pink salmon, the GSI estimates have also been used in other in-season management applications including run size estimation and marine migration timing and pattern assessments. Future research to increase the potential management applications of the data collected by the PSC's pink salmon DNA program will include expanding the number and sample size of stocks in the genetic baseline as well as the identification of additional genetic markers by researchers at the Pacific Biological Station.

Presentation title: Genetic stock identification of Chum salmon in the Tannana River, Alasaka,

Presenter: Nick Docovich

Authors: Nick DeCovich, Bonnie Borba, Jim Jasper, and William Templin, Alaska Department of Fish and Game

Chum salmon *Oncorhynchus keta* enter the Yukon River as two runs, summer and fall. The Tanana River is a second order tributary of the Yukon River and is home to both summer and fall chum salmon runs, and some tributaries likely have overlapping runs. Recent single nucleotide polymorphism (SNP) analyses suggest that current baseline samples from some Tanana River collections may be composed of both summer and fall run individuals. The analyses presented here give evidence of significant structure among Tanana River chum salmon populations, and also highlight the need for improved temporal sampling. We explore the current population structure revealed by this analysis, the questions it raises, and possible implications for mixed stock analysis of fishery samples.

Presentation title: Southern Chums – hanging in there: Population biology and genetics at the southern limit of their range

Presenter: Oraly Johnson

Authors: Orlay W. Johnson, Anna Elz, Kathleen Neely, and Jeffrey J. Hard, NOAA, Northwest Fisheries Science Center.

Spawning populations of chum salmon historically extended as far south as the San Lorenzo River in California and 322 km upstream in the Sacramento River. In 1905-06 chum salmon juveniles were the most abundant salmon species in streams surveyed between the Sacramento and Columbia rivers. Today, these populations have greatly declined, and in the Columbia River are now listed under the ESA as a threatened species. Little life history,

genetic, or other biological information has been developed on these fish. This information is important as southern runs may represent remnants of historical populations with characteristics essential to the successful restoration of depleted present-day populations. In cooperation with ODFW, WDFW, USFWS we collected life history, genetic, and demographic data (such as presence or absence of spawning populations and timing of migrations) from 2003 through 2009. Preliminary microsatellite genetic data indicate population structure among coastal populations is different from interior and Puget Sound runs. Run timing and other life history traits are also different between these southern populations and others. These runs may contain unique genotypes and adaptations of importance as increasingly rapid changes in climate, pollution impacts, and development expose salmonids to pressures beyond their ability to adapt, forcing further declines and even extinction.

Presentation title: Stock structure and in-season mixed-stock analysis of Yukon River chum salmon.

Presenter: Blair Flannery
Authors: Blair G. Flannery, Terry D. Beacham, John R. Candy, and John K. Wenburg, US Fish and Wildlife Service, Department of Fisheries and Oceans

The management of Yukon River chum salmon fisheries is difficult because of the need to address a variety of complex issues, such as meeting escapements, while still providing harvest opportunities in a mixed-stock and mixed-species fishery. Yukon River chum salmon were assayed for genetic variation at 22 microsatellite loci to establish a baseline for mixed-stock analysis (MSA) applications to assist in addressing these issues. Yukon River chum salmon exhibited a relatively low degree of genetic divergence (G_{ST} = 0.0157) that was structured by seasonal race and geographic region. Using the 12 most informative loci, accuracies in MSA simulations for 10 of 12 reporting groups exceeded 90%, with a range of 80–98%. Stock composition estimates were within 10% of the actual proportions in a known-origin mixture analysis. The baseline was applied in-season to estimate the stock composition of chum salmon caught in the Pilot Station sonar test fishery. Estimates were emailed to fishery managers within 24-48 hours of receiving the samples for a time period or pulse of fish. Stock specific abundance estimates, derived from combining the estimates of genetic stock composition with Pilot Station sonar abundance estimates, were concordant with upriver escapement data, after accounting for harvest. The combination of genetic MSA estimates from the baseline developed in this study and Pilot Station sonar abundance estimates provides a viable tool for assessing stock strength and assisting managers in regulating fisheries to maintain the productivity and evolutionary potential of Yukon River chum salmon.

Presentation title: Microsatellite variation in a chum salmon population genetically marked at to allozyme loci.

Presenter: Adrian Spidle
Authors: Adrian Spidle and Mike Crewson, Northwest Indian Fisheries Commission
The Tulalip Hatchery population of chum salmon, originating from Walcott Slough in Hood Canal, has been genetically marked with two allozyme loci in order to differentiate it from other Hood Canal populations of chum salmon. This selection process may have introduced a founder effect that could have shifted the portions of the gene pool assayed by microsatellite DNA as well. We are in the process of screening known Tulalip chum at microsatellite loci and allozyme loci in order to determine whether there are DNA markers in the selected chum population that can be used as a DNA stock assessment tool for Tulalip chum. We are genotyping the same chum salmon at microsatellite loci and at the two diagnostic allozyme loci. We will compare Tulalip chum salmon population structure to

existing data on microsatellite variation in Hood Canal, Strait of Juan de Fuca, and Puget Sound chum salmon. We will analyze a mixed fishery sample at both allozyme loci and with microsatellite loci and compare estimates of Tulalip contribution to the mixture.

Habitat assessment, enhancement and restoration
Wednesday, 8:20- 9:40

Presentation title: Overview of enhancement activities east coast of Vancouver Island
Presenter: Greg Bonnell
Authors: Greg Bonnell, Department of Fisheries and Oceans.

To come

Presentation title: A multi-year investigation of chum salmon escapements in the Cheakamus River, B.C.
Presenter: Peter Troffe
Authors: Peter Troffe, InStream Fisheries Research Inc.
Since 2007, a novel continuous passive mark recapture technique has been employed to estimate the annual chum salmon spawning escapements in the Cheakamus River, British Columbia. There is little historic data for chum salmon in this regulated south coastal river system and the long term goal of this multi-year monitoring program is to link juvenile out-migrant data and adult escapements to explore long-term hypotheses surrounding water use and fish production.

Presentation Title: Trophic interactions amoung wild and hatchery juveniles chum salmon in Taku Inlet, Southeastern Alaska
Presenter: Molly Sturdevant
Authors: M. Sturdevant[1], E. Fergusson[1], C. Reese[2], A.Wertheimer[1], N. Hillgruber[3], W. Smoker[3], and J. Orsi[1]

[1]Auke Bay Laboratories, Alaska Fisheries Science Center, NOAA Fisheries
[2]Alaska Department of Environmental Conservation
[3]Juneau Center, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks
This study was conducted to examine trophic interactions as a potential cause for the decline in harvests of wild chum salmon (*Oncorhynchus keta*) in Taku Inlet, southeastern Alaska. We examined diet and energy content of wild and hatchery chum salmon juveniles near the inlet during spring releases and weekly for three months thereafter in 2004 and 2005. Juveniles were sampled in nearshore habitats by beach seine and Kodiak trawl at locations in inner, middle, and outer Taku Inlet during outmigration from April to June, and in epipelagic habitat by Nordic trawl as they approached the Gulf of Alaska (Icy Strait) in June and July. Fish were frozen for calorimetry or preserved for diet analyses, and all otoliths were examined for hatchery thermal marks. We used multivariate ordination techniques on data from ~3100 subsamples representing hatchery and wild chum salmon to examine for spatial and temporal interactions between the stocks, including fish condition (weight and length, energy and moisture content, and stomach fullness index) and diet (prey composition by weight, number, and frequency of occurrence). In both years, hatchery chum salmon were initially larger and had greater energy content than wild fish, and diets were partitioned between the stocks in Taku Inlet. However, by June, energy values converged and diets were indistinguishable between the stocks. The high feeding indices for both stocks and

apparent lack of disadvantages between them suggest that any potentially negative, density-dependent interactions in the inlet must affect wild chum salmon very rapidly. Detailed analyses are underway to examine paired samples of hatchery and wild chum salmon in relation to abundance and habitat in outer Taku Inlet, the location where stock interactions were greatest.

Presentation title: An examination of the biological basis of return variability for Nitinat River hatchery

Presenter: Ron Tanasichuk

Authors: Ron Tanasichuk and Dave O'Brian, Department of Fisheries and Oceans

We investigated the effects of hatchery release practices, prey availability and predation on return variability of chum (*Oncorhynchus keta*) salmon from the Nitinat River Hatchery. An historic preliminary analysis suggested that age 3 returns were affected by prey availability, age 4 (the dominant age-class) returns varied inversely with the biomass of piscivorous Pacific hake (*Merluccius productus*), and that there was a strong sibling relationship between age 4 and 5 returns. We re-visit the analysis after time series of hatchery productivity, and prey and predator biomass lengthened. Effects of marine mammal predation are also considered now.

Marine Ecology Wednesday, 10:00-11:40

Presentation title: The effects of elevated water temperature on adult pink salmon survival and blood physiology

Presenter: Ken Jefferies

Authors: Ken M. Jeffries[1], Scott G. Hinch[1], Eduardo G. Martins[1], S. Matthew Drenner[1], Charlotte K. Whitney[1], Kristi M. Miller[2]

1. Centre for Applied Conservation Research, Department of Forest Sciences, University of British Columbia, Vancouver, B.C.

2. Pacific Biological Station, Fisheries and Oceans Canada

Peak summer temperatures in the Fraser River, B.C., have increased ~2ºC in the past 60 years and are expected to increase another 2ºC by the end of the century. Historically, pink salmon (*Oncorhynchus gorbuscha*) experienced ~11.5-16.5ºC water temperatures during spawning migrations. In recent years, they have encountered river temperatures greater than 18ºC more frequently. Elevated river water temperatures have been associated with higher *en route* and prespawn mortality in Pacific salmon. We collected wild Lower Fraser pink salmon and exposed them to different temperature treatments in a controlled laboratory environment to evaluate the effect of water temperature on survival and blood physiology. We found higher mortality (98%) in the 19ºC treatments in both males and females when compared to the 13ºC treatments (45-80% mortality). The duration of the temperature treatment, 5 or 10 days, only influenced survival in the 13ºC treatment. Fish were live sampled before and during the temperature exposure period to evaluate how water temperature affects blood variables. The results will be contrasted with a previous temperature holding study conducted on Harrison sockeye that used similar temperature treatments. These results will provide insight into the potential consequences of elevated water temperatures on Pacific salmon survival during spawning migrations.

Presentation title: Evidence of competition between pink salmon and other juvenile Pacific Salmon in the Strait of Georgia

Presenter: Beamish

Authors: R.J. Beamish, R.M. Sweeting, K. Lange, D. Preikshot and C. Neville

Juvenile pink salmon enter the Strait of Georgia from the Fraser Rive in even-numbered years. There is an overlap in the diet of juvenile pink, and chum and sockeye salmon, but it is the alternating pattern of growth of juvenile chum and sockeye salmon that indicates competition. In even-numbered years, the average size of juvenile chum and sockeye salmon is consistently smaller than in odd-numbered years. There is an intriguing relationship between juvenile pink salmon abundance and the return age of Harrison River sockeye salmon. There is a higher percentage of age 4 sockeye salmon returning when the brood year enters the Strait of Georgia in an even-numbered year. This indicates that reduced early marine growth is related to the age at return, 2 and 3 years after their interaction with juvenile pink salmon. There also is a negative relationship between the abundance of juvenile pink salmon and the early marine survival of coho salmon with the impact being greater for hatchery coho than wild coho salmon.

Presentation title: Tropic variability with and among juvenile salmon species in years of contrasting ocean conditions

Presenter: Erica Jenkins

Authors: Erica Jenkins[1], Marc Trudel[2], Asit Mazumder[1]

University of Victoria, Department of Fisheries and Oceans

Marine survival of salmon varies greatly between years and among regions, and much of the mortality is thought to occur in coastal marine environments. It is expected that the trophic characteristics of juvenile salmon will change as ocean conditions change, which will in turn have an effect on marine survival. The purpose of this study is to explore the trophic interactions of juvenile salmon in coastal environments using stable isotope analysis. The isotope signatures of zooplankton will be used to understand and model inter-annual and spatial variability in nitrogen dynamics and carbon sources in coastal foodwebs. The isotope signatures of zooplankton will also act as a baseline for analyzing the trophic positions of juvenile salmon. This exploration of juvenile salmon isotope signatures, with respect to baseline isotope signatures of zooplankton, will shed light on the ontogenetic niche shifts within species as a function of body size, as well as the patterns of trophic interactions among juvenile salmon species in coastal marine environments.

Presentation title: Growth of Bristol Bay Alaska Chum salmon in relation to climate factors and inter-specific competition

Presenter: Beverly Agler

Authors: Beverly Agler and Greg Ruggerone, Alaska Department of Fish and Game

Growth of salmon in marine and freshwater habitats is believed to be a key factor affecting salmon survival and characteristics such as age-at-maturation. Historical scale samples from the ADFG archives were used to create indices of annual and seasonal growth of age 0.4 Bristol Bay chum salmon for each year from 1966-2006. These indices were used to examine relationships between growth and the influence of the Pacific Decadal Oscillation. We also examined the influence the effect of Russian pink salmon abundance on growth. Results of generalized linear modelling indicated a significant positive correlation of the PDO and pink salmon abundance on the first year of growth and a negative correlation of the PDO, pink salmon abundance and gender on the third year of growth. During the first and

third growth years, there also was a significant interaction between the PDO and the abundance of pink salmon. Use of a general additive model yielded similar results.

Presentation title: Juvenile Chum salmon biophysical parameters in southeaster Alaska: Examining the relationships between survival and harvest

Presenter: Emily Fergusson
Authors: Joe Orsi[1], Emily Fergusson[1]*, Molly Sturdevant[1], Rich Focht[2],
[3]Chip Blair, [4]Susan Doherty, and [5]Steve Heinl
[1]Auke Bay Laboratories, Alaska Fisheries Science Center, NOAA Fisheries
[2]Douglas Island Pink and Chum, Inc.,
[3]Northern Southeast Regional Aquaculture Association

Chum salmon (*Oncorhynchus keta*) are an economically important resource in the commercial salmon fisheries of Southeast Alaska (SEAK), where marked hatchery stocks comprise the majority of the harvest. Detailed regional information exists on chum salmon, both for hatchery marine survivals and for annual harvests of wild and hatchery stocks. In addition, high marking rates of hatchery stocks from the three major enhancement facilities in SEAK permit stock-specific metrics, such as growth and catch, to be determined from juvenile chum salmon caught at sea. From 1997 to 2005, the Southeast Alaska Coastal Monitoring project sampled juvenile chum salmon during summer in seaward migration corridors of SEAK. A full suite of biophysical parameters was developed from field sampling and laboratory analyses (e.g., temperature, zooplankton measures, chum salmon energy density). These data were combined with information from thermal marks to examine stock-specific relationships of chum salmon and biophysical parameters to marine survival and harvest over a nine year period. The goals of this study are to better understand chum salmon survival mechanisms and to identify potential forecast model parameters for this species in SEAK.

Future Directions, New Technologies
Wednesday, 1:10 – 2:30

Presentation title: Performance evaluations of automated counting of Pink salmon in the Lower Fraser River with DIDSON Imaging Sonar.

Presenter: Li Ding
Authors: Li Ding[1] and Yumbo Xie
[1]Li Ding, Vitech Innovative Research and Consulting
[2]Pacific Salmon Commission

Migration of pink salmon (*Oncorhynchus gorbuscha*) to the lower Fraser River is characterized by dense near-shore spatial distributions and tightly schooling behaviour. This presents a serious challenge for the use of conventional split-beam sonar to enumerate fish passages. In order to obtain better estimates of pink passage, especially in near-shore regions, the Pacific Salmon Commission (PSC) deployed two dual-frequency identification sonar (DIDSON) systems, in near-shore waters from both river banks in September 2009 at the PSC Mission Hydroacoustic site. However, manual counting of salmon in DIDSON image data is very labor intensive, especially in the case of high pink passage in the limited observation area. For example, pink passage can reach an hourly rate of 30,000 fish over a 20-m range window, and manual counting of 5 minutes of the data can take up to one hour. Here we present the results of automated counting by a software system (IntelliHAT™) developed over the past few years and compare with the manual counting results provided by the PSC. We will discuss the potential and limitations of the software at the present status, and new developments currently underway for improving the software.

Presentation title: A Blueprint for in-season estimation using test fishery data with a Bayesian cumulative normal model

Presenter: Jim Cave
Authors: Cave, J.D. and Michielsens, C.G.J. Pacific Salmon Commisson

A Bayesian form of the Cumulative Normal Model to estimate abundance of salmon returns from a single test fishery is presented. This model has been applied to provide in-season run size estimates for Fraser river pink salmon. The Bayesian estimation method allows quantifying the chance that the run size would exceed or reach the escapement goal. In addition, the methodology allows incorporating additional data such as hydro-acoustic abundance estimates, fence data and commercial catch data. The code required to do this advanced Bayesian evaluation within WinBUGS is surprisingly brief and can easily be adjusted to provide in-season run size estimates for other stocks and species based on test fisheries.We describe a Bayesian version of the Cumulative Normal Model (Pacific Salmon Commission 1995). The model utilizes priors (means and CV) of forecast timing and abundance together with historical information on catchability in purse seine test fisheries in Canadian Area 20 and Area 12. The model also uses daily CPUE data from Area 20 and Area 12, obtained during the season. As independent information on historical Johnstone Strait diversion is unavailable, historical estimates of catchability in these test fisheries were found to co-vary ($r = 0.91$). Consequently, different versions of model structure were explored with and without priors on covariance in catchability. Results indicate that run-size estimates using CPUE data from purse seine test fisheries are highly uncertain. The model that incorporated covariance in catchability was only marginally less certain than the model that did not include this covariance term. In 2009, the final end-of-season return abundance was 19.1 million with an 80% prediction interval of 9-31 million. Fisheries managers need to consider whether this level of certainty is sufficient for management of Fraser River pinks.

Presentation Title: Chehalis experimental chum and pink salmon fisheries lower Fraser River

Presenter: Kim Charlie

Authors: Kim Charlie, Fisheries Coordinator, Chehalis First Nations

Fraser River chum have a long history as a commercial species, but have been managed as well to protect the Food, Social and Ceremonial (FSC) fisheries for First Nations, and more recently to provide for a growing sport fishery in-river. Post-contact, the predominant commercial fishing effort on Fraser chum took place in mixed-stock fisheries in the straits and Fraser River mouth which grew significantly from salmon enhancement. A large portion of the Fraser chum originate from the Harrison River, the lower Fraser's largest tributary, and enhancement programs like the Harrison's Chehalis River Hatchery provided significant support to the commercial industry. In the last 3 decades its surplus supported much of the hatchery's rack fishery operated by the Chehalis Indian Band, as well as most recently experimental terminal fisheries, including a selective beach-seine fishery operated by the Chehalis Indian Band and partners in and around the Harrison River.Today's modern fishery ethic is to direct salmon enhancement more strategically at stocks that need the help, and to fish sustainably through selective fishing methods directed at harvesting surpluses where they exist, while avoiding less productive and weak stocks. These new fisheries support of the Wild Salmon Policy (WSP) and Pacific Fisheries Reform, DFO's vision for the Pacific Salmon Fishery that promotes more precautionary and sustainable fishing practices and protects the natural diversity of our Pacific salmon. Chehalis and other First Nation partners in the Fraser are experimenting with selective fisheries as a part of Pacific Fisheries Reform and are negotiating licenses and co-management agreements with the Department of Fisheries and Oceans (DFO). Although there have been many challenges, these fisheries have made progress with selective fishing, improved landing and production logistics, traceability, and sustainable fishing principles that include creating more profits from less fish. An overview of Chehalis's experimental fisheries outlining progress in each of these elements will be presented.

Presentation Title: Pinks for the pier

Presenter: Brian Banks

Authors: Brian Banks

The success of the "Pinks for the Pier" program at Campbell River and the results of a 2003 pilot program in Nanaimo Harbour, when an estimated 3000 Pink salmon (Oncorhynchus gorbuscha) adults returned from a net pen release of 130,000 fry, prompted the Directors of Nanaimo River Stewardship Society to pursue an extensive net pen imprinting program in Nanaimo Harbour. This descriptive report provides information on the project objectives, chronology of events and methodology. Results for the three 3 years of project implementation are also presented. Adult Pink returns to Nanaimo River in 2009 from a release of one million net-pen-imprinted juveniles released in early 2008 were estimated at 50-55,000.

Wednesday 3:10-5:10
No sessions.

Contributed Papers Session
Thursday, 8:20 – 9:40

Presentation Title: Diet, size, and distribution of chum salmon in the Strait of Georgia

Presenter: Rusty Sweeting

Authors: R.J. Beamish, R.M. Sweeting, K. Lange, D. Preikshot and C. Neville Department of Fisheries and Oceans

This paper will summarize juvenile chum salmon data from 13 years of summer and fall midwater trawl surveys in the Strait of Georgia and Puget Sound. Chum salmon, unlike coho and chinook, appear to be surviving at high rates in the marine environment. There is, however, still wide variability in size, diet, and distribution across seasons and years. Interactions with juvenile pink salmon, which are present in the Strait of Georgia only in even-numbered years, are also indicated.

Presentation Title: Estimation of Mortality of Wild Juvenile Pink Salmon (Oncorhynchus gorbuscha) due to sea lice (Lepeophthericus salmonis) in the Broughton Archipelago, B. C. from 2003-2006 by Monte Carlo Simulation.

Presenter: Vic Palermo

Authors: R.V. Palermo, Hargreaves, N.B., and S.R.M. Jones, Department of Fisheries and Oceans

We constructed a Monte Carlo simulation model to estimate the spatial and temporal patterns of mortality on out migrating juvenile pink salmon (*Oncorhynchus gorbuscha)* in the Broughton Archipelago caused by sea lice (*Lepeophthericus salmonis)*.

The Broughton area of British Columbia has more than 20 Atlantic salmon (Salmo salar) commercial farm sites that are located predominantly in the western portion of the Archipelago. This region also supports large wild stocks of pink salmon. Concerns have previously been raised (e.g. Morton 2003; PFRCC 2003) about sea lice that potentially originate from these salmon farms directly and negatively affecting the sympatric wild populations pink salmon. The focus of this paper is to estimate mortality rates over time and space on migrating juvenile pink salmon in the Broughton from 2003 to 2006. We use a Monte Carlo simulation applied to data obtained from extensive sampling of wild juvenile salmon in the field, combined with mortality data observed in laboratory experiments (Jones et.al.2008). We used two approaches to model the mortality data. The first approach was based simply on calculating the mean proportion of infected pink salmon that died over the course of the laboratory experiment as a function of fish weight. The second approach examined the laboratory results in more detail. Individual measurements of weight for each fish that suffered mortality was recorded at the time of mortality. A mortality model was constructed using an inverse sigmoid relationship between fish mortality and weight, and model parameters were fit using logistic regression and Bayesian methods. The mortality model was then used to estimate immediate mortality rates of juvenile pink salmon, for each of the sampled time periods and geographic zones in the Broughton Archipelago. The laboratory results indicate that immediate mortality resulting from sea lice infection is greatly reduced once the wild pink salmon grow to a size of 0.7 grams. The results of the model imply that if low levels of lice infection occur during the early part of the year when wild pink salmon are small, immediate mortality is likely low. Adjustment of farm management procedures to ensure sea lice levels on farmed fish remain low until pink salmon exceed 0.7 gms likely will result in low immediate mortality rates of wild pink salmon from sea lice that originate from fish farms.

Presentation Title: Abundance modelling of sea lice and pink salmon on the BC north coast

Presenter: Allen Gottesfeld

Authors: Allen S. Gottesfeld and Charmaine Carr-Harris, Skeena Fisheries Commission

Lepeophtheirus salmonis is an external parasite of salmonid fishes. High intensities of infestation cause morbidity in salmon on farms and in the wild. We determined infestation rates for an undisturbed population of pink salmon in the Skeena and Nass estuary between 2004 and 2006 (N=21,355). Salmon lice abundance ranged from 0.003 in April to 0.318 in July. Overall abundance was 0.026 in 2004, 0.055 in 2005 and 0.049 in 2006. There are few overwintering marine salmonids on the north coast, few sticklebacks, and no salmon farms. The most likely source of salmon lice infestation is returning adult salmon, especially Chinook, the earliest migrants which are closely sympatric with pink smolts staging prior to beginning their migration up the SE Alaska coast. Returning Chinook have a 99.5% prevalence of *L. s.* with an abundanceof 17.83.
We attempt to model the population size of *L. s.* by assigning values for the population of resident salmon, the abundance of *L. s.* on them, the number of juvenile pink salmon, and the number of early returning Chinook. This calculation suggests that the population of adult female *L. s.* on wild pink salmon on the north coast ranges between 2.8 and 8.7 x 10^5. This value is similar to the number of lice on fish from a single salmon farm with lice levels at the action limit established by the Province of BC. Contributions from many salmon farms could bring the infestation level above a threshold value and lead to epizootics that damage wild pink salmon.

Presentation Title: Shifting warm-water to cold-water conditions and foodweb dynamics of juvenile pink and chum salmon in the Eastern Bering Sea Ecosystem

Presenter: Marc Trudel
Author Asit Mazumder[1], S. Mazumder[1], M. Trudel[2,1], E. Farley[3], J. Moss[3], L. Eisner[3], J. Murphy[3]

1 Water and Aquatic Sciences Research Program, University of Victoria, PO Box 3020, Station CSC, Victoria, British Columbia, Canada, V8W 3N5.
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3 Auke Bay Laboratory, NOAA Ted Stevens Fisheries Science Center, Juneau, Alaska, USA.

Pink and chum salmon are important fisheries resource for several Pacific Rim countries, and in recent decades the productivity of these species been shifting significantly. Although the underlying mechanisms are still unclear, there is a growing sense that such declines may be linked to large-scale changes in ocean conditions and the resultant variability in temperature, nutrients, the quantity and quality of zooplankton, forage fish and predator assemblages. We hypothesize that changing ocean conditions through shifts in the quality and quantity of prey may affect foodweb dynamics and ontogeny of salmon as a function size within species, and significant diet overlaps among species, and ultimately the growth and survival. Shifts in relative strength of Pacific Decadal Oscillation and Arctic Oscillation, and associated shifts in thermal regimes in the Eastern Bering Sea (EBS) have been suggested to have major implications for energy flow along foodweb and trophic interactions among forage fish and these juvenile Pacific salmon. The EBS ecosystem shifted from a warm-water condition during 2002-2005 to a relatively cold-water condition during 2006-2007. This shift seems to be linked to dramatic shifts in the abundance of the major forage fish species, the most common diet of juvenile pink and chum salmon. We evaluate if the reversal of ocean thermal regimes caused significant shifts in foodweb dynamics and trophic interactions among the juveniles of pink and chum salmon, ontogenetic niche shifts as a function of size within species, and diet overlaps among species. To test our objectives, we

used N and C stable isotope signatures of juvenile pink and chum salmon, forage fish and zooplankton collected during six years. We present results showing how a change from warm to cold conditions are associated with significant contrasts in diet overlaps and trophic interactions between salmon species, and onshore-offshore variability in trophic shifts within species as a function of body size, and discuss the implications of the observed variability for growth, survival and productivity of pink and chum salmon.

Contributed Papers Session
Thursday, 10:00-11:00

Presentation Title: Chum salmon in the arctic and how they avoid lethal low temperatures

Presenter: Jim Irvine
Authors: J.R. Irvine[1], R.W. Macdonald[2], R.J. Brown[3], L. Godbout[1], J.D. Reist[4], and E.C. Carmack[2]
[1] Pacific Biological Station, Department of Fisheries and Oceans
[2]Institute of Ocean Science, Department of Fisheries and Oceans
[3]US Fish and Wildlife Service
[4]Arctic Fish Ecology and Assessment Research Station, Department of Fisheries and Oceans

With climate change, scientists and others are interested in the future of Pacific salmon in the Arctic. Chum, pink, sockeye, coho, and chinook salmon have been encountered in the Beaufort Sea, well within Canadian Arctic waters. Chum is the only salmon species regarded as natal to the Mackenzie River watershed, although both pink and chum salmon appear to be natal to Alaska's North Slope rivers. It is not possible to say whether apparent recent increases in the frequency of occurrence of salmonids in the Arctic is an effect of climate change, but it appears there are either increases in the survival of natal fish from the Mackenzie, or in the wandering of non-natal fish to the Mackenzie, or both. We propose three hypotheses to explain how chum salmon survive cold marine winter conditions, and thereby persist in the North American Arctic: (1) Bering Sea Refuge – young salmon migrate to the Bering Sea and Gulf of Alaska where they remain until they are ready to return to spawn; (2) Atlantic Layer Beaufort Refuge – salmon remain in the Beaufort Sea, wintering offshore deep under pack ice; and (3) Freshwater Beaufort Refuge – salmon remain in the Beaufort Sea region, wintering in the brackish, under-ice Mackenzie River plume or in fresh water adjacent to the Beaufort Sea. Limited strontium-to-calcium ratio analyses of chum otoliths as well as examination of size and age data suggest that arctic chum salmon live in the North Pacific for most of their marine life, rather than in the Beaufort Sea region. Because of the long distance to migrate between the mouth of the Mackenzie and the North Pacific Ocean, we suggest Mackenzie chum salmon may spend their first winter deep within the Beaufort Sea (i.e., a combination of Hypotheses 1 and 2). Additional elemental and isotopic signature measurements will enable a more thorough testing of these hypotheses, allow us to understand how chum salmon survive cold winter conditions, and thereby better predict potential climate change effects on chum and other salmon in the Arctic.

Presentation Title: Heavy infections of Aniskis simplex (Nematoda Anisakidae) larvae in the muscle of maturing chum salmon.

Presenter: Shigehiko Urawa
Authors: Shigehiko Urawa, North Pacific Anadromous Fish Commission

Heavy infections with 3rd-stage larvae of *Anisakis simplex* (sensu strico) were observed in the muscle of maturing chum salmon caught in the central Bering Sea (53-54ºN, 180º) and

the Chitose River, Hokkaido, Japan. In adult chum salmon returning to the Chitose River, the abundance of *A. simplex* larvae was less than 20 parasites/fish in 2002 and before, while it increased rapidly since 2003, reaching to 167 parasites/fish in the 2006 fall run season. A heavy parasite infection was also observed in maturing chum salmon caught in the central Bering Sea in June 2006. The complex life cycle of *A. simplex* includes paratenic crustacean hosts and final cetacean hosts especially mink whale. The unusual mass infection of *A. simplex* may reflect changes in the North Pacific ecosystems. This is also a concern for human health, because *A. simplex* larvae occasionally cause gastric anisakiasis when humans consume the infected fish.

Presentation Title: Hatchery chum salmon straying in southeastern Alaska streams.
Presenter: Andrew Piston
Authors: Andrew Piston, Alaska Department of Fish and Game

Hatchery production of chum salmon in Southeast Alaska increased dramatically over the last two decades, from 8.7 million fry released at eight locations in 1980, to 380 million fry released at 21 locations in 2008. Hatchery fish accounted for an average of 79% of the commercial harvest of chum salmon—86 million fish—over the 10 years, 1999–2008, and the total exvessel value of the commercial chum salmon harvest averaged $29 million a year. Alaska's Sustainable Salmon Policy states that "wild salmon stocks and fisheries on those stocks should be protected from adverse impacts from artificial propagation and enhancement efforts (5 AAC 39.222)." High rates of straying of hatchery fish into streams would make it difficult for fisheries managers to monitor wild chum salmon populations through standard survey techniques, thereby reducing the ability of the Alaska Department of Fish and Game (ADF&G) to formulate meaningful escapement goals and test whether those goals are being met for wild chum populations as required by the Sustainable Salmon Fisheries Policy. Although ADF&G has implicitly assumed that hatchery-reared salmon successfully home to their release site, no formal studies have been conducted to assess straying of hatchery salmon in Southeast Alaska. Chum salmon spawning abundance is currently monitored though a series of peak survey estimates at 88 index streams upon which escapement goals are based. An obvious criticism of this approach, however, is that trends in the escapement indices may have been affected by an increase in hatchery strays. Limited sampling conducted by ADF&G between 1995 and 2007, primarily in northern Southeast Alaska near Juneau, indicated that streams near major hatchery chum salmon release sites were likely to contain high proportions of stray hatchery fish. No such information existed for most of Southeast Alaska, and the degree of straying by hatchery fish outside the immediate vicinity of hatchery release sites was completely unknown. In 2008, ADF&G began a focused three-year effort to sample wild chum salmon index streams throughout Southeast Alaska for stray hatchery chum salmon. Results from all samples collected since 1995 indicate that streams within 50 km water distance from hatchery release sites are likely to have high proportions of stray hatchery fish in their escapements—nine streams located within 50 km of release sites in which sample sizes were greater than 50 fish had an average sample proportion of more than 50% stray hatchery fish. For 13 streams over 50 km from the nearest release site in which sample sizes were greater than 50 fish, the average sample proportion dropped to less than 3%, although individual streams up to 80 km from the nearest release site had sample proportions as high as 10%. Sampling will continue in 2010 and ADF&G will continue to assess the impact of stray hatchery chum salmon on the wild chum salmon monitoring program, chum salmon escapement goals, and the health of the resource overall.

Presentation Title: The effects of high water temperature on the maturation of pink salmon and their offspring.

Presenter: Ted Sweeten
Authors: Ted Sweeten, Department of Fisheries and Oceans.

Adult pink salmon (*Oncorhynchus gorbuscha*) were exposed to three declining water temperature regimes prior to spawning. The mean (range) test temperatures for the chilled, ambient, and heated regimes were15.1°C (11.6°C-19.4°C), 18.4°C (15.0°C-21.8°C), and 21.3°C (16.6°C-24.0°C), respectively, from August 28 to Sept. 17, 2002. During that period, the adult mortality was 2, 10, and 82 %, respectively. Maturation rates also were affected with 53, 7, and 0 % of females ripe by October 1, 2002, respectively. Thirdly, mean egg mortality was 14, 41, and 60 %, respectively. Hence, the adverse influence of high water temperature during the latter phase of maturation was demonstrated to significantly ($P< 0.05$) increase adult mortality, delay maturation rate, and reduce gamete viability. Models developed from this study could be used show changes caused by climate change on the maturation of adult Pinks and the impact on fry production.

Abstract

Factors affecting the early marine growth and survival of juvenile Chinook salmon (*Oncorhynchus tshawyscha*) on the west coast of Vancouver Island, British Columbia.

Katherine Middleton, Marc Trudel, and Asit Mazumder

Marine survival is highly variable and difficult to predict in Pacific salmon, which constitute a major challenge to managers. Most of the variability is thought to be driven by changes in early marine growth, either because faster growing fish can avoid predators, or survive the poor feeding conditions that prevail during winter. The objective of this study is to compare the early marine growth of hatchery and wild juvenile, as well as the early marine growth of the juvenile salmon that survived through their first winter with those that were caught at the end of their first growing season. This study will focus on west coast Vancouver Island Chinook salmon (*Oncorhynchus tshawyscha*) as they are known to remain close (100-200km) to shore during their first year at sea. Early marine growth will be assessed from the daily calcium increment patterns that are produced in the fish sagital otoliths. By looking at the otoliths of juvenile Chinook salmon, the growth rate over an entire lifetime can be assessed. Juvenile Chinook salmon will be used as the sample species due to a greater sample size, their close migratory range and larger otoliths which can be more accurately analyzed. We will compare known hatchery and wild (Marble River) juvenile salmon otolith growth, as well as compare juvenile Chinook salmon growth rings from the northwest coast of Vancouver Island to those of the southwest coast of Vancouver Island. It is anticipated that Marble River hatchery juvenile Chinook salmon will have a higher growth rate in their first year at sea in comparison to their wild counterparts. We also expect that the fastest growing will survive through their first winter at sea. A significant difference in growth is also predicted to occur between juvenile Chinook salmon foraging on the northwest and southwest coasts of Vancouver Island.

Poster Session

Presentation Title: The phylogeography of chum salmon (*Oncorhynchus keta*) in Alaska as determined by single nucleotide polymorphisms (SNPs)

Presenter Name: Eleni Leto Petrou

All Authors, affiliations, phone number, email: Petrou, Eleni L. and Seeb, Lisa W. Both affiliated with the University of Washington. 1-726-923-3950. elpetrou@uw.edu.

Abstract:

Identifying phylogeographical trends and describing the process of population differentiation is critical to understanding current patterns of diversity and informing decisions on the management of a species. However, few studies have examined genetic variation within adaptive loci (loci under selection). This type of research is valuable because it expands our understanding of how adaptive genetic variation is spatially distributed and how phenotypic and life history traits evolve. In recent years, the development of high-throughput technologies such as next-generation sequencing is finally making genome-wide research economically feasible for non-model organisms.

Here, we propose to use next-generation sequencing to identify single nucleotide polymorphisms in the chum salmon genome. We will then use these SNPs to examine the evolutionary and ecological processes that shaped the contemporary population structure of chum salmon in the Alaska Peninsula and Kodiak Island region. Additionally, we will examine whether variation among adaptive genetic markers shows differentiation along an environmental cline. This is a collaborative study between the University of Washington and the Alaska Department of Fish and Game.

Student Presenter: Yes

Presentation Type:

1. Poster presentation only

SESSION: Alternative Energy Development – Biological Considerations for Freshwater and Marine Environments

Title: Kinetic Hydropower: Extended-term, continuous monitoring of biological activity by automated, autonomous hydroacoustic systems.

Authors: Robert McClure*, James Dawson. BioSonics, Inc. (206) 782-2211. bmcclure@biosonicsinc.com, jdawson@biosonicsinc.com *presenter.

Abstract: As more kinetic hydropower projects are proposed, piloted, and implemented it is obvious that the rapid pace of these developments requires rapid and simultaneous information on the presence, abundance, distribution and behavior of biological components of the nearby habitat. Most of these projects are small and working on shoestring budgets and it is not economically feasible to require extensive habitat assessment and monitoring, as if these projects were going to be fully built-out. Many of these pilot-scale projects consist of one, or a few, energy devices and impact a relatively small volume of the aquatic or marine habitat. Everything about these projects, including impact assessment, is best served by taking one-step-at-a-time, including biological impact assessment. As these technologies rely on the dynamic nature of the water, and accompanying dynamic nature of the biological environment, it is important to understand the short and long-term temporal variations at the project site. A hydroacoustic solution for autonomous, automated, hydroacoustic system for rapid, economical deployment at project sites has been developed, working with the Northwest Marine Renewable Energy Center, and is to be used in the Salish Sea in 2010.

Session Name: Ecology and Management of Kokanee

Presentation Title: Assessment of Lake Sammamish kokanee population for possible listing under the Endangered Species Act

Presenter Name: Jeff Chan

Authors:
Jeff Chan, U.S. Fish & Wildlife Service, 360-753-9542, jeffrey_chan@fws.gov
Roger Tabor, U.S. Fish & Wildlife Service, 360-753-9541, roger_tabor@fws.gov

Abstract:

The Lake Sammamish kokanee population in western Washington was petitioned for possible listing under the Endangered Species Act in July 2007. The U.S. Fish & Wildlife Service is currently evaluating this population to determine whether it warrants listing under the ESA as a threatened or endangered species. We review the historical and current status of kokanee in the greater Lake Washington/Lake Sammamish Basin and the current and potential threats to this kokanee population. Once widespread throughout both Lake Washington and Lake Sammamish, the abundance and distribution of kokanee has been significantly reduced within this highly urbanized setting. Kokanee no longer appear to be present in Lake Washington and their numbers have been greatly reduced in Lake Sammamish. Recently, estimated adult escapement in Lake Sammamish has been as low as 42 spawners. Potential limiting factors to this population include: redd scour, habitat loss, predation, and changes in water quality. When evaluating populations (e.g., life history forms, population segments) within a species under the ESA, there are specific listing requirements. We review these requirements under the U.S. Fish & Wildlife Service's and NOAA Fisheries' joint Distinct Population Segment (DPS) policy, as well as the associated complications in evaluating this multi-jurisdictional species.

Student Presenter: No

Presentation Type: Oral presentation only

Session: Improving Understanding of Freshwater Capacity for Increasing Salmonid Fish Populations

Title: Estimating Population Capacity in the Ecosystem Diagnosis and Treatment Model

Presenter: Greg Blair, ICF International, 206 463 6022, gblair@icfi.com

Abstract:
The bottleneck metaphor is only partially useful in describing the effects of capacity constraints on a population. Capacity is affected by: 1) the quantity of key habitat, 2) the quality of key habitat, and 3) the amount of time the fish are exposed to capacity constraints. The third point implies that knowledge about the specific life history pathway expressed by a population is important to understanding population capacity. Juvenile Chinook salmon typically express multiple life history pathways. Because each pathway describes a unique trajectory through time and place, cumulative capacity back to spawning is partially determined by differences in the time spent in different habitats. Population capacity is the combination of these life history pathways. I present examples of capacity estimates from the Ecosystem Diagnosis and Treatment model for alternative Chinook life history pathways, showing how estimates of population capacity are affected by specific life history pathways.

Presentation Type: Oral Only

Session Name: Alternative Energy Development – Considerations for Freshwater and Marine Environments

Presentation Title: Tidal Energy and Fish

Presenter Name: Daryl B. Williams

All Authors, affiliations, phone number, email:

Daryl B. Williams, Tulalip Tribes, 360-716-4632

Abstract: Presenter will give an overview of the proposed Admiralty Inlet tidal energy project proposed in Puget Sound and discuss the types of monitoring that the tribes and agencies would like to see completed for assessing the impacts on fish and marine mammals.

Tidal energy is a relatively new type of energy project, with little information available for projecting impacts from the installation and operation of the turbines on fish and marine mammals. The depths, velocities and limited visibility in Puget Sound waters also make monitoring fish and marine mammal behavior near the turbine very difficult.

Public Utility No. 1 of Snohomish County filed their Draft License Application for the Admiralty Inlet Tidal Energy Project with the Federal Energy Regulatory Commission on December 28th, 2009. Comments concerning the proposal are due February 26th, 2010.

The presenter will give an overview of the monitoring studies that the Utility is proposing to do for assessing the impacts on fish and marine mammals, and what the tribes and agencies will be asking them to add or change to the monitoring plans through the licensing process.

Student Presenter? No

Presentation Type:

1. **<u>Oral presentation only,</u>**
2. Poster presentation only, or
3. Oral presentation preferred, but poster presentation acceptable.

AFS Abstract

Title: Do Rockfish Conservation Areas work?

Ryan Cloutier

Ryan Cloutier & Isabelle M. Côté , Simon Fraser University

Contact Ryan @ rnc@sfu.ca or 778-888-7118

Many rockfish (*Sebastes* spp.) populations are at low levels of abundance due to overexploitation. In an effort to curb declines of nearshore rockfish, Canada's Department of Fisheries and Oceans has established a network of Rockfish Conservation Areas (RCAs) along the coast of British Columbia to provide spatial refuges from fishing. However, the lack of post-establishment monitoring is preventing an evaluation of the effectiveness of RCAs at rebuilding depleted stocks. We conducted scuba-based assessments of abundance of rockfish and other fish species within RCAs in three areas of the Southern Strait of Georgia and at adjacent, ecologically equivalent unprotected sites. In the absence of baseline information, these space-for-time substitutions provide the first estimates of whether RCAs actually work.

Student presenter: YES

Presentation type: Oral preferred, but poster acceptable

Ocean Recovery of Endangered Sockeye Salmon Stocks

M. Trudel[1], S. Tucker[1], J.R. Candy[1], D.J. Teel[2], and T.D. Beacham[1]

[1]Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC, Canada
[2]NOAA Fisheries, Northwest Fisheries Science Center, Manchester, WA, USA

Abstract: Large scale declines in the returns of Pacific salmon (*Oncorhynchus* spp.) ranging from California to south central British Columbia brought some stocks to the verge of extirpation in less than a decade, even in nearly 'pristine' watersheds. Adult returns have been so low for some southern stocks that severe fishing restrictions and closures have been put in place to protect and rebuild these stocks. Although a number of factors may be responsible for the decline of southern stocks, a simultaneous decline of salmon originating from geographically-distant watersheds suggests a common cause is affecting these stocks in the marine environment. Hence, an understanding of stock-specific migration behavior is required to determine how climate and ocean conditions regulate Pacific salmon production. Here, we use coded-wire tag recoveries and DNA analyses performed on juvenile salmon caught at sea to describe the early marine life of two depressed stocks of sockeye salmon (*O. nerka*): Redfish Lake (Columbia River, USA) and Cultus Lake (Fraser River, Canada).

Presentation Type: Oral

Session Title: Westslope and coastal cutthroat trout in British Columbia and Washington

Presentation Title: Habitat effects on energy equivalence and self-thinning in juvenile cutthroat trout

Presenter Name: Jordan Rosenfeld

All Authors, affiliations, phone number, email: B.C. Ministry of Environment, 2202 Main Mall, Vancouver, V6T 1Z4 Jordan.Rosenfeld@gov.bc.ca

Abstract: The energy equivalence hypothesis infers constant available energy to a cohort as it ages, i.e. that increases in average body size are balanced by a reduction in density (self-thinning) that can be predicted from body size-metabolism relationships. This theory has been applied extensively to understand patterns of self-thinning among juvenile salmonids, with variable success. I use a simplified stream habitat and bioenergetic model to assess 1) the validity of the assumption of equivalent available energy for cohorts of different individual size, 2) the effects of differences in channel structure (e.g. proportion of pools vs. riffles) on slopes of self-thinning curves, and 3) the implications of varying channel structure for limitation of productive capacity in a size-structured population.

1. Oral presentation only

Mark-recapture experiments of Pacific salmon: matching up current sampling efforts with modern mathematical, statistical and computational advances

Luis Antonio Vélez-Espino

Two-sample, closed population estimates of spawning escapement in Pacific salmon populations have constituted a common practice. This pooled-Petersen mark-recapture approach seems appropriate for cases where closed-population assumptions are met, but could ignore major bias sources if violations to these assumptions are overlooked. In addition, the richness of information commonly generated by well-planned sampling practices is not thoroughly used under a standard Petersen protocol, therefore missing important opportunities to enrich our knowledge of salmon ecology. In the last 25 years important developments in capture-recapture analysis have taken place; however, the appreciation many practicing biologists have for modern methods lags behind these recent mathematical, statistical, and computational developments. Taking the mark-recapture experiment for the 2009 Chinook salmon spawning escapement in the Atnarko River as case study, fish were encountered in 33 sampling occasions over a 47-day period with the first 15 occasions encompassing the tagging period. A total of 4,281 fish were encountered during the experiment, from which 925 live fish were tagged (some of them recaptured alive once or more times or recaptured death once), 969 fish were removed from the system for hatchery purposes, and 220 tagged carcasses were recovered. This richness of information is rarely seen in mark-recapture experiments in vertebrate populations. It is therefore argued that such an effort should be capitalized on by applying modern methods and following an experimental approach characterized by the evaluation of closure assumptions, mark-recapture model selection, and the optimization of the use of information. As an example of the latter I address the use of the Atnarko 2009 mark-recapture data to generate residence times (required for area-under-the-curve estimates of population size) and to reconstruct migration phenologies that could shed new light into salmon reproductive ecology. Both, the use of modern mark-recapture techniques and the optimization of information require no additional sampling effort. Field logbooks designed for the Petersen, as used in the past in the Atnarko, were still appropriate for the application of modern techniques but required additional data-management work to generate the individual encounter histories upon which modern techniques operate. The transition to the compilation of individual encounter histories has a cost only in terms of the thoroughness to record recaptures and losses-on-capture (i.e., removals and incidental mortality).

A method of estimating the abundance of steelhead in the Nicola River watershed is described. This method follows that of Hilborn et al. (1999) who described a likelihood approach to the analysis of periodic spawner count data. However, unlike the scenarios described by Hilborn et al. (1999) where counting areas include the upstream limits of the spawning spatial distributions, the counting area for the estimation of Nicola steelhead is located well *within* the spatial distribution of spawning because of a number of limiting factors like water clarity, accessibility, and factors like stream size and forest canopy cover which limit visual surveying options. As a result, the process of fish movement in and out of the survey area is more complex than the imagery of fish simply arriving to the survey area, spawning within it, and either dying or emigrating downstream. Instead, some fish arrive, spawn and either die or leave while others arrive and pass-on-through, migrating beyond the survey area to spawn upstream. Furthermore, many of these upstream spawners will then migrate downstream after spawning and re-enter and re-exit the survey area as they migrate back to sea. In the interest not only estimating abundance but also quantifying precision, this presentation describes an estimation model based on this imagery and also describes how telemetry data were used and incorporated into the procedure.

Session Name: **"contributed"**

Presentation Title:
Family Matters: parental and temperature influences on the early life survival, morphology and burst swim performance of sockeye salmon

Presenter name: **Jenn Burt**

J.M. Burt[1]*, **S.G. Hinch**[1], **D.A. Patterson**[2]

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Conference Abstract:
Understanding the sources of offspring variation is critical in determining salmonid population dynamics. River temperatures are warming due to climate change and development activities, increasing our desire to understand thermal influences on salmonid development. While temperature is a primary extrinsic factor, intrinsic parental influences are shown to affect offspring traits. To explore the relative importance of parental identity and temperature in offspring development, ten families of sockeye salmon were incubated at 12°, 14° and 16°C and reared to fry stage. Mean embryonic survival was significantly lower and lag mortality was observed in alevins/fry incubated at 16°C. Within temperature treatments, substantial variation in embryonic survival, fry morphology and fry burst swim performance were attributable to family identity. Family accounted for 38% of the variation in embryonic survival under optimal thermal conditions (12°C) and 61% of the variation at 16°C. Significant family x temperature interactions were observed suggesting that parentally-mediated offspring selection occurs differently across a temperature gradient. Overall, the increased divergence in survival between families exposed to high temperatures and the superior survivorship of one particular family suggests that parental influences may affect early population structure and should be considered in gaining a more holistic understanding of population-level spawning success.

Student Presenter? (Work being reported was completed while a student): **Yes.**

Presentation Type: **Oral presentation only.**

Session Name: Improving understanding of freshwater capacity for increasing salmonid fish populations

Presentation Title: Vulnerability and adaptation in British Columbia's freshwater ecosystems: implications of climate change on freshwater habitat capacity

Presenter: Katherine Wieckowski

Affiliation: ESSA Technologies Ltd.

Authors: Katherine Wieckowski (ESSA Technologies Ltd., Phone: 604 733 2996, kwieckowski@essa.com); Marc Nelitz (ESSA Technologies Ltd., mnelitz@essa.com); Marc Porter (ESSA Technologies Ltd., mporter@essa.com), and Katrina Bennett (Pacific Climate Impacts Consortium, Phone: 250 472-4484, kbennett@uvic.ca.)

Abstract :

In the Pacific Region, climate change and variability are expected to lead to measurable changes in freshwater environments. Changes in air temperatures, precipitation, snow pack, and stream flow are expected. The biological implications of these physical changes on freshwater ecosystems and species are significant. Overlaid on the biophysical responses of freshwater systems are the effects of human activities (stressors and restoration actions). It is therefore important to develop adaptation strategies (i.e., reducing stressors or implementing restoration actions) that benefit freshwater ecosystems affected by climate change induced variability.

This presentation briefly describes two methods to assess vulnerabilities of freshwater ecosystems. Method 1 identifies streams that are "temperature sensitive", defined as having temperatures high enough to cause negative effects, impaired capacity for thermoregulation because of altered/degraded ecosystem function, or are sensitive to the effects of climate change. Method 2 identifies the effect of changes to stream flow on habitat capacity and fish abundance using habitat-based intrinsic potential and juvenile production models. We present a case study of the Cariboo-Chilcotin to illustrate how these methods can be integrated into a common framework to explore how freshwater ecosystems respond under alternative climate change scenarios. Last, we present alternative adaptation strategies available to managers to cope with identified freshwater ecosystem vulnerabilities.

Student presenter: No

Presentation type: Oral presentation only

Session Name (if known, otherwise "contributed"): CONTRIBUTED

Presentation Title: Effects of thermal and capture stress on physiology, behaviour and survival of adult sockeye salmon (*Oncorhynchus nerka*)

Presenter Name: Marika K. Gale

All Authors, affiliations, phone number, email:
Marika Kirstin Gale[1*], Scott G. Hinch[1,2], Michael R. Donaldson[1], David A. Patterson[3,4], and Steven J. Cooke[5].

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Abstract:
Fraser River sockeye salmon populations now migrate upriver at temperatures near their thermal limits. Policies have shifted fisheries from the cool ocean to the warm river and encourage release of non-targeted fish. However, survival of released fish and the role of high temperatures are unknown. Adult migrating sockeye from two run-timing groups (populations) were collected and held under three different temperatures, and exposed to three levels of capture-stress: no exercise, strenuous exercise (3 min), or strenuous exercise followed by air exposure (1 min). For one population, same-day mortality was greatest in the warmest (19°C) air-exposed treatment group. Fish that suffered same-day mortality were characterized by: high plasma lactate and cortisol, low plasma glucose and ions (Na^+, Cl^-, K^+), depressed ventilation rates, and prolonged equilibrium loss after treatment. For another population, all fish survived until 3 days after treatment, when mortality was only observed in the warmest (21°C) treatment. Responses to and the ability to recover from capture stressors in warm water may be population-specific. This supports a growing body of evidence that Fraser sockeye populations are adapted to historical thermal conditions. The combination of climate warming and increased fishery capture/release stressors could lead to a conservation crisis for some populations.

Student Presenter? YES

Presentation Type: Oral presentation only

Contributed

Juvenile salmonid monitoring: its utility in assessing watershed performance in a regulated river.

Mitchell, Peter.(Presenter) InStream Fisheries Research, mitchell.p.h@gmail.com 604 837 9870

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Variances in fluvial discharge of a freshwater ecosystem may alter its potential to support life history stages of salmonids by modifying the quantity and quality of spawning and incubation habitat, and the availability of food and space for rearing. A water diversion project built by BC Hydro on the Cheakamus River watershed, a major tributary to the Squamish River in South-Eastern BC, artificially manipulates fluvial discharge below the project site. With the expectation to maximize benefits to wild fish populations, new water discharge rules, were applied to the diversion project operation in 2006. Monitoring projects are being undertaken to evaluate the effects of the new discharge order on salmonid populations. One of these monitors compares out migrating juvenile populations between years prior to and post discharge change. Annual estimates of the total yield of smolt and fry outmigrants for five species of salmonids; coho salmon (*Oncorhynchus kisutch*), chum salmon (*O. keta*), chinook salmon (*O.tshawytscha*), pink salmon (*O. gorbuscha*) and steelhead trout (*O.mykiss*) are being generated. Estimates are derived using downstream trapping methods, Rotary Screw Traps in the mainstream and full and partial traps at the outlet of key spawning channels (sill traps, fyke nets and minnow traps and resistivity counters), in conjunction with mark recapture methodology. Analysis will eventually include time series evaluations of linkages between watershed yields and discharge in an attempt to evaluate the impacts of the altered flow regime.

Poster

Session name: Contributed

Presentation title: Accuracy of Using Scales to Age Mixed Stock Chinook Salmon of Hatchery Origin

Presenter name: Shayne E. MacLellan

All authors, affiliations, phone number, email: Richard E. McNicol and Shayne E. MacLellan, Fisheries and Oceans Canada, 250-756-7189, shayne.maclellan@dfo-mpo.gc.ca

Abstract:

Historically, there have been few attempts to validate scale-derived ages for Pacific salmon, especially Chinook (*Oncorhynchus tshawytscha*), that exhibit a wide range of life histories across stocks. We assessed the accuracy of scale age data produced by multiple readers from multiple agencies of known-age hatchery chinook from mixed stock, non-terminal fisheries conducted along the Pacific coast of Canada from 1991-2003. The test sample included scales from 434 CWT-marked stream- and ocean-type fish. Sample stocks originated from Oregon, Washington and British Columbia. Five readers of varying experience levels from three federal or state Pacific Northwest fisheries agencies participated. Experience was classified as deep or shallow (depth) depending on the number of years involved aging Chinook scales and broad or narrow (breadth) depending on the variety of encountered stocks. Accuracy ranged from 84-94%. Readers with both deep and broad experience consistently achieved accuracies >90%. Those with narrower breadth of experience tended to show age bias. The results suggest that scales can accurately age ocean-caught hatchery fish and that previous exposure to stocks of a wide range of life history types may be at least as important as the number of years of experience in achieving a high level of accuracy.

Student presenter: No

Presentation type: Oral presentation preferred, but poster presentation acceptable.

Session Name :

Technical Innovations for Fisheries Field Work

Presentation Title:

Demonstration of a novel continuous passive mark recapture technique to estimate chum salmon escapement in the Cheakamus River, BC.

Presenter Name:

Peter M. Troffe,

InStream Fisheries Research Inc.,

Peter@instream.net,

604-831-4139

Abstract: There are many challenges associated with accurately estimating chum salmon spawning escapements in turbid glacial river systems like the Cheakamus River in south coastal British Columbia. Here we demonstrate the use a continuous passive mark recapture technique in place of a traditional mark recapture carcass recovery or visual estimation study to greatly improve recapture efficiencies and reduce estimate error. This passive tag recovery approach involves applying PIT tags (Passively Integrated Transponder) to spawners before they enter spawning areas and the subsequent use of fixed location resistivity fish counters and PIT tag detection arrays to continuously monitor and identify the number of marked and unmarked spawners entering spawning channels. These data allow for the back calculation of watershed wide spawner escapement through mark recapture statistical methodology.

Student Presenter? (Work being reported was completed while a student):

No

Presentation Type:

Oral presentation only

Session**: Plankton, Mar. 4,2010-01-28**
Presentation title**:** Discovery Passage Plankton Monitoring and Juvenile Salmonid Assessment
Presenter name**: Dr. Alexandra Eaves**

Info**: BC Centre for Aquatic Health Sciences,**
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Abstract: DFO enhancement facilities on the BC coast time the release of enhanced of coho smolts according to guidelines established in the early 1980's. Salmon hatcheries that border the Strait of Georgia have seen smolt to adult survival for coho decline from 8-10% to less than 1%. Changes in the magnitude and timing of ocean productivity in the Strait of Georgia have likely resulted in a mismatch between the timing of smolt release and the occurrence of spring plankton blooms they rely on as a primary food source.

The Discovery Passage Plankton Monitoring project has focused on developing a program to monitor plankton productivity, and examine the diets of coho captured in the near-shore marine environment. The objective of this program is to develop a monitoring program that could best predict the timing of smolt releases to coincide with favourable marine food availability to increase juvenile coho survival. This project has completed its third year of phytoplankton and zooplankton surveys in the nearshore marine environment near the Campbell River Estuary. Preliminary work has shown that the plankton blooms are happening in late April/early May and the enhanced coho have somewhat different diets upon initial entry to the marine environment.
The success of this program will be measured by the survival of returning adult coho salmon to the hatchery, assessed through the retrieval of coded wire tag (CWT) data.

Presentation type: oral/power point

Session Title:
Alternative Energy Development – Biological Considerations for Freshwater and Marine Environments (Robert McClure)

Presentation Title:
Marine and Hydrokinetic Energy Development - What are the real environmental effects?

Presenter:
Andrea Copping
Pacific Northwest National Laboratory
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Developers in the US and around the world are engineering devices for deployment into industrial scale marine and hydrokinetic (MHK) installations, as well as smaller-scale distributed applications. Tidal power technologies are typically turbines mounted on or tethered to the bottom that generate power on ebb and flood tides. Smaller turbines are being developed to harness the unidirectional movement of water in rivers and sloughs. Wave power is harvested from floating tethered devices that may use water, air, metals, or hydraulic fluid to transform the up and down motion of waves to electricity.

A broad range of permitting and resource management agencies, as well as stakeholders of many varieties, are taking a keen interest in the development of marine and hydrokinetic energy, and have many questions and concerns about the environmental harm these devices may cause. The U.S. Department of Energy has mobilized their national laboratories to help determine priorities among the many potential effects on aquatic organisms and systems. This presentation will cover the risk-based approach to examining effects of MHK development and plans to investigate specific effects on fish and other organisms.

NOT a student presentation.
Oral session.

Session: Recovery of Depleted Species: Tools and Targets

Effectiveness and applications of a large scale acoustic array for estimating juvenile salmon survival in the ocean

Presenter: Erin Rechisky
University of British Columbia, 778-389-2111, e.rechisky@fisheries.ubc.ca

David Welch
Kintama Research, 250-729-2600, david.welch@kintama.com

We used the Pacific Ocean Shelf Tracking (POST) acoustic telemetry array to estimate the early marine survival of juvenile hatchery spring Chinook salmon migrating In-River from the Snake and Yakima tributaries of the Columbia River, USA. Early marine survival estimates for the southern Washington to northwest coast Vancouver Island migration corridor (a 485 km, 1 month journey) ranged from 5-8% in 2006, increased to 24-27% in 2008, and declined to 3-8% in 2009 (2007 estimates were not available). We also estimated survival of salmon smolts transported to the lower Columbia River and released below all dams. Early marine survival for this group was slightly higher compared to the In-River release groups (2006=14%, 2008=27%, 2009=17%). Our results indicate that "*differential delayed mortality"* of transported Spring Chinook smolts was not evident one month after ocean entry. Perhaps more important, our ocean survival measurements are consistent with juvenile salmon survival predictions based on ocean indicators for 2006 and 2008 (2009 predictions were not released at the date of writing this abstract). Marine telemetry arrays seem to be effective tools for directly measuring early marine survival and rapidly ground-truthing predictions of marine survival, as well as testing hypothesis regarding salmon conservation.

Student presenter
Oral presentation

Anadromous sockeye salmon return after an absence of nearly 90 years: a case of reverse evolution?

Presenter: Lyse Godbout (250) 756-7193 Lyse.Godbout@dfo-mpo.gc.ca

Authors: L. Godbout[1], C. C. Wood[1] ,R. Wihtler[1], S. Latham[2], J. Nelson[3], R. Johnson[4], L. Wetzel[5], J. R.Irvine[1]M. J. Grove[6], A. K. Schmitt[7]and K. D. McKeegan[7].

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Sockeye salmon (*Oncorhynchus nerka*) were thought to have been extirpated by the construction of hydroelectric dams on the Coquitlam and Alouette Rivers, British Columbia, in 1914 and 1927, respectively. These dams continue to prevent upstream migration by salmon, yet adult sockeye salmon returned to both rivers in 2007 and 2008. Their return was not a complete surprise because unusual downstream migrations of juveniles had been observed during experimental spills to manipulate river flow in 2005 and 2006. We used genetic (microsatellite and mitochondrial DNA) markers and stable isotopes ($\delta^{34}S$ and $^{87}Sr/^{86}Sr$) patterns in otoliths to confirm that the juvenile downstream migrants and returning anadromous adults were the progeny of non-anadromous sockeye salmon (kokanee) that now inhabit the reservoirs formed by the dams. Low genetic diversity and lack of evidence for alternative explanations suggest that anadromous sockeye salmon runs had been extirpated by dams in both rivers but that the populations have persisted as non-anadromous kokanee. We conclude that these landlocked kokanee populations have retained the capacity for anadromous migration for over 20 generations, and can revert to anadromy if given a suitable opportunity for upstream and downstream migration.

Session Name: Escapement Estimation

Presentation Title: A habitat-based framework to improve the accuracy of peak count salmon escapement estimation

Presenter Name: Chuck Parken or Mike Chamberlain

Authors: Chuck Parken, Mike Chamberlain, Richard Bailey & Nicole Trouton. Fisheries & Oceans Canada, Chuck.Parken@dfo-mpo.gc.ca, 250-756-7199

Abstract: Salmon spawner abundance is used to evaluate stock status under Canada's Wild Salmon Policy and the Pacific Salmon Treaty. For many Chinook salmon populations, spawner abundance is estimated by multiplying the peak count by an area-specific expansion factor that accounts for the percentage of the escapement counted at the peak of spawning activity. In the Fraser River watershed, one expansion factor has been used for the majority of populations for decades, whereas in others the methods and rationale for the chosen expansion factor were not recorded in a way that provided repeatability. Using data from 1983 to present, we have detected significant variation in the accuracy of expansion factors among populations and the variation was influenced by system-specific habitat characteristics. To improve the accuracy of spawner estimates, we developed a habitat-based framework to organize populations into groups with similar counting characteristics. Within each group, the river- and year-specific expansion factors were evaluated to describe the uncertainty expected when employing a group-specific mean expansion factor. The framework helps to standardize the application of expansion factors and improves the accuracy of peak count salmon escapement estimation. Also, the framework guides planning new studies to better represent the habitat characteristics influencing the accuracy of peak count salmon escapement estimates.

Student Presenter: No

Presentation Type: Oral presentation only

Session Name: Escapement Estimation

Presentation Title: Improving abundance estimates on the Fraser River's South Thompson Aged 0.3 Chinook Aggregate

Presenter Name: Mike Chamberlain

Authors: Josh Korman (Ecometric Research Inc.),Chuck Parken (DFO), Mike Chamberlain (DFO), and Ivan Winther (DFO). 250-851-4947, Micheal.Chamberlain@dfo-mpo.gc.ca

Abstract: The Fraser River Chinook South Thompson aged 0.3 aggregate is a major contributor to the total Chinook harvest for both Canada and the United States and represents a large portion of the total coast-wide Chinook salmon resource. Current estimates of spawning escapement are determined through visual indices for all but one of the populations within the aggregate and are known to be under estimates. Poor visual counting conditions occur in the systems in which majority of the aggregate appears to spawn. Visual counting conditions in these systems are exceptionally poor because of both the physical characteristics of the systems and the biological characteristics of the Chinook spawning within them. To improve the accuracy of spawner estimates we have developed a model which estimates the annual escapement for a wild stock based on its catch in a distant fishery and the recoveries of coded wire tags (CWTs) from its associated hatchery indicator stock in the fishery and escapement. The catch of the wild stock in the fishery is determined by genetic stock identification (GSI). The expected value for the escapement estimate of the wild stock by age is determined by the ratio of the expanded catch of fish from the wild stock in the fishery and the CWT expansion ratio, where the CWT expansion ratio is simply the expanded number of CWTs caught in the fishery to the expanded number in the escapement. We believe that this model will be useful for improving escapement estimates of Chinook in the South Thompson aggregate, as well as to those systems where GSI and CWT data are readily available in fisheries and on the spawning grounds.

Student Presenter: No

Presentation Type: Oral presentation only.

2010 AFS WA/BC Chapter Annual Meeting

Session: Lamprey Ecology and Life History, Oral presentation, Non-student

Title: Methow Lamprey Inventory and Restoration Assessment

Presenter: John Crandall, Ecologist, Wild Fish Conservancy, 509.341.4341, john@wildfishconservancy.org

ABSTRACT

The widespread decline of Pacific lamprey in the Pacific Northwest has sparked recent interest in the conservation, protection and restoration of lamprey populations and their habitat. The decline of Pacific lamprey in the Columbia River Basin (CRB) has been especially precipitous. The Methow Subbasin lies near the upstream extent of recently documented lamprey presence in the CRB. Downstream of the Methow, nine mainstem Columbia River dams and their impoundments likely pose significant passage challenges for anadromous lamprey; consequently, lamprey returning to and inhabiting the Methow may be among the most regionally imperiled. In the Methow, scant data exist related to the distribution and abundance of, or habitat used by, adult and juvenile Pacific lamprey. Without this fundamental information, effective and responsible conservation, protection and restoration efforts will not be possible. Furthermore, these data gaps make it challenging to determine the short- and long-term effects that numerous salmonid-based restoration projects have on the lamprey that occupy these same stream reaches and whether lamprey specific modifications of such projects are either justified or appropriate.

To address these issues, we addressed several important data gaps for Methow lamprey. Specifically, we conducted a systematic basin-wide survey to determine lamprey distribution, relative abundance, habitat use, and genetic composition. The integration of this information with several salmonid-based restoration planning efforts currently underway in the Methow will assist with the identification and prioritization of stream reaches where on-going and future restoration may benefit lamprey. It is hoped that this approach will benefit Pacific lamprey through the inclusion of lamprey habitat needs in the on-going salmonid-based restoration efforts in the CRB and elsewhere.

Session Name:

Survey of sonar applications in salmon management in Canada and U.S

Presentation Title:

When is sonar a practical tool for Chinook escapement estimation in Western Washington? : Confronting small populations and small budgets

Presenter Name:

Martin Liermann

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Martin Liermann: Northwest Fisheries Science Center / NOAA Fisheries; 206 860-6781; Martin.Liermann@noaa.gov

Dan Rawding: Washington Department of Fish and Wildlife; 360 906-6747; Daniel.Rawding@dfw.wa.gov

Keith Denton: Northwest Fisheries Science Center / NOAA Fisheries; Keith.Denton@noaa.gov

Abstract:

Escapement estimation is central to salmon population management yet is often very imprecise. Sonar has been used effectively for estimating escapement of large runs of salmon in British Columbia and Alaska. Over the last three years we have been evaluating sonar as a tool for estimating Chinook escapement in Western Washington Rivers. In these systems the population sizes are small and the resources available for escapement estimation are limited. We discuss where and why sonar may be effective in Western Washington based on many factors including, river size, geomorphology, run timing, species overlap in size and timing, access, and trends in technology. These conclusions are based on extensive site visits to several rivers, a compilation of species and river specific salmon timing and size distributions, and two years of experience using sonar to estimate Chinook escapement in two Western Washington Rivers.

Student Presenter?: No

Presentation Type: Oral presentation preferred, but poster presentation acceptable.

Session Name (if known, otherwise “contributed”): Recovery of Depleted Species: Tools and Targets

Presentation Title: **Population viability analysis of Cultus lake Sockeye Salmon, it performance and prospects.**

Presenter Name:

Michael Folkes, 250-756-7264, michael.folkes@dfo-mpo.gc.ca

Mike Bradford, 604-666-7912, mike.bradford@dfo-mpo.gc.ca

Josh Korman, 604-734-8314, jkorman@ecometric.com

Abstract:

The Cultus Lake Sockeye population, situated approximately 100km upstream from the Fraser River mouth, has endured declining escapement for over three generations. Long term survival of the population was evaluated using population viability analysis (PVA) during 2004, 2007, and 2010. The utility of PVA is considered. Large uncertainty in key parameters, including marine survival and pre-spawn mortality, result in highly uncertain long-term prospects. The role of PVA is put into context with other recovery planning exercises for this and other weak salmon populations.

Title: **Genetic Groupings of Fraser River Chinook Salmon populations determined by mean-field annealing**

J.R. Candy, C.B. Wallace, and T.D. Beacham
Molecular Genetics Laboratory, Pacific Biological Station, Nanaimo

Conservation of species diversity relies on an understanding of the relatedness of populations. Typically this involves clustering populations that are genetically most similar using a genetic distance measure. The neighbour-joining tree building algorithm is commonly used to build dendrograms showing genetic structure. This method is “bottom up”, or agglomerative, which sequentially joins populations and groups of populations together with the shortest genetic distance. Here we introduce an alternative method that is “top down”, or divisive, where all populations are considered at once. Since combinations of possible group assignment grows exponentially with the number of populations being considered, a mean-field annealing heuristic is used to find the optimal solution. Using 58 Fraser River Chinook salmon populations the agglomerative and divisive methods are compared. The new program (PORGS-MFA) using mean-field annealing is available for download from our website http://www.pac.dfo-mpo.gc.ca/sci/mgl/applications_e.htm.

Using PIT Technology to Study Sculpin and Dace Life History

Presenter: Rachel Keeler (AMEC Earth & Environmental)
Authors: Rachel Keeler[1], Louise Porto[1], Crystal Lawrence[1], Dave DeRosa[2] and Guy Martel[2]

BC Hydro operates the Hugh L. Keenleyside (HLK) Dam on the Columbia River near Castlegar, BC. BC Hydro's water use planning process identified a lack of life history data on sculpin and dace species in the lower Columbia River. In 2009, AMEC was retained to complete a 2-year of a 5-year sculpin and dace life history assessment and determine the impacts of flow fluctuations below HLK Dam. The 2009 research focused on tributaries of the unregulated Similkameen River near Princeton, BC to provide a comparison to 2010 research in the regulated Columbia River. In order to investigate movement and habitat use, sculpin and dace were tagged with PIT tags and tracked seasonally with a portable PIT antenna system. In total, 596 Columbia sculpin, 146 torrent sculpin, 11 prickly sculpin and 57 longnose dace were tagged in the Similkameen watershed with <1% mortality. The tracking system was successful in tracking adult male sculpin to nest sites which were inspected for egg masses and hatch times. Columbia sculpin spawning times varied by tributary and were likely related to differences in water temperatures. Movement and habitat use by species will be discussed. Our study will provide recommendations on ways to minimize the impact of the HLK Dam operations on sculpin and dace species.

[1]AMEC Earth & Environmental, [2]BC Hydro

The declining trend of early marine survival of coho salmon in the Strait of Georgia reaches alarming low levels.

R.J. Beamish, R.M. Sweeting, K. Lange, C. Neville and D. Preikshot

Most juvenile coho salmon enter the Strait of Georgia about mid May. We can determine the abundance of hatchery and wild coho salmon that enter the Strait of Georgia and the numbers that survive through to mid September. We also can show that most of these coho salmon do not leave the Strait of Georgia until after our September surveys. Our studies identified about a 90% decline in early marine survival from 1998 until the present. Early marine survival is now about 1% or 2%, indicating that the brood year strength is effectively determined in the first four months in the Strait of Georgia. The sources of mortality are not known, but are apparently linked to ecosystem changes associated with warmer water and stronger winds in the winter and early spring.

Acoustic tagging of juvenile chinook salmon in the Strait of Georgia indicates exceptionally high levels of mortality within the Strait of Georgia

C.M. Neville, R.J. Beamish, C.M. Chittenden, T.D. Beacham, K. Lange and R.M. Sweeting

Juvenile chinook salmon were tagged in September 2007 in the Strait of Georgia. The 100 fish were tagged by experienced biologists and released in the same location as captured. Only 6 of these fish were detected outside of the Strait of Georgia. In June 2008, 30 juvenile chinook salmon were tagged in the Strait of Georgia and 40 juvenile chinook salmon were tagged in the Gulf Islands. One fish from each of the tagging areas was detected leaving the Strait of Georgia. An additional 78 fish were tagged in July 2008 in the Strait of Georgia. None of these fish were detected outside of the Strait of Georgia. We conclude that either the tagging caused exceptionally high mortality or that natural mortality is exceptionally high within the Strait of Georgia.

Life history polymorphism and speciation in lampreys

R.J. Beamish

Lampetra richardsoni is a species paired with *Lampetra ayresii*. There are some who think that they are the same species. However, they are readily distinguished by differences in the teeth of adults and by body proportions. Contrary to the prevailing interpretation, *Lampetra pacifica* can be shown to be distinct from *L. richardsoni* using a new character within the gill pore. There are other derivatives of *L ayresii* and *L. richardsoni* that are not as readily separated into species. One derivative is the Morrison Creek lamprey which I now consider to be a subspecies, *L. richardsoni marifuga*. Deciding how to classify nonparasitic lamprey is not just an exercise in taxonomy; it is also an exercise in understanding the evolutionary history of lamprey and ensuring that the lamprey that are key to this understanding are protected. This means lamprey need to be recognized as being distinct if they are isolated physically or reproductively, have a distinct life history strategy and have morphological distinctions that are outside of the range of related species.

AFS WA-BC Annual General Meeting Abstract Submission

Session Name (if known, otherwise "contributed"): contributed

Presentation Title: Reconstructing historical trends in marine species abundance from local ecological knowledge in Puget Sound, Washington

Presenter Name: Anne Beaudreau

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Abstract:

Lacking historical records of harvested marine populations, scientists and resource managers are often confronted with a loss of collective memory that may lead to misconceptions about the sustainability of fisheries. In Puget Sound, Washington, a number of fish and invertebrate species have declined from past abundances; however, the magnitude of these changes is difficult to quantify because of limited historical data. This study was designed to develop a historical record of bottomfish and crab populations in Puget Sound over the last 70 years from knowledge of fishers, divers, and researchers. More than 50 experts from Olympia to the San Juan Islands were interviewed about their experience and observations of marine species. As a component of the interviews, subjects were given color photos of 46 marine mammal, fish, and invertebrate species in Puget Sound and asked to group the organisms according to their own criteria. Multivariate methods were used to evaluate whether the way in which people classified marine organisms varied according to their age or years of experience, geographic region, or expert type. Continued work will focus on determining whether individuals with shared classification systems also have common perceptions of species abundance changes over time.

Student Presenter? (Work being reported was completed while a student): No

Presentation Type: Oral presentation only

Abstract

An Overview of Pink Enhancement in the Pacific Region and Planning New Fishery Development Projects

Gregory Bonnell
Fisheries and Oceans Canada
Oceans, Habitat and Enhancement Branch
Nanaimo, BC

Recent enhancement of pink salmon in Canada's Pacific Region falls into three general categories: habitat improvement projects, manned production spawning channels and fish culture (hatchery) operations. The first enhancement efforts began in the1950s with the first spawning channel in Canada at Jones Creek on the lower Fraser River. This was joined in the 1960s by Seton spawning channel on the upper Fraser with Releases exceeded 30M by the late 1970s. Fish culture operations began in the late 1970s and early 1980s in Johnstone Strait and the northeast coast of Vancouver Island. Overall releases peaked in the late 1980s and early 1990s at over 50M annually. Since the late 1990s with the cessation of operations at Seton Channel, enhancement has been dominated by growing fish culture operations mainly in Johnstone Strait, with significant contributions from habitat improvements in the lower Fraser. Recent overall releases have been in the 30M range.
In 2006, following up on the success of pink fry rearing in seapens by Quinsam River Hatchery, interest was expressed by several community groups and the Province of BC in developing small local recreational fisheries in other area using this technique. The planning procedure for implementation of these is discussed.

Session: Recovery of Depleted Species: Tools and Targets

A multi-faceted approach to the recovery of Cultus Lake sockeye salmon is needed in the face of adverse marine conditions

Mike Bradford[1], Michael Folkes, Al Stobbart, Jeremy Hume. Fisheries and Oceans Canada.

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The population of sockeye salmon that spawns in Cultus Lake, BC, has considerable scientific and cultural value and has been intensely monitored since 1925. However, a long-term decline resulted in it being declared endangered in 2003. A suite of recovery actions including suppression of the resident northern pikeminnow population to increase juvenile survival in the lake, development of a captive breeding and supplementation program, and a reduction in harvest rates have been implemented. Current smolt-spawner survival rates are about 1%, which implies population growth can only occur when at least 100 smolts/spawner are being produced, which is more than twice the historical rate. Over 50,000 pikeminnow have been removed from the lake, and the survival of both wild and hatchery-released juveniles in the lake has increased in recent years. Hatchery fry releases to the lake have successfully contributed to adult returns and the combined production of smolts from hatchery and wild origins now exceeds the threshold needed for population growth. However, no sockeye salmon population is sustainable under the current ocean conditions, and continued interventions to maintain the Cultus population will be needed until smolt survival rates increase.

Adfluviual bulltrout spawner evaluations utilizing resistivity counters and their application in calibrating redd count surveys.

Andrusak G. Redfish Consulting. gregandrusak@shaw.ca 250-8252729

McCubbing D.J.F (presenter) InStream Fisheries Research Inc. don@instream.net 604 837 9870

Abstract

During August 2009 portable resistivity counters were placed on the lower portions of the Kaslo River and Crawford Creek in an effort to record downstream movements of spawned out adfluvial bull trout that inhabit Kootenay Lake. Run timing was well defined by the counters and the peak of spawning was determined after downstream movement increased at the end of September. This information signaled the timing of redd surveys on both systems that were conducted in the first week of October.

Redds counts per km were 27/km for the Kaslo River, 23/km in Keen Creek and 1/km in the main river below the counter. A similar survey on Crawford Creek counted a total of 268 redds with the majority (n=233) observed in the mainstem while the balance were located in the lower reaches of three tributaries. Redd densities were much lower in Crawford Creek compared to the upper Kaslo River with 11fish/km in the mainstem.

The Kaslo River resistivity counter recorded a total of 1,219 spawners while the Crawford Creek count was 486. Count efficiency based on video records was high (>95%). Comparing the 2009 redd counts to the counter numbers results in a conversion factor of 2.2 fish/redd for the Kaslo system and 1.8 fish/redd for Crawford Creek. The differences in total spawner numbers between the two watersheds are attributed to far greater amounts of suitable spawning habitat in the upper Kaslo River compared either Crawford or Keen creeks. These derived expansion factors based on redd counts could be applied to other tributaries in an effort to evaluate spawner numbers where resistivity counters cannot be operated due to geography or cost but redd surveys are feasible.

Oral Presentation only

Session Name: Recovery of Depleted Species: Tools and Targets
Presentation Title: Mean trophic levels and the Worm-Hilborn collaboration
Presenter Name: Trevor A. Branch

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Abstract: In recent years Boris Worm and Ray Hilborn have set aside their differences, and forged a broad consensus on the status of global fisheries (Science 325:578-585). The collaborative effort they led also involved collecting together in one place global databases containing catches, stock assessments, trawl surveys and ecosystem models. As a follow-up to that project, we examined these data to detect trends in mean trophic levels both in catches from marine capture fisheries, and in ecosystems as measured by surveys and stock assessments. We found some counter-intuitive trends over time in the different data sources, both globally and within individual ecosystems, including negative correlations in some ecosystems between mean trophic levels estimated from catches, surveys and stock assessments. Similarly, global trends in mean trophic levels also differ among data sources, a finding that is better understood when viewed in the light of ecosystem models. We conclude that to understand the impact of fishing on mean trophic levels in any particular region, multiple data sources should be examined.

Student Presenter? No

Presentation Type: oral presentation only

Session**: Plankton, Mar. 4,2010-01-28**
Presentation title**:** Discovery Passage Plankton Monitoring and Juvenile Salmonid Assessment
Presenter name**: Alexandra Eaves**

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Abstract: DFO hatchery facilities on the BC coast time the release of enhanced of coho smolts according to guidelines established in the early 1980's. Since then, salmon hatcheries that border the Strait of Georgia have seen smolt to adult survival for coho decline from 8-10% to nearly 1%. Changes in the magnitude and timing of ocean productivity in the Strait of Georgia have possibly resulted in a mismatch between the timing of smolt release and the occurrence of spring plankton blooms they rely on as a primary food source upon seawater entry. The Discovery Passage Plankton Monitoring project has focused on developing a program to monitor plankton productivity, and examine the diets of coho captured in the nearshore marine environment. The objective of this program is to develop a monitoring program that could best predict the timing of smolt releases to coincide with favourable marine food availability to increase juvenile coho survival. This project has completed its third year of phytoplankton and zooplankton surveys in the nearshore marine environment in proximity to the Campbell River Estuary. Preliminary work has shown the plankton blooms are occurring in late April/early May and the hatchery-derived coho have somewhat different diets upon initial entry to the marine environment compared to wild juvenile coho. The success of this program will be measured by the survival of returning adult coho salmon to the hatchery, determined by the retrieval of coded wire tag (CWT) data.

Presentation type: oral/power point

Session name: contributed

Presentation title: Coho salmon population growth rates in relation to direct and trophic transmission of sea lice from salmon aquaculture

Presenter name: Brendan Connors

B. M. Connors[1,4], M. Krkošek[2], J. Ford[3] and L.M. Dill[1]

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Abstract: Pathogen transmission from aquaculture facilities can depress sympatric wild fish populations. However, little is known about the effects of pathogen transmission from farmed fish on species interactions or other ecosystem components. Coho salmon (*Oncorhynchus kisutch*) smolts are susceptible hosts to parasitic sea lice (*Lepeophtheirus salmonis*) as well as a primary predator of juvenile pink (*O. gorbuscha*) salmon. We used a hierarchical model of stock-recruit dynamics to compare coho salmon population dynamics across a region that varies in sea louse infestation of juvenile coho and pink salmon. During a period of recurring sea louse infestations in a region of open net pen salmon farms, coho salmon populations had population growth rates that were depressed ~ 3 fold relative to unexposed populations. Alternate explanations for the observed difference in population growth rates, such as declines in coho prey, perturbations to freshwater habitat or stochasticity, are unlikely to explain this pattern. Sea lice parasitizing juvenile coho salmon were likely trophically transmitted during predation on infested juvenile pink salmon as well as directly transmitted from salmon farms. These findings suggest species interactions may cause the effects of pathogen transmission from farmed to wild fish to propagate up marine food webs.

Student presenter: work was completed while a student

Presentation type: Oral

Session Name: contributed

Presentation Title: Influence of resident rainbow trout on abundance of sympatric steelhead in the Upper Yakima Basin

Presenter Name: Ian Courter

All Authors, affiliations, phone number, email: Cramer Fish Sciences**,** courter@fishsciences.net, 503-491-9577

Abstract: Numerous populations of steelhead have been designated as threatened or at risk of extinction along the Pacific Coast of North America, while robust populations of sympatric resident rainbow trout persist in abundance. We explored the interdependence of anadromous and resident *Oncorhynchus mykiss* life-histories using a life-cycle model. Stock-recruitment and life-history parameters were estimated from an extended time series of *O. mykiss* sampling in the Upper Yakima Basin, Washington. Recruitment between age classes residing in freshwater showed strong density dependence. Rates of interbreeding between types, and the proportion of offspring that became resident or anadromous from each parental cross were estimated from experiments conducted in the Yakima River, Grande Ronde River, Oregon and Sashin Creek, Alaska. Mean abundance of steelhead and rainbow trout predicted by the model were similar to estimates from field studies. The sympatric population model also provided better predictions of fluctuations in steelhead abundance compared to a model that assumed no smolt production from resident female spawners. Thus, smolt contributions from resident rainbow trout populations may strongly influence viability of the anadromous life-history form. We recommend further study of anadromous fish production from resident rainbow trout as a potentially important driver of steelhead persistence during periods of low marine survival.

Student Presenter? No

Presentation Type: Oral presentation only

Session Name: Contributed (previously - Smolt Monitoring)

Title: **Cowlitz Falls Anadromous Fish Reintroduction, the Good, the Bad and the Ugly**

Presenter: Michael S. Kohn

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Abstract:

The Cowlitz River in western Washington historically produced abundant runs of salmon and steelhead. In the1960s two dams were constructed that blocked upstream and downstream migration. In the early 1990s, plans were developed to reintroduce anadromous fish into the 240 river miles of historic habitat. This unique opportunity began following the completion of the Cowlitz Falls Dam in 1994 and the subsequent construction of the adjoining Cowlitz Falls Fish Collection Facility two years later. The reintroduction program is based on “trap and haul” where adult spring Chinook, coho and late winter steelhead are captured at a downstream facility and trucked upstream and released to spawn naturally above the three Cowlitz River dams. Juvenile fish and steelhead kelts are collected at Cowlitz Falls and trucked downstream to continue their migration to saltwater.

This attempt to reestablish three anadromous species into the upper Cowlitz River is about to begin its fifteenth season. More than two million smolts have been transported downstream for release since the program began but the numbers fall short of those necessary to attain self sustaining populations. This presentation will focus on three problems facing reestablishing these ESA threatened species and the efforts being made to overcome them.

Session Name (if known, otherwise "contributed"): Recovery of Depleted Species: Tools and Targets

Presentation Title: Use of spatial population viability analysis (PVA) models to prioritize research and set recovery targets for species at risk.

Presenter Name: Janelle Curtis

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Abstract: Delays in critical habitat identification for data-poor species at risk jeopardize their recovery. Lengthy delays also underscore the need for robust generalizations to set interim habitat and distribution recovery targets. Our goal was to identify generalizations to help prioritize research and guide interim decisions concerning the amount and spatial configuration of habitat likely to meet recovery goals. We summarize results from 45 spatial PVA models for species that vary in life history. For each species, we calculated the number of populations and habitat carrying capacity required to achieve 3 widely used recovery goals. We also estimated the mean distance between populations that minimized extinction risk. In our sensitivity analyses, the most influential parameters included carrying capacity, initial population size, number of populations, connectivity, and distance between populations. The amount of habitat required to meet a recovery goal increased with the stringency of that goal, as did the uncertainty in the estimated habitat and distribution targets. We found no correlation between species-specific targets and 8 life history variables. However, the optimal spatial configuration of populations was related positively to maximum dispersal distance. Use of interim recovery targets for the number, size and arrangement of habitat should enhance recovery potential and reduce management uncertainty for data-poor species.

Student Presenter? (Work being reported was completed while a student): No

Presentation Type:

1. Oral presentation preferred, but poster presentation acceptable.

Session name: Contributed
Presentation Title: **Early marine migration patterns of Coastal cutthroat trout (*Oncorhynchus clarki clarki*), steelhead trout (*Oncorhynchus mykiss*), and cutthroat x steelhead hybrid smolts**
Presenter Name: Megan E. Moore
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Jose Reyes-Tomassini, NOAA Fisheries, Northwest Fisheries Science Center, (360) 871- 8309, jose.reyestomassini@noaa.gov

Abstract: Hybridization between steelhead or rainbow trout (*Oncorhynchus mykiss*) and coastal cutthroat trout (*Oncorhynchus clarki clarki*) has been documented in several streams along the North American Coast, where the two species occupy similar habitats. Intermediate morphological, physiological, and performance traits have been attributed to hybrids of cutthroat and steelhead, though little is known about hybrid behavior. This study used acoustic telemetry to record migration patterns ('tracks') of 52 cutthroat, 42 steelhead x cutthroat hybrid, and 89 steelhead smolts, starting with entry into the Big Beef Creek estuary and subsequent movement into the Hood Canal (part of Puget Sound). Median hybrid residence time, estuary time, and tortuosity values were intermediate in relation to median values of the same track parameters for the pure species. The median total track distance measurement was higher for hybrid smolts than for both cutthroat and steelhead smolt groups. At the end of each track (i.e., last detection), most steelhead smolts were located north of the Big Beef Creek estuary along their seaward pathway. Cutthroat tracks grouped more closely to the estuary (both north and south) than did steelhead tracks. Individual hybrids behaved similarly to either cutthroat or steelhead, but some exhibited novel dispersal patterns. Hybridization events appear to significantly affect migration patterns of Big Beef Creek steelhead and cutthroat populations and could affect the productivity of both species.
Presentation type: Oral

Session: Plankton (or New Technologies)

High Resolution Time Series from a Cabled Ocean Observatory in the Salish Sea

Richard Dewey and Verena Tunnicliffe

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The Victoria Experimental Network Under the Sea (VENUS) is a permanent cabled ocean observatory supporting a wide range of research into marine ecosystems. The facility includes cabled arrays in both Saanich Inlet and the Strait of Georgia. The Saanich Inlet array consists of a cable extending from IOS to a single Node at 100m depth at the mouth of Patricia Bay and has been operating continuously since February 2006. In the Strait of Georgia, a 40km cable extends from the Iona causeway to two Nodes, one in the Central Southern Strait at 300m depth and a second in the Eastern Southern Strait at 170m depth, logging data since September and February 2008, respectively. Connected to each Node on the observatory is a VENUS Instrument Platform (VIP), supporting dozens of sensors related to a variety of marine parameters (temperature, salinity, pressure, dissolved Oxygen, currents, etc.). Other observatory systems include cameras and hydrophones. Mounted on each VIP is an inverted echo-sounder, continuously logging the vertical distribution of plankton and fish. The echo-sounder data reveal significant variations in the distribution and abundance of plankton over time scales of hours, days, months, and years. In addition to monitoring the daily vertical migration of the zooplankton, fish, both individually and in concentrated schools are frequently detected. The presentation will provide an overview of the VENUS observatory, with a focus on the events captured in these high resolution data.

Oral Presentation

Session Name: Poster Session

Title:
The Hood Canal Steelhead Project: A watershed-scale experiment to assess the demographic, ecological, and genetic impacts of supplementation on natural steelhead

Presenter Name: Katy Doctor

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Abstract:
In recent decades, salmon and steelhead hatcheries in the Pacific Northwest have been developed to aid in the conservation and rebuilding of depleted natural populations. The benefits and risks associated with hatcheries have been debated in public and scientific forums, with little resolution. The 2007 ESA-listing of steelhead in the Puget Sound basin (USOFR 2007) has highlighted the importance of understanding the impact of conservation hatchery programs on natural populations.

The Hood Canal Steelhead Project (HCSP) formed as a collaborative effort between the lead NOAA Fisheries, state, tribal, and other federal agencies, and two major non-profit salmon restoration groups working in the Hood Canal watershed. We have designed and are currently implementing a watershed-scale experiment to address a major question critically important to steelhead populations throughout the Pacific Northwest: What are the demographic and genetic impacts of conservation hatchery programs on natural steelhead populations? A before-after control-impact (BACI) experiment will examine the effect of indiginous broodstock supplementation on productivity, life-history, and genetic characteristics of natural steelhead populations in Hood Canal before supplementation (2007-2010), during the period of supplementation (2011-2018), and after supplementation (2018-2022). The experiment contains three supplemented streams (Dewatto, Duckabush, and Skokomish Rivers) and three non-supplemented streams (Big Beef Creek and Tahuya, Little Quilcene Rivers). Steelhead are currently being reared to smoltification (age-2) and adulthood (age-4 and -5). Data collected prior to the influence of any hatchery-origin fish suggest that natural populations within Hood Canal differ in parr- and smolt-size at age, spawn timing, life history diversity, early marine survival and migration patterns.

Student Presenter: No

Presentation Type: Poster presentation only

Hood Canal summer chum salmon – interim genetic analysis of subpopulation structure in a metapopulation receiving supplementation fish

Maureen P. Small, Ken Currens, Thom Johnson, Cheryl Dean and Cherril Bowman
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Abstract
For over 15 years, the endangered Hood Canal summer chum salmon ESU has been the focus of an intensive recovery effort designed by the Summer Chum Salmon Conservation Initiative. Supplementation with in-river broodstock was implemented in several tributaries with extant populations and fry from three supplementation broodstocks were additionally released in tributaries where populations had gone extinct. We present genetic profiles of summer chum salmon

before and during supplementation and compare genetic profiles of supplemented and unsupplemented subpopulations.

Session Name: Contributed

Presentation Title: Reconstructing Salmon Escapement using Dendrochronology: Testing Methods

Presenter Name: Jody Gerdts

Authors	Jody Gerdts	Jim Helfield	Andy Bunn	Hal Michael	Peter Jenkins
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Student Presenter: Yes

Presentation type: Oral presentation preferred, but poster presentation acceptable.

Abstract

The number of salmon escaping catchment to spawn in rivers and lakes has declined drastically over the last century leaving some species extinct or at threshold levels in many systems. Restoration efforts aiming to mitigate human impacts on salmon lack historic or prehistoric spawning estimates needed to quantify restoration goals.

Salmon flesh decomposing in riparian systems can load the environment with traceable nitrogen acquired while accumulating biomass at sea. This nitrogen becomes integrated into the surrounding biota and ecosystem, potentially marking a "salmon signature" in annual growth rings of trees. Studies using pioneering dendrochronological techniques have documented changes in atmospheric nitrogen deposition through chemical analysis of tree ring. This project seeks to test the effectiveness of using these techniques to detect shifts in marine derived nutrient subsidies in riparian trees potentially leading to reconstructing historic salmon escapement. Research will take place on three salmon-bearing rivers in Washington State with known changes in salmon abundance: The Skykomish River, the Elwha River, and Icicle Creek. A fourth system, Kennedy Creek, will test the methods as trees were exposed to isotopically labelled fertilizer chemically composed to mimic salmon flesh in 2003 and should have a clear "salmon signal" in their tissue.

Contributed paper

Title: **Adult salmon and steelhead passage evaluations involving low elevation obstructions in the Umatilla River**.

Presenter: Kinsey E. Frick

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Large hydropower projects in the Columbia River basin have been demonstrated as impediments to upstream migration of adult salmonids, but low-elevation dams and irrigation diversions may also impact migration as fish approach spawning areas in smaller tributaries. The Umatilla River has seven low elevation dams that may obstruct Chinook salmon and steelhead access to historically productive spawning areas. The timing of migration, particularly of steelhead, during high-flow, turbid times of year, makes traditional counting methodologies difficult to employ. We used radiotelemetry to examine fallback rates, passage routes, rates, and delays, holding and spawning locations, and maximum upstream distribution of Chinook salmon and steelhead in the Umatilla River. Fixed receivers and mobile tracking of 76 tagged steelhead and 32 Chinook salmon in 2009 allowed these estimations. Once obstructions are identified, structures can be modified as necessary to enable fish passage and aid in recovery within the basin. Locating key holding and spawning areas will provide information for habitat and restoration needs. The determination of upstream distribution and spawning of hatchery fish will allow managers to better assess the use of hatchery releases to supplement historical spawning areas.

Student presenter? No.

Presentation type: oral presentation preferred, but poster presentation acceptable.

Forrest, R.E. and C.J. Walters. 2009. **Estimating thresholds to optimal harvest rate for long-lived, low-fecundity sharks accounting for selectivity and density dependence in recruitment.** Canadian Journal of Fisheries & Aquatic Sciences. 66: 2062-2080.

Abstract
Deepwater dogsharks (Order Squaliformes) are thought to be particularly vulnerable to overfishing, due to life-history strategies that place them at the lower end of the shark productivity spectrum. Sharks frequently have relatively low value in multispecies fisheries, where management is usually aimed at maintaining harvest of more valuable and productive teleosts. This results in low priority being given to data collection for sharks and hampers identification of appropriate harvest strategies. Here an age-structured model with maximum sustainable harvest rate (U_{MSY}) as leading productivity parameter is systematically applied to show that, for certain growth, reproductive schedules that apply to some sharks, the range of possible values that can be taken by UMSY can become very small. The model was applied to twelve Australian dogshark species and was used to show that UMSY is highly constrained under some selectivity schedules. Results were consistent with estimates of the intrinsic rate of growth obtained using a demographic model, suggesting that there may be more certainty about UMSY than expected for many shark species, given uncertainty in recruitment parameters. The approach could be used to inform policy for some sharks and may be useful in the development of informative Bayesian priors for assessment models.

AFS oral presentation abstract

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Title: Rockfish bycatch in spot prawn traps

The depressed state of many rockfish (*Sebastes* spp.) stocks is a major concern to fishery managers and conservationists. Fisheries that target rockfish have been managed through quota reductions and through the establishment of rockfish conservation areas (RCAs), and bycatch mortality in the ground-fish fishery has been highly scrutinized. However, rockfish bycatch in spot prawn (*Pandalus platyceros*) traps is a potential source of mortality which has yet to be assessed. We performed the first evaluation of bycatch in prawn traps based on data collected in a fishery-independent monitoring survey conducted by DFO. The overall rate of rockfish catch was low – 0.015 rockfish per trap. However, the majority of rockfish caught in the survey were quillback rockfish (*S. maliger*), which is deemed "Threatened" by COSEWIC. Most of the rockfish catch consisted of juveniles. The potential impact of this source of juvenile mortality on rockfish recovery is unknown, but given the sensitivity of rockfish populations to overexploitation, measures (such as modified fishing gear) to reduce rockfish bycatch would be desirable.

For Session: Technical Innovations for Fisheries Field Work

Estimating sockeye escapements using weirs, mark-recapture, and video

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It is not easy to be “smarter than a sockeye”. Just estimating how many swim into one little Southeast Alaska stream can be challenging and expensive. With many streams, limited funds, and management concerns we need efficient and reliable methods to estimate escapements. Federal subsistence funding in recent years has enabled me to develop and test new weir, mark-recapture, and video enumeration methods at several locations in Southeast Alaska. Floating camps, “net weirs”, and traditional channel-and-picket weirs modified with welded panels, collapsible bipods, and trap-in-weir configurations have helped. Knowing that sockeye can, and do, swim through weirs uncounted, I’ve streamlined methods for estimating escapements using weir-to-above-weir mark-recapture methods. I have also developed a reliable, low cost, fish-friendly, mini-DVR/video system for counting and examining fish for marks. This applied-science presentation is not for sissy’s that count fish from the backseat of SuperCubs.

Session: SoG Plankton dynamics
Title: **Multiple Currencies of Zooplankton Change in the Strait of Georgia**
Presenter: Rana El-Sabaawi*
Co-Authors: Akash Sastri, Robert W. Campbell, John F. Dower, Asit Mazumder, Marc Trudel
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Zooplankton time-series are typically reported in terms of “energetic” currencies such as biomass, abundance and areal density. Those units are susceptible to numerous biases resulting from sampling techniques or natural variability (in terms of patchiness and seasonality). Recent evidence suggests that expressing zooplankton time-series in multiple currencies (e.g. indices of food quality, elemental or biochemical composition) may alleviate many sampling biases, and may also yield more physiological or mechanistic insight into zooplankton dynamics than traditional units. Here we describe recent changes in the zooplankton community of the Strait of Georgia in terms of biomass, diversity, elemental and biochemical composition. We emphasize changes in the copepod community that occurred in the last decade, which shifted from lipid-rich species (*Neocalanus plumchrus* and *Calanus marashallae*) to lipid-poor species (e.g. *Metridia pacifica*). We relate these shifts to the biochemical composition of these copepods, and discuss our findings in terms of food quality for forage fish and higher predators.

*Work completed while being a student, but primary author is currently a post doctoral associate
Oral presentation

Seasonal Diet and Energetic Condition of Chinook Salmon in the Bering Sea

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Poster Presentation
"contributed"

Recent declines of Chinook salmon, *Oncorhynchus tshwaytscha*, returns to the Arctic-Yukon-Kuskokwim region of Alaska have prompted this research investigating the effects of seasonal ocean conditions on diet and energetic condition. The goal of this study is to develop an understanding of Chinook seasonal diet composition and its influence on energy allocation. The severe winter conditions of the Bering Sea force most salmon species to leave, with Chinook being the exception remaining throughout their ocean life stage. Previous winter food habits studies on Chinook have shown a higher frequency of empty stomachs and an increase in diet variability. The presence of walleye pollock offal (cut fins, bones, skin, etc.), discarded from commercial at-sea groundfish processors, in the stomachs of Chinook may indicate that winter is a food limiting season. To investigate seasonal feeding conditions, stomach content analysis was conducted on Chinook sampled by U.S. groundfish observers, Japanese research cruises, and directly from the by-catch in commercial pollock processing plants in Dutch Harbor. To supplement the food habits analysis, Chinook muscle tissue was collected from the winter and summer pollock fishery by-catch for carbon and nitrogen isotope analysis. If food is limiting during the winter season, then Chinook would limit energy allocation to growth and fat storage. To asses the influence of seasonal diets on energetic condition, whole Chinook collected from winter and summer by-catch were processed for total energetic content. Gonads were removed prior and analyzed for energetic content to determine seasonal energy allocation to reproductive tissue. The seasonal variability of ocean conditions directly and indirectly affects Chinook prey availability, prey quality, and energetic condition. Energetic content of salmon fluctuates seasonally as consumption, metabolism, and growth rates are influenced by ocean conditions and can be a useful tool to evaluate responses to the ecosystem.

EFFECTS OF EXTENDED TRANSPORT ON SMOLT PREDATION IN THE LOWER COLUMBIA RIVER

Greg Blair and Bruce Watson

Transporting smolts from Snake River dams to a point below Bonneville Dam is a strategy to spare outmigrants mortalities associated with hydroelectric dams. The ACOE is evaluating strategies to improve survival of transported fish by extending the release point downstream. Our study addressed concerns that extended transport might increase losses among in-river migrants.

We developed a model to estimate smolt mortality in the Columbia River below Bonneville Dam attributable to predation by Caspian terns, double-crested cormorants, and northern pikeminnow. We used bioenergetic techniques to estimate the energy requirements of the predators and Ivlev's Electivity Index to distribute this demand over salmonid and non-salmonid prey populations. The model predicted a 10 to 50% increase in survival from Bonneville to the Columbia mouth for transported fish under extended transportation. The model also predicted that extended transport would decrease survival of non-transported smolts by no more than 1 to 3%, whether the smolts originated upstream or downstream of Bonneville. The minimal impact on in-river migrants was largely attributable to the large number of hatchery salmon and steelhead entering the Columbia River below Bonneville Dam.

Session Name: Contributed.

Presentation Title: A comparison of early development between a domesticated stock of coho salmon (*Oncorhynchus kisutch*) and its parent stock.

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Abstract
Although the effect of selection on the growth of finfish is well established, we decided to investigate whether the genetic changes brought about by selection affect developmental and embryonic growth mechanisms as well. We compared early development and yolk conversion efficiency in a domesticated strain of coho salmon (*Oncorhynchus kisutch*), that had been selected for increased body size over 16 generations, to that of its unselected parental hatchery stock. The domesticated fish produced smaller eggs, reached blastopore closure sooner, and utilized stored yolk more efficiently than the parental stock. Because we were concerned that egg size may have confounded our results from the blastopore closure component of the experiment, we repeated this component using different sized eggs from a single stock. These results indicated that rates of early development (to blastopore closure) were more strongly influenced by egg size differences than by selection. In contrast to growth rates expressed later in development, rates of embryonic development depended primarily on the quantity and quality of resources available in the egg. Nevertheless, selection did produce substantial effects on yolk conversion efficiency in developing fry, illustrating that complex changes across the life history can be produced by selective breeding on a single trait.

Contributed

FLOW VELOCITY ENHANCEMENT SYSTEM – ANALYSIS OF SMOLT GUIDANCE IN THE COWLITZ RIVER, SUMMER 2008

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ABSTRACT

Juvenile salmon follow river currents downstream during outmigration. Impounded rivers can remove migratory cues; water diversions can misdirect migrants to hazardous areas. Induced currents may aid juveniles to safe migration routes or collection devices. A hydraulic system (FVES) generates currents similar to natural streams. Bonneville Power Administration funded field tests to determine whether smolts would orient to and follow induced currents.

Two-dimensional acoustic telemetry detected and recorded fish in the vicinity of the FVES-generated plume. Ninety juvenile Chinook salmon smolts implanted with acoustic transmitters were released in a Cowlitz River (WA) dam tailrace 9/d for 10 d. A rotating on-off FVES schedule compared natural and guided migration trajectories. River flow was generally slack or circa 1.5 fps downstream.

Most tracked fish remained in or near the FVES plume longer than other fish in the same zone when the FVES was off ($P<0.0001$). More fish entered the plume multiple times, exhibiting tracking behavior, when the FVES was on than when it was off. A majority of smolts passed through or lingered in the plume about 100 ft from the FVES when it was operating (but not when off), a favorable location to capture or divert smolts with the FVES.

Session Name: Lamprey ecology and life history

Presentation Title: Myth Busters: There's no information on lamprey.

Presenter Name: Joshua G. Murauskas, Public Utility District No. 1 of Douglas County, 1151 Valley Mall Parkway, East Wenatchee, WA 98802. Phone (509) 881-2323; Email joshm@dcpud.org

Lamprey research has recently become an ever-increasing component of fisheries management in the Pacific Northwest. Regional fish biologists have continuously declared, as stated in a 2009 peer-reviewed publication, that lamprey conservation and restoration is "hindered by a lack of basic information on their natural history and habitat requirements." Although some aspects of the local Pacific lamprey (*Entosphenus tridentatus*) remain undefined, the significant similarities among lampreys and decades of research conducted on several continents provide a sizeable knowledge base. Similar to the popular Discovery Channel show, "Myth Busters," I will attempt to replicate the circumstances, then duplicate the results… ultimately labeling this myth as "Busted" and revealing how lampreys are among the most studied fishes in North America.

Student Presenter? No.

Presentation Type: Oral presentation only.

Fisheries and handling-related stressors on adult Pacific salmon physiology, behaviour and survival.

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Recently there has been a call for more integrative and experimental approaches to understanding the consequences of fisheries interactions on Pacific salmon. Sockeye salmon were biopsied or telemetry tagged across three treatment groups (beach seine or angling and immediate release, or 24 h recovery from angling in a net pen). Overall, 52.2 % and 36.3 % of fish immediately released by beach seine and angling reached natal subwatersheds, respectively. Only 2.9 % of the individuals released from the net pen reached spawning areas. Blood plasma stress indices reflected these survival patterns, where the net pen group had significantly elevated plasma cortisol (~ 4 fold increase) and glucose (~ 2 fold increase) and depressed plasma ions and osmolality relative to fish sampled upon capture. Plasma lactate did not differ between groups. A companion study used four treatment groups; a short or long duration beach seine capture, or a fine-mesh or standard-

mesh gill net simulation. Telemetry data revealed striking differences among short-term survival following the gill net and tangle net treatments, and interesting trends in longer term behaviour and survival. These results, combined with focused laboratory comparisons, provide insight into the sublethal and lethal consequences of fisheries encounters on migrating Pacific salmon.

Student presenter, oral presentation.

Session Name:
Contributed

Presentation Title:
Link between hydrologic variability and freshwater fish life histories in the United States

Presenter Name:
Meryl Mims, University of Washington

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Julian Olden, University of Washington

Abstract:
Hydrologic variability is one of the most influential physical characteristics of freshwater ecosystems, yet our understanding of how hydrologic variability shapes freshwater fish diversity remains limited. We examined the relationships between hydrologic variability and life history strategies of freshwater fishes throughout the United States by 1) determining whether predictable relationships exist between natural (i.e. unaltered) hydrologic variability and life history strategies of freshwater fishes, and 2) examining whether altered hydrologic variability (via impoundments) impacts the dominant life history strategies in communities of freshwater fishes downstream of dams. Relationships between hydrologic variability (natural and altered) and fish life history strategies were examined by major flow regime types. Our results show that altered hydrologic variability affects life history trait composition of freshwater fish communities, with the direction of these changes being largely in agreement with predictions from life history theory. This study contributes to the understanding of how fish species and biodiversity respond to anthropogenic changes in the hydrologic regime and has implications for flow regulation and restoration via managed flow releases from dams.

Student Presenter?
Yes

Presentation Type:
Oral presentation preferred

What makes a "good year"? Time series evidence linking zooplankton abundance and composition to growth and survival of juvenile fish

David Mackas, Marc Trudel, Azit Mazumder

Session Name (if known, otherwise "contributed"):"Zooplankton" [convenor Chrys Neville]

Presentation Title: What makes a "good year"? Time series evidence linking zooplankton abundance and composition to growth and survival of juvenile fish

Presenter Name: David Mackas

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Abstract:

Zooplankton occupy a key intermediate position in marine pelagic food webs, connecting the microscopic primary producers with larger secondary and tertiary consumers such as finfish, marine mammals and seabirds. Multi-decade zooplankton time series are now available from many ocean regions (including the Vancouver Island continental margin). These time series clearly show that zooplankton populations undergo large seasonal and interannual changes in total biomass, community composition, and seasonal timing (phenology). Much of the interannual variability appears to be driven by fluctuations and trends in ocean climate. We have also found strong bottom-up covariance with indices of success (growth, survival, and recruitment) for juvenile coho salmon. Zooplankton community composition, and its covariance with weight-specific lipid content, appears to be especially important for allowing juvenile fish to grow rapidly and avoid mortality.

Session Name (if known, otherwise "contributed"): Plankton
Presentation Title: Interannual variability (1990-2006) in zooplankton communities in the Strait of Georgia, British Columbia, and evidence for a 1997/98 regime shift**.**

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Abstract

Regime shifts in large ecosystems have been recently increasingly recognized and described as rapid temporal changes in environmental conditions and sharp changes in abundance and structure across trophic levels. In the context of regime sifts, we here investigate the interannual variability of zooplankton communities in the Strait of Georgia (SoG), British Columbia, using a 17-year time series. The SoG zooplankton time series was collected uninterrupted between 1990 and 2006, from the upper 20m of the water column. Multivariate analyses have been applied in this study using PRIMER package. Nonmetric multidimensional scaling (MDS) and cluster analysis showed a regime-like shift in 1997/1998 based on two most intensively sampled months, June and September. SIMPER analysis revealed that euphausiids contributed 50% to the dissimilarity between the two regimes in June and over 30% to the dissimilarity in September. Prior to 1997/1998, euphausiids dominated zooplankton biomass in the SoG surface waters, but after 1997/98 their biomass decreased dramatically and siphonophores came to dominate in September. The interannual variability of euphausiids, siphonophores, ctenophores and other groups

was also examined. Changes in the zooplankton community co-varied with environmental changes. As euphausiids and siphonophores may support different food webs, the shifts in the secondary production observed in the late 1990’s may have had a substantial impact on higher trophic levels and the ecosystem as a whole.

The differential early marine mortality of juvenile coho salmon in the Strait of Georgia and Puget Sound

The early marine mortality of juvenile coho salmon is greater in the Strait of Georgia than in Puget Sound. Marine survival indices suggest that regional and basin scale changes in atmospheric and oceanic conditions are more detrimental to juvenile coho salmon rearing in the Strait of Georgia than those in Puget Sound. Sea Surface Temperature (SST) from May to September, the time that is most critical to the success of juvenile coho salmon, has increased and is coincidental with declines in early marine survival. The increase in SST over the past few decades was greater in the Strait of Georgia and may now be affecting the metabolic success of juvenile coho salmon. Hatchery practices such as optimal size and time of release can help provide juvenile coho salmon with the best possible conditions for survival during the first few weeks in the marine environment. Hatcheries in Puget Sound generally release fish at a larger size and over a greater window of time. Larger fish may be more physiologically able to adapt to less than favorable conditions, and releasing over a longer window of time allows for a greater chance of entering the ocean when feeding and growth conditions are favorable. Fish that are given the opportunity to grow quickly are more likely to reach a critical size that makes them less susceptible to death from predation, disease and metabolic stress. Changes in climate may be responsible for declines in the early marine survival of juvenile coho salmon in the Strait of Georgia and Puget Sound, but survival could be improved through optimal enhancement strategies.

Efficiency trials in juvenile salmonid trapping studies: When is enough, enough?

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Abundance estimates of outmigrating juvenile salmonids offer managers an important indicator of the status of ESA listed species. These estimates are often derived from a series of mark-recapture efficiency trials. Trials are typically conducted throughout the trapping season in order to detect any temporal heterogeneity in capture probabilities. Capture probabilities can differ due to the diverse life history strategies often displayed by outmigrating juvenile salmonids and the stochastic environmental conditions encountered during a trapping season. An often unresolved issue with juvenile salmonid trapping studies is knowing how large mark groups need to be to accurately measure trap efficiency. Different methods to stratify mark-recapture studies will be presented and evaluated for potential bias in outmigrant production estimates. A power analysis will be applied to illustrate how large mark groups need to be to detect a statistical difference in efficiency between release groups. These analyses will be discussed with respect to juvenile Chinook and steelhead trapping studies conducted in western Washington.

Session Name: Contributed

Presentation Title: **Spatial and temporal analysis of Chinook salmon redds from historical and current aerial surveys on the Cowlitz River, Washington**

Presenter Name: Katherine Murray

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Christopher Murray, Pacific Northwest National Laboratory, (509) 371-7090, chris.murray@pnl.gov

Abstract:

Using a unique set of fine- and large-scale temporal and spatial data, we investigated the spawning patterns of fall and spring Chinook salmon *Oncorhynchus tshawytscha* on the Cowlitz River, Washington. Coarse-scale spatial data had been collected from 1991-2007, and fine-scale spatial data (resolution of 100-500 m) were collected in 2008 and 2009 from bi-weekly helicopter flights on the lower Cowlitz River by Washington Department of Fish and Wildlife. We examined Chinook salmon redd reoccupation among and within years, and explored whether (1) redds were distributed randomly and (2) the spatial distribution of redds was related to large-scale geomorphic features. Five years (1993, 1998, 2000, 2002, and 2009) were compared for reoccupation, and the minimum correlation coefficient for reoccupation was 0.90 (adjusted p-value of 0.002). These preliminary results demonstrate that Chinook spawn in the same sections each year with little variation among years. These results also indicate that redds are distributed in clusters and that redd distribution varies at different spatial scales, ostensibly related to channel geomorphology and availability of spawning habitat.

Student Presenter?: Yes

Presentation Type: Oral presentation only

Habitat Restoration or contributed

Habitat Restoration: Its role in the stabilization of coho smolt yields on the Keogh River based on a 30year data time series.

D.McCubbing

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Coho salmon adult escapement has been monitored at the Keogh river, North Vancouver Island, BC with an electronic fish counter since it's installation in the autumn of 1998. During this period adult coho salmon numbers have ranged from a low of circa 750 fish in 2008 to a high of 8246 fish in 1998. During the same period (and since 1977) smolt yield has been monitored with a full river counting fence close to the river mouth. In general coho smolt yields since 2000 have been close to or above average for this watershed, likely due to improved freshwater rearing conditions, resulting in part from watershed restoration. Coho smolt yield from this watershed in 2003, at 93,000 fish was the second highest recorded in 27 years of monitoring. Indications of improvements in smolt size and condition resulting in a substantive increase in coho smolt biomass yield were also observed on this watershed. These increased and apparently stabilized smolt yields result from an improvement in smolt per spawning female production, up from 9 smolts per spawner in 1999 to over 90 smolts per spawner in 2003, rather than increased adult returns. Recent adult returns despite the observed increase in annual smolt yields have been significantly lower than historic highs, due it appears to persistently low marine survival post the El Nino years of 1998 and 1999.

Presentation Title: Genetic Characterization of Kokanee within Lake Roosevelt, Arrow Lakes, B.C., and Surrounding Basins
Presenter: Todd W. Kassler
Authors: Todd W. Kassler, WA Dept of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501, (360) 902-2722, Todd.Kassler@dfw.wa.gov; Cherril Bowman, WA Dept. of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501, (360) 902-2774; Cherril.Bowman@dfw.wa.gov; and Bret Nine, Colville Confederated Tribes, (509) 209-2419, bret.nine@colvilletribes.com

Abstract: Kokanee (*Oncorhynchus nerka)* in Lake Roosevelt have been evaluated to determine the genetic relationship of those individuals to each other and to kokanee in nearby basins. Kokanee from Lake Whatcom and Meadow Creek have been planted extensively into Lake Roosevelt, but there have been questions whether there are any naturally reproducing kokanee present in Lake Roosevelt. There are also questions if the kokanee in Lake Roosevelt have migrated in from a nearby basin. The status of kokanee in Lake Roosevelt has been addressed by collecting and analyzing kokanee from four at-large reaches within Lake Roosevelt, the Sanpoil River, the Nespelem River, the Arrow Lakes system (British Columbia), Lake Whatcom, and nearby basins. Results of the tests of population subdivision and the neighbor-joining tree suggested the at-large collections of kokanee from within Lake Roosevelt, Sanpoil River, and Nespelem River are all genetically similar to each other while they are differentiated to all other collections that were analyzed. The collection of kokanee from Lake Whatcom and Meadow Creek show a small amount of genetic ancestry to kokanee in Lake Roosevelt. This implies that the majority of genetic ancestry of the Lake Roosevelt kokanee is from naturally reproducing kokanee in the Lake Roosevelt system. The kokanee in the Arrow Lakes system, British Columbia are also undifferentiated to each other, but are genetically differentiated to other areas with exception of Hill and Norns Creek. The collection of kokanee from below Keenleyside Dam is more similar to the collections in the Arrow Lakes system than to the collections in Lake Roosevelt suggesting that kokanee do not migrate down the Columbia River into Lake Roosevelt.

Session Name: **Contributed (Salmon)**

Presentation Title: A summary of Chinook salmon acoustic tagging results for Puget Sound.

Presenter Name: **Anna N. Kagley**

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Many of the world's most abundant fish are migratory. Puget Sound salmon show a particularly wide variety of migration patterns. For Chinook salmon in particular, we have documented a continuum of migration patterns in individuals from those that migrate to the ocean (ocean-type) to others that spend their entire lives in inland bodies of water (residents). We used acoustic telemetry to document behavior and compare these fish. We also characterized the movements of residents at a range of spatial (e.g. between basins, speed of movement, etc.) and temporal scales (e.g. seasonal, diel, tidal patterns of horizontal movement etc.) and determined how selected environmental and biological (e.g. fish size, hatchery versus naturally-produced, etc.) factors related to patterns of movement. All of this can assist managers in estimating life stage specific mortality as well as assist in optimizing efforts to protect and restore nearshore ecosystems that are most utilized by salmonids.

International Fisheries Consulting Related to Approval of Major Infrastructure Projects

By Mark G. Pedersen, Margenex International

Experienced AFS members may be called upon to be part of a team of international Independent Environmental Consultants to international lenders for the review of the Environmental and Social Impact Assessments of proposed major infrastructure construction and operation in several countries around the word. Most scopes of work have the objective of providing professional support to the proponent for the aquatic natural resources and fishing components review;
The project proponent entrusts the Consultant, who accepts, the consultancy related to the duties of aquatic natural resources expert. The assignments typically include the following in-field and office tasks:
Task 1: Preliminary review of the EIS documentation (office) prior to the Team Site visit;
Task 2: Team site visit to assess resources and affected stakeholders.
Task 2: Contribution to the draft and final Environmental and Social Due Diligence Report after the team site visit, in liason with all team members (home).

This presentation will review the biologist's role in interpreting relevant World Bank, International Finance Corporation, and Espoo protocols to assure the project's Environmental Impact Assessment and associated Management Plans are compliant with the aforementioned standards and associated guidelines. Several examples will be presented (Peru, Mauritania, Baltic Sea, Papua-New Guinea).

Logistic regression models for resolving primary stream-bearing length or area for coastal cutthroat (*Onchorhyncus clarki clarki*) **and steelhead trout** (*Onchorhyncus mykiss*) **at the landscape and reach scale**

Abstract

Steelhead and cutthroat commonly co-occur in larger coastal watersheds. Provided cutthroat spawning and early rearing occurs in small streams, it is unknown which reaches are primarily used by each species at the landscape level. To quantify species dominance at the reach level, I completed meta-analyses using parr-sized trout captures and relative catch frequency (counts per 100) of each from nearly 600 streams or reaches. Various GIS map layers and physical habitat measurements were assembled with reach-occurrence data to perform a logistic regression predicting species dominance. Variables included stream width, channel width, stream order, watershed area, unit runoff, ecoregion placement, and long-term mean annual discharge. Watershed area stratified by ecoregion or mean annual discharge (mad) was the single best predictor of cutthroat and steelhead occurrence with a classification rate of 99% correct for the entire species range. Primary watersheds with an ocean terminus and those not routinely documented as steelhead fishery sites were dominated by cutthroat. Cutthroat dominated in reaches where mad≤800 $L \bullet s^{-1}$and steelhead dominated in reaches where mad>800 $L \bullet s^{-1}$.

Session Name (if known, otherwise "contributed"): contributed

Presentation Title: Comparative selectivity on length at maturity among Alaskan sockeye salmon fisheries

Presenter Name: Neala W. Kendall

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Abstract: Bristol Bay, Alaska, USA, produce some of the most abundant and biologically diverse sockeye salmon (*Oncorhynchus nerka*) runs in the world and has been heavily fished by gillnet fisheries for over 100 years. Quantification of fishery exploitation and selection on age and size at maturation over long time periods is essential to understand evolutionary consequences on stock demographics and sustainable fishery management. We performed these quantifications for five fishing districts in Bristol Bay from 1946-2008 and evaluated how different management strategies affected fishery selection and exploitation in different areas. Analyses revealed that larger than average fish were caught in most years by gillnet fisheries and significantly different patterns of age and size selectivity based on harvest levels and fishing gear used, which have implications for the evolution of age and size at maturation. Management strategies that include smaller gillnet mesh sizes and robust escapement goals can ease fishery selection on larger fish and thus potential negative ecological and evolutionary impacts of such selection.

Student Presenter? (Work being reported was completed while a student): Yes

Presentation Type:

1. Oral presentation only please

Abstract

A dynamic model of the Strait of Georgia ecosystem suggests that both bottom-up and top-down mechanisms have influenced biomass changes of most managed species between 1950 and the present. This Ecosim model emulates historic biomass changes derived from stock assessment data for marine mammals, birds, salmonids, herring, lingcod, and dogfish . Specifically, the model successfully predicts the timing, direction and magnitude of historic changes in population dynamics of these species. While some species dynamics appear primarily influenced by top-down mechanisms like fisheries, *e.g.*, lingcod and seals, most other modelled species show that bottom-up forcing has also influenced biomass changes. The degree to which either bottom-up or top-down forcing explains historic biomass dynamics appears to wax and wane for some species, *e.g.*, herring and salmonids. Surprisingly, bottom-up processes appear to be more important in helping explain biomass changes in upper trophic level species like orcas and marine birds. The potential of this work therefore is that by using these modelled historic processes we can develop credible models of future ecosystem configurations. These future model simulations could serve as a strategic complement to single species stock assessments and help determine research priorities and achievable management options.

Session: Poster
Title: **Ecosystem Diagnosis & Treatment 3.0**
Greg Blair, ICF International, 206 463 6022, gblair@icfi.com
Bruce Watson, ICF International, 206 463 6022, bwatson@icfi.com
Abstract:
The Ecosystem Diagnosis & Treatment system (EDT) was developed more than fifteen years ago as an application of the medical model of diagnosis and treatment to watershed management issues. The first EDT tool was developed in a desktop database environment and focused almost exclusively on Chinook, coho, and steelhead in their freshwater life stages. The second version of that tool included its evolution to a web-based environment and provided a shared system for cooperative basin planning. While there was much strength in these systems, modern ecosystem management problems present ever increasing challenges for flexibility, integration and transparency. Ecosystem Diagnosis & Treatment 3.0 (EDT3) is a modernized toolset based on public facing Webservices and the Windows Presentation Foundation environment. It leverages the power of desktop computers, while providing opportunities for integration with outside Webservices. EDT3 was designed to offer integration with ACOE HEC data, EPA hydrological unit data, and a variety of GIS data sources. The system includes a more flexible data management and reporting structure that allows for ESU-specific species-habitat-relationship rules, habitat status and trends reports, and variable out of basin conditions. The model provides a more comprehensive user interface for designing, testing, implementing, and publishing EDT models. Importantly, EDT3 can utilize data created in EDT2 allowing users to build on past investments.
Presentation type: Poster

Session: Plankton (or New Technologies)

Plankton and Nekton Time Series from Permanent Inverted Echo-Sounders in the Salish Sea

Richard Dewey and Verena Tunnicliffe

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The Victoria Experimental Network Under the Sea (VENUS) is a permanent cabled ocean observatory supporting a wide range of research into marine ecosystems. The facility includes cabled arrays in both Saanich Inlet and the Strait of Georgia. The Saanich Inlet array consists of a cable extending from IOS to a single Node at 100m depth at the mouth of Patricia Bay and has been operating continuously since February 2006. In the Strait of Georgia, a 40km cable extends from the Iona causeway to two Nodes, one in the Central Southern Strait at 300m depth and a second in the Eastern Southern Strait at 170m depth, logging data since September and February 2008, respectively. Connected to each Node on the observatory is a VENUS Instrument Platform (VIP), supporting dozens of sensors related to a variety of marine parameters (temperature, salinity, pressure, dissolved Oxygen, currents, etc.). Other observatory systems include cameras and hydrophones. Mounted on each VIP is an inverted echo-sounder, continuously logging the vertical distribution of plankton and fish. The echo-sounder data reveal significant variations in the distribution and abundance of plankton over time scales of hours, days, months, and years. In addition to monitoring the daily vertical migration of the zooplankton, fish, both individually and in concentrated schools are frequently detected. The presentation will provide an overview of the VENUS observatory, with a focus on the fascinating signals captured in the acoustic echo-sounder data.

Oral Presentation

Southern Chums – hanging in there: Population biology and genetics at the southern limit of their range (California, Oregon, and Columbia River)

Orlay W. Johnson, Anna Elz, Kathleen Neely, and Jeffrey J. Hard

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KEYWORDS: Chum Salmon, Genetics, and Climate Change

Abstract

Spawning populations of chum salmon historically extended as far south as the San Lorenzo River in California and 322 km upstream in the Sacramento River. In 1905-06 chum salmon juveniles were the most abundant salmon species in streams surveyed between the Sacramento and Columbia rivers. Today, these populations have greatly declined, and in the Columbia River are now listed under the ESA as a threatened species. Little life history, genetic, or other biological information has been developed on these fish. This information is important as southern runs may represent remnants of historical populations with characteristics essential to the successful restoration of depleted present day populations.

In cooperation with ODFW, WDFW, USFWS, we collected life history, genetic, and demographic data (such as presence or absence of spawning populations, age structure, and timing of migrations) from 2003 through 2009. Preliminary microsatellite genetic data indicate population structure among coastal populations is different from interior and Puget Sound runs. Run timing and other life history traits are also different between these southern populations and others. These runs may contain unique genotypes and adaptations of importance as increasingly rapid changes in climate, pollution impacts, and development expose salmonids to pressures beyond their ability to adapt, forcing further declines and even extinction.

Session Name:

Improving Understanding of Freshwater Capacity for Increasing Salmonid Fish Populations

Presentation Title:

Using geomorphic potential and historical ecology to estimate historic spawning capacity for multiple salmonid species in the Columbia River basin

Presenter Name:

George Pess

All Authors, affiliations, phone number, email:

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Abstract:

An important question in designing watershed restoration scenarios is “How do we integrate the natural physical habitat template and historical ecology into a picture of restoration potential?” Recent efforts to identify intrinsic salmon potential and restoration options rely on representation of rivers as single-line networks, however these can miss up to 70% of potential habitat capacity for salmonids, primarily because they miss habitat areas formed by complex river channels. Our study integrates geomorphic potential and historical ecology to identify portions of the Columbia River basin that have the greatest potential for multiple salmonid species recovery. Specifically, we used historic estimates of salmon spawnable area and Monte Carlo simulations to determine the range of salmonid spawning habitat capacity for Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), and coho salmon (*Oncorhynchus kisutch*) in several tributaries of the Columbia River basin. Preliminary analysis for two river basins indicates that historic spawning capacity estimates for each salmonid species range from 70,000 to over 5 million potential spawners depending upon watershed, species, and spawning behavior assumptions. This method can be used for historic and current estimates in other Pacific Northwest watersheds to help identify potential spawning capacity for salmonids, a key component in restoration planning.

Student Presenter?: No

Presentation Type: Oral presentation only

Presentation Type: Oral

Session Name: Contributed

Presentation Title: The use of PIT and acoustic tags to estimate migration mortality of Okanagan sockeye in 2010

Presenter Name: Jeffrey K. Fryer, Columbia River Inter-Tribal Fish Commission, 729 NE Oregon Street, Portland, OR 97232, 503-731-1266, fryj@critfc.org

Other authors:

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Skyeler Folks, Okanagan Nation Alliance, 3255-C Shannon Lake Road, Westbank, BC, 1V4 1V4. 250-707-0095, sfolks@syilx.org.

Abstract: Okanagan sockeye salmon migrate 986 km from the ocean to their Canadian spawning grounds, passing nine Columbia River dams, one Okanagan River dam and a series of control structures. To estimate mortality on this migration, we PIT tagged 838 adult sockeye at Bonneville Dam and acoustic tagged 50 sockeye at Wells Dam and deployed acoustic receivers in the Okanagan Basin. Survival from Bonneville to Wells dam of Okanagan sockeye salmon was 78%, while acoustic tags suggested a 50% survival from Wells Dam to Zosel Dam and 42% survival to Osoyoos Lake. An expanded acoustic tagging program is planned for 2010.

Student Presentation: No
Presentation Type: Oral

Contributed

Ocean Energy Technology Overview

Larry Armbruster

Ocean energy device developers worldwide are developing ingenious devices to harness energy form the world's ocean and rivers. There are over 150 active developers of wave, tidal and ocean thermal technologies in various stages of development from concepts to grid connected systems. The industry is striving to learn how to integrate the need for green energy alternatives in an environmentally acceptable way. The presentation will identify the technology development process and how it interacts with fish, birds and marine mammals during various test events. This presentation will summarize the technologies and address some of the environmental concerns of each, highlighting some of the possible conflicting objectives of developers and environmental stakeholders.

Session Name: Contributed

Presentation Title: The effects of elevated water temperature on adult pink salmon survival and blood physiology.
Presenter Name: Ken M. Jeffries

All Authors, affiliations, phone number, email:

Ken M. Jeffries[1], Scott G. Hinch[1], Eduardo G. Martins[1], S. Matthew Drenner[1], Charlotte K. Whitney[1], Kristi M. Miller[2]

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Abstract:

Peak summer temperatures in the Fraser River, B.C., have increased ~2ºC in the past 60 years and are expected to increase another 2ºC by the end of the century. Historically, pink salmon (*Oncorhynchus gorbuscha*) experienced ~11.5-16.5ºC water temperatures during spawning migrations. In recent years, they have encountered river temperatures greater than 18ºC more frequently. Elevated river water temperatures have been associated with higher *en route* and prespawn mortality in Pacific salmon. We collected wild Lower Fraser pink salmon and exposed them to different temperature treatments in a controlled laboratory environment to evaluate the effect of water temperature on survival and blood physiology. We found higher mortality (98%) in the 19ºC treatments in both males and females when compared to the 13ºC treatments (45-80% mortality). The duration of the temperature treatment, 5 or 10 days, only influenced survival in the 13ºC treatment. Fish were live sampled before and during the temperature exposure period to evaluate how water temperature affects blood variables. The results will be contrasted with a previous temperature holding study conducted on Harrison sockeye that used similar temperature treatments. These results will provide insight into the potential consequences of elevated water temperatures on Pacific salmon survival during spawning migrations.

Student Presenter? Yes

Presentation Type: Oral presentation preferred, but poster presentation acceptable.

Tsolum River: Limiting Factors to Pink Salmon Production

Pink salmon production in the Tsolum River has declined from an historical high of 100,000 pink salmon adults returning per year in 1935 and 1936 to a record low of ten pink salmon returning to spawn in 1984.

Historical escapement data shows that stocks declined sharply in 1957 and that despite enhancement efforts there has been limited recovery of odd year stocks and no recovery of even year stocks.

In the summer of 2009 a geotextile cover was placed over the abandoned Mount Washington Copper mine site. Assuming that this barrier reduces the concentration of dissolved copper to below .007 mg/L as prescribed by Provincial Water Quality Objectives for Tsolum River, restoration efforts can focus on other factors limiting salmon production.

These factors include access to tributaries and thermal refuges, restoring the balance of even and odd year pink salmon productivity and restoring degraded instream and estuary habitat to reach historic levels of health and productivity.

Prediction of Stream Carrying Capacity for Spring Chinook Salmon: the Unit Characteristic Method

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We describe and demonstrate the Unit Characteristic Method (UCM) as a means by which measurements of habitat from typical stream surveys can be used to estimate the capacity of a stream to rear juvenile spring Chinook salmon (*Oncorhynchus tshawytscha*). Channel unit features of importance include surface area by unit type, width, and depth. We tested the fit of model predictions to juvenile steelhead production observed in the Coldwater River, British Columbia. Comparisons are made to observations made in 22 streams in Idaho, the Wenatchee River in Washington, the Tucannon River in Washington, and streams in the Grand Ronde Basin in Oregon. We also demonstrate application of the model in designated critical habitat in the Willamette River Basin in Oregon. The UCM predictions revealed that parr capacity was unevenly distributed among the watersheds and that habitat quality (parr capacity/m_2) differed between reaches. Thus, the UCM provides a framework for understanding the habitat features that determine the production potential of a basin, for identifying factors that limit production, spatial distribution of habitat use within a basin, and for predicting potential fish benefits from differing habitat management strategies.

Session Name: Future directions

Presentation Title: **Searching for SNPs: Mining the sockeye salmon, *Oncorhynchus nerka,* transcriptome for high-resolution molecular markers**

Presenter: Caroline Storer

Authors: Caroline Storer, University of Washington, 206-221-0978, cgs5@uw.edu
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Abstract: Advances in molecular techniques and decreasing technology costs have enabled a growing use of molecular markers for the study of non-model organisms. Recently, single nucleotide polymorphisms (SNPs) have begun to replace microsatellites as the molecular marker workhorse of population genetics. SNPs provide varying degrees of resolution across a range of temporal and spatial scales. In order to effectively use SNPs for fisheries population genetics there is a need for novel SNPs with high-resolution, and temporal and spatial stability. Here we describe the use of next generation transcriptome sequence data and high resolution melting techniques to discover and develop new SNP assays for sockeye salmon that are spatially and temporally stable. Over seventy new SNP markers have been developed using these techniques thus far. These new SNPs will be used in addition to existing SNP markers by the Alaska Department of Fish and Game (ADF&G) to assemble a 96 SNP pseudo-multiplex chip for high-throughput standardized stock assessment. The 96 SNP suite will help improve stock identification and the current DNA baseline used for stock mixture assignment. This SNP discovery work flow can be adopted for the development of SNP markers for many non-model organisms.

Student Presentation: Yes

Presentation Type: 1. Oral presentation only

Session Name: Lamprey ecology and life history

Presentation Title: **Lessons from 830 kilometers upstream: Solutions for Pacific lamprey in a biotelemetry and salmon-oriented world.**

Presenter Name: Joshua G. Murauskas, Public Utility District No. 1 of Douglas County, 1151 Valley Mall Parkway, East Wenatchee, WA 98802. Phone (509) 881-2323; Email joshm@dcpud.org

Pacific lamprey (*Entosphenus tridentatus*) is a primitive anadromous fish found in the Columbia River Basin. The number of adult lampreys observed annually passing Bonneville Dam (river km 228) quadrupled in the early 2000s, and then declined over 90% through the following six years to a record low in 2009. Since most of the Pacific lamprey life cycle (e.g., juvenile and early adult stages) has yet to be detailed, managers have focused on the adult migration and upstream passage in an attempt to identify causes of the recent population decline. The prevailing technology used for assessing fish behavior – biotelemetry – has significant limitations in lamprey research, particularly at upstream locations where fish have exhausted energetic reserves and are approaching the overwintering period. The few lampreys available for research and simultaneous migration of ESA-listed salmon further complicate management efforts. Our research demonstrates how innovative strategies are able to overcome these challenges to (1) create environments more conducive to lamprey passage without negatively affecting salmon; and (2) passively examine lamprey behavior to avoid invasive surgical procedures. To our knowledge, this study is the first of its kind, and is symbolic of the need for coordination between lamprey and salmon managers in the Pacific Northwest.

Student Presenter? No.

Presentation Type: Oral presentation only.

Session Name: Contributed

Presentation Title: Use of video technology to assess smolt migration at Bonneville Dam

Presenter Name: Jeffrey K. Fryer, Columbia River Inter-Tribal Fish Commission, 729 NE Oregon Street, Portland, OR 97232, 503-731-1266, fryj@critfc.org

Abstract: Large numbers of juvenile salmon are handled annually at several Columbia Basin dams, including Bonneville Dam, to estimate salmonid passage indices and condition. In 2007, we initiated a project to see if video technology can be used to reduce handling and, in 2009, deployed a video system at the Bonneville Dam juvenile bypass. This system used a high speed camera to capture video to both a digital video recorder as well as a computer running software designed for capturing video of adult passage. Late deployment and lighting problems resulted in little useable video in 2009, but suggested a number of changes to be implemented in 2010.

Student Presenter: No

Presentation Type: Oral

Session Name:
Contributed

Presentation Title:
Fisheries programs at the Cushman Hydroelectric Project

Presenter Name:
Chris Sergeant

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Abstract (200 words max):
The Cushman Hydroelectric Project on the North Fork Skokomish River near Hoodsport, Washington, consists of two dams that were built in 1926 and 1930. The Project was due for relicensing in 1974, but became mired in a licensing process that lasted until a January 2009 settlement agreement between Tacoma Public Utilities, Skokomish Indian Tribe, and state and federal natural resource agencies. The agreement, which is still under review by the Federal Energy Regulatory Commission before license issuance, includes many environmental mitigation components. Fisheries requirements include provisions for fish passage, resident and anadromous fish supplementation, habitat and population monitoring, habitat enhancement, and flow regime adjustments. Tacoma Public Utilities, in collaboration with the Skokomish Tribe and natural resource agencies, has begun the early stages of research, monitoring, and construction of new facilities. This presentation is an overview of what fisheries work has happened recently, and what will be happening in the future.

Student Presenter: No

Presentation Type: Oral presentation only

Session Name: Plankton

Presentation Title: One-year record of variability in diel vertical migration from the VENUS observatory in Saanich Inlet

Presenter Name: Mei Sato (office: 250-721-6079, e-mail: meisato@uvic.ca)

All authors, affiliations: Mei Sato, John Dower, Eric Kunze, Richard Dewey
School of Earth and Ocean Sciences, University of Victoria

Abstract
Euphausiids play a key role in coastal British Columbia food webs as leading prey items for Pacific hake, spiny dogfish, Pacific herring and Pacific salmon. Diel vertical migration (DVM) by euphausiids also connects deep water and pelagic communities through bidirectional transfer of organic matter and excreted inorganic nutrients. Here we explore a one-year continuous record of euphausiid DVM from a 200-kHz echosounder that is part of the VENUS observatory in Saanich Inlet. The continuous record allows us to examine both diurnal and seasonal variability in the timing of DVM, the effect of insolation on deep scattering layers, and vertical migration speed. The timing of DVM corresponds to sunrise and sunset regardless of variations in insolation. Instead, insolation seems to control the depth of deep scattering layer during daytime. The upward migration speed of the scattering layer shows some seasonal pattern, with values of 1.6 – 3.5 cm s^{-1} in fall – winter and a minimum of 0.9 cm s^{-1} in May. This seasonal pattern appears to correspond, at least in part, to the life cycle of *Euphausia pacifica*. Understanding variability of migration patterns is an important prerequisite to quantify the effect of spatially and temporally varying euphausiid migrations on benthic-pelagic coupling.

Student presenter?: Yes

Presentation type: Oral presentation

Session: Contributed

Estimating species and size composition of rockfish in acoustic surveys of untrawlable areas using an ROV, stereo video and bottom trawls

Chris Rooper (AFSC; chris.rooper@noaa.gov), Tom Weber (UNH-CCOM; weber@ccom.unh.edu), John Butler (SWFSC; john.butler@noaa.gov), Chris Wilson (AFSC; chris.wilson@noaa.gov), Michael Martin (AFSC; michael.martin@noaa.gov), Mark Zimmermann (AFSC; mark.zimmermann@noaa.gov), Mark Wilkins (AFSC; mark.wilkins@noaa.gov).

Rockfish are difficult to assess using standard bottom trawl surveys due to their propensity to aggregate in rocky high relief areas. We evaluated the ability of an ROV, a modified bottom trawl, and a stereo drop camera system (SDC) to discriminate rockfish species composition and estimate the size of rockfish targets during acoustic surveys of untrawlable habitats. The ROV, bottom trawl and SDC were deployed at 21 sites where fish sign was observed during acoustic surveys of the “Snakehead” area of the Gulf of Alaska. The results indicate that the species observed in the water column were dusky rockfish, northern rockfish, and adult Pacific ocean perch (POP). The fish observed in highest abundance near the seafloor were harlequin rockfish, juvenile POP, redstripe rockfish and lingcod. All rockfish species were observed in untrawlable habitats, but generally only POP, dusky rockfish and northern rockfish were observed in trawlable habitats. The diversity of species identified was highest by the ROV and lowest with the SDC. However, the fish length distributions were similar among all three methods. The results suggest that selection of the appropriate method for groundtruthing depends on the specific objectives, habitat types and species complexes that will be examined.

Session:
Recovery of Depleted Species: Tools and Targets

Title:
Harvest control rules for Pacific herring management: business as usual or in need of repair?

Presenter:
Jaclyn Cleary

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Abstract
Despite consistent application of a harvest control rule (HCR) since 1986, abundance of three of the five major Pacific herring (*Clupea pallasi*) stocks in Canada are currently below levels considered adequate for exploitation. Commercial fisheries have been closed on two of these stocks in 7 of the past 10 years as abundances are below commercial fishing thresholds defined at $0.25B_0$. An alternative harvest control rule (HCR) was proposed by Canada's precautionary fisheries management policy, which includes default limit (LRP) and upper stock reference (USR) points at $0.4B_{MSY}$ and $0.8B_{MSY}$. We developed a closed-loop simulation of the existing Pacific herring fishery management system to compare performance of the current HCR to that proposed by the new policy in achieving conservation objectives including the ability to rebuild stocks to sustainable levels. Specifically, our simulations examine whether (a) realized fishery performance over the past 10 years should be expected, using the existing herring HCR and (b) if performance could be improved by adopting a HCR based on alternate limit reference points. Both candidate HCRs were successful at rebuilding stocks to sustainable levels under assumptions of high stock productivity, however, both rules performed poorly when stock productivity was low. When evaluated against conservation objectives, we found the existing herring HCR to be slightly more

precautionary than the default DFO rule. However, future research should explore whether the narrow fixed width of the “recovery window” of the herring HCR impacts the responsiveness of the rule to changes in productivity regimes.

Session Name (if known, otherwise "contributed"): Biology, Management and Recovery of Pacific Sturgeon

Presentation Title: Recovery strategy for white sturgeon (*Acipenser transmontanus*) in BC

Presenter Name: Louise Porto and Tola Coopper

All Authors, affiliations, phone number, email:

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Fisheries & Oceans Canada, 604-666-9909, Tola.Coopper@dfo-mpo.gc.ca

Abstract: Within Canada, white sturgeon occur only in British Columbia and are divided into six populations, based on geography and genetics: the lower, middle and upper Fraser River; Nechako River; Columbia River; and, Kootenay River. All populations were listed as endangered by COSEWIC, but only the latter four are legally listed under SARA. A SARA-compliant recovery strategy has been produced by the National Technical Coordinating Committee (NTCC) for the four SARA-listed populations, which also includes recovery and management recommendations for the lower and middle Fraser River populations. The primary human activities that threaten white sturgeon in the wild are direct habitat loss, river regulation, harvest of prey/food, introduction of invasive non-native fish species, direct and indirect harvest, release of pollutants, and floodplain development. Primary threats to white sturgeon that occurred historically and initiated population declines due to recruitment failure and ongoing threats that may continue to cause population declines are included in the recovery strategy. Activities and threats that are likely to destroy critical habitat are also provided. This paper will provide an overview of the recovery of SARA-listed white sturgeon populations in BC as well as the main challenges for recovering the species as a whole.

Student Presenter? (Work being reported was completed while a student): No

Presentation Type:

1. Oral presentation only,

Session Name (if known, otherwise "contributed"): Biology, Management and Recovery of Pacific Sturgeon

Presentation Title: Recovery efforts for white sturgeon *Acipenser transmontanus* in the upper Columbia River, Washington.

Presenter Name: Jason McLellan

All Authors, affiliations, phone number, email:

Jason McLellan, Washington Department of Fish and Wildlife, 509-892-100, jason.mclellan@dfw.wa.gov

Matthew Howell, Washington Department of Fish and Wildlife, 509-892-100, matthew.howell@dfw.wa.gov

Abstract: Various studies conducted in the Transboundary Reach of the Columbia River (Grand Coulee Dam in the U.S. to Keenleyside Dam in Canada) since 1990 have shown that natural recruitment of white sturgeon is absent in most years. In response to increasing concerns over the threat of extinction, the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI), an international organization with members from state, provincial, and federal fisheries agencies and First Nations tribes in British Columbia and Washington State, was formed in 2000. The UCWSRI produced an Upper Columbia White Sturgeon Recovery Plan (UCWSRP) that outlined various goals, objectives, strategies, and actions deemed necessary for recovery. The Lake Roosevelt White Sturgeon Recovery Project was initiated in 2003 to implement the strategies outlined in the UCWSRP. Strategies included implementation of a conservation aquaculture program, evaluating and monitoring population status, controlling mortality, determining genetic stock structure, and a course of research related to recruitment failure. An overview of the specific recovery strategies implemented in Washington State under the Lake Roosevelt Sturgeon Recovery Project will be presented.

Student Presenter? (Work being reported was completed while a student): No

Presentation Type:

1. Oral presentation only,

Title: The effect of temperature and dissolved oxygen on the vertical distribution of kokanee and cutthroat trout in Lake Sammamish, Washington.

Authors:
Hans B. Berge*****, Hans.Berge@metrokc.gov
King County Department of Natural Resources and Parks

David A. Beauchamp, Daveb@u.washington.edu
University of Washington School of Fisheries and Aquatic Sciences
Washington Cooperative Fish and Wildlife Research Unit
USGS Biological Resources Division

presenter

Abstract:

Movement and distribution of fishes are strongly influenced by environmental conditions, ecological constraints, and physical habitat characteristics. We examined the seasonal and diel distribution of salmonids in response to changing dissolved oxygen and temperature profiles in Lake Sammamish, Washington by combining concurrent limnological measurements with gill netting and hydroacoustic surveys. Rapid warming of the surface waters caused the lake to stratify in July. Stratification intensified through summer and fall with increasing temperatures in a deepening epilimnion. As the summer progressed, low hypolimnetic dissolved oxygen encroached into the metalimnion, creating a temperature-dissolved oxygen squeeze that reduced the amount of favorable (<17{degree sign} C and > 4 mg/L) habitat available for salmonids by as much as 90%. The dominant salmonids in Lake Sammamish, kokanee Oncorhynchus nerka and cutthroat trout O. clarki, responded to these limnological changes by moving to the metalimnion which segregated them from the high epilimnetic densities of Daphnia during peak stratification in August-September. As thermal stratification relaxed in November, salmonids redistributed throughout the water column. Non-salmonids did not experience the same thermal constraints in their vertical distribution and are better suited to current and expected future climatic conditions including an increase in the duration of thermal stratification in Lake Sammamish.

Session Name: Salmon Out-migration Monitoring.
Presentation Title: Fish use in nearshore marine and estuarine habitats of a large transboundary river system.
Presenter Name: Kercia Schroeder
All Authors, affiliations, phone number, email: Kercia Schroeder, Alaska Dept. of Fish and Game, 907-465-8546, kercia.schroeder@alaska.gov; Jeff Nichols, Alaska Dept. of Fish and Game, 907-465-8576, jeff.nichols@alaska.gov; Kathy Smikrud, Alaska Dept. of Fish and Game, 907-465-8253, kathy.smikrud@alaska.gov; and Patricia Hansen, Alaska Dept. of Fish and Game, 907-267-2441, pat.hansen@alaska.gov.
Abstract: Nearshore marine and estuarine waters provide important habitats and critical ecological functions for many anadromous and forage fish species. Currently, only limited information exists on fish use in these habitats in Southeast Alaska. In 2008 and 2009, we conducted field work to assess spatial and temporal fish habitat use patterns in nearshore areas of the Taku River estuary and associated Taku Inlet. The Taku River is a large, glacial mainland river system that is one of the largest producers of all five species of Pacific salmon in Southeast Alaska. Fish and habitat parameters were sampled monthly at high and low tides. A variety of fish sampling gear was used to sample the diverse and challenging nearshore habitats in the study area. Over the two field seasons, a total of 129 locations were sampled and 2,525 salmon were captured. In addition to our field data collection, a remotely-sensed habitat classification is being developed for the study area using high-resolution digital aerial imagery collected in-house. Specific objectives for this project are still being addressed; however, results from this project will ultimately provide base-line data to managers, which will assist them in making informed resource management decisions for these important habitats.
Student Presenter: No.
Presentation Type: 2. Poster presentation only.

Abstract – 2010 WA-BC Chapter of AFS Annual General Meeting

Session: Contributed

Presentation Title: Ecological History of Rockfish Exploitation in Puget Sound

Presenter Name: Gregory D. Williams

All Authors, affiliations, phone number, email: G. D. Williams, PSMFC / NOAA Fisheries, Tel. 206 861 7604; greg.williams@noaa.gov; P. S. Levin, NOAA Fisheries, Tel. 206 860-3473; phil.levin@noaa.gov ; W. A. Palsson, Washington Department of Fish and Game, Tel. 425 379 2313; palsswap@dfw.wa.gov

Abstract: Rockfish (*Sebastes* spp.) have significantly declined in abundance in Puget Sound, WA (USA), with multiple petitions to list individual species under the Endangered Species Act. We reviewed the history of rockfish exploitation in Puget Sound in order to better understand the ecological legacy of fishing to this degraded ecosystem. Over time, rockfish exploitation patterns have changed from an opportunistic subsistence activity by indigenous peoples to a year-round commercial and recreational target. These harvests together peaked (almost 400 mt) in the early 1980s as anglers' attitudes changed, gear technology improved, rockfish became more familiar to the market, and agency programs promoted fisheries to sustain employment. Rockfishes were generally not managed intensely or with conservation goals in mind until the late 1980s, in part due to scientific shortcomings and lack of resources. By the time management actions were deemed necessary, the greatest harvest had already occurred. The low intrinsic productivity of most rockfish species suggests that the legacy of fishing will remain for years to come. As managers strive to restore the integrity and resilience of Puget Sound, they must realize the significance of historical fishery removals to the ecosystem while using the proper social and economic incentives to motivate conservation.

Student Presenter: No

Presentation Type:

1. Oral presentation preferred, but poster presentation acceptable.

Session: Poster – Habitat Restoration

Title: **The Influence of Re-Establishing Upstream Large Woody Material Transport Processes in the Green River, Washington**

Presenter: Tyler H. Patterson

Author, affiliation, phone number, and email:

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Abstract:

The Green River flows from the Cascade Mountains entering Puget Sound in Seattle's Elliott Bay. It sustains six anadromous salmonid species including ESA-listed Puget Sound Chinook salmon and steelhead. Army Corps of Engineers (USACE) construction of Howard Hanson Dam (HHD) at river mile 64 on the Green River in 1962 prevented upper Green River large woody material (LWM) from reaching the middle and lower river salmon populations. Permitting documents for Tacoma Water's Green River Habitat Conservation Plan (HCP) and the USACE HHD Additional Water Storage Project (AWSP) stipulated at least 50% of LWM entering the HHD pool be transported to the middle Green River to re-establish channel and habitat forming processes afforded by delivery of LWM from upstream sources. Delivery of loose wood to the middle Green River was an untested and experimental process. Thus a research requirement was developed to monitor LWM levels in the middle Green River over the first fifteen years, following AWSP implementation, to evaluate resulting distribution and architecture of transported LWM. Data collected from this project will be used to guide future HCP/AWSP wood management efforts. A comparative analysis from the first five years of post project implementation monitoring, relative to baseline conditions, is presented.

Presentation Type: Poster presentation

Session Name: “Contributed”
Presentation Title: Production, survival, and life history diversity of juvenile Chinook in the Skagit River, Washington
Presenter Name: Mara Zimmerman
Authors:
Mara Zimmerman, Wash. Dept. Fish & Wildlife, mara.zimmerman@dfw.wa.gov, 360-902-2779
Clayton Kinsel, Wash. Dept. Fish & Wildlife, clayton.kinsel@dfw.wa.gov, 360-902-2669
Eric Beamer, Skagit River Systems Cooperative, ebeamer@skagitcoop.org
Abstract: Recovery of Puget Sound Chinook will be evaluated based on four criteria that include abundance, productivity, diversity, and distribution. This paper focuses on variables limiting abundance and survival (juvenile productivity) of two life history strategies exhibited by subyearling Chinook outmigrants. A 15-year data set of spawner and juvenile abundance in the Skagit River (Washington) is used to evaluate the variables that best explain inter-annual variation in survival. Freshwater production and egg-to-migrant survival of Skagit River Chinook has varied 13-fold between 1994 and 2009. Production is impacted by a number of interacting variables including spawner abundance and incubation flows. Abundance of an early migration of small, fry migrants is a density-dependent function of total outmigrant abundance whereas abundance of later migration of large, parr migrants is relatively consistent among years. These results demonstrate that a freshwater carrying capacity for Chinook salmon exists in the Skagit River. Density-dependent migration from the river indicates the importance of the downstream estuary as further rearing habitat for this species.
Student Presenter: No
Presentation Type: Oral presentation only

Session Title: "Technical Innovations for Fisheries Field Work" or other session as deemed appropriate by the organizers

Presentation Title: "**NEW TECHNOLOGY DEVELOPMENTS FOR UNDERSTANDING SPATIAL AND TEMPORAL ACTIVITY PATTERNS OF FISH IN NATURE"**

Presenter Name: Denise King, P. Eng., Director of Market Development Vemco

Contributing Authors: Dale Webber[1], Denise King[2], Richard Vallee[3]

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Measurements of fish movements, activity, and energetics in nature, have always been
technologically challenging. In many species around the world detailed movement and activity information is urgently required for a variety of reasons. Issues related to fishing pressure, habitat degradation, pollutants, and responses to environmental change are just a few of the many applications that require knowledge of the temporal and spatial movement and activity patterns of fish.

Here we describe the development and implementation of a new multi-array positioning system (VPS – VR2W Positioning System) and a new activity acoustic transmitter (V9AP) that can be used in a variety of biological applications to study the behavior of fish in nature. VPS is more suited to a larger variety of applications compared to existing positioning systems that are constrained by cost and equipment deployment limitations (i.e., wire connecting hydrophones). A VPS study can be as small as 1 triangle covering 2500 m^2 or less (3 receivers) and up to tens of $kilometers^2$ and greater. To date VPS has been successfully used in small and large area studies in lakes, rivers and ocean environments.

In this presentation we will discuss the design and specifications of VPS, the factors that influence positioning accuracy and we will show examples of various VPS study designs. We will also illustrate how to use an accelerometer transmitter to get the most of your VPS study.

Oral Presentation Only

Session Name: Contributed

Presentation Title: Survey of Sonar Applications for Population and Habitat Assessment

Presenter Name: Drew Hubbard

All Authors:
Drew Hubbard, Sound Metrics, 206-364-1441 ext. 304, drew@soundmetrics.com
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Many researchers provided slides and are attributed in the presentation

Abstract:
A new family of sonars (acoustic cameras) help count escapement in large runs to manage commercial and sports fisheries and in small runs to assess success in population viability projects. These sonars also allow observation and validation of fish behavior around natural and man-made structures, and determine the quality of the habitat in turbid water where optical systems fail. This presentation is a composite of slides provided from an international cast of researchers in organizations including Alaska Department of Fish and Game, NOAA, Fisheries and Oceans Canada, U.S. Fish and Wildlife Service, Pacific Salmon Commission, Nez Perce Tribe, Columbia River Inter-Tribal Fish Commission, and The Marine Institute in Ireland. The presentation ends with highlights of current research for better auto-counting, auto-sizing, and species identification.

Student Presenter? No

Presentation Type: Oral presentation only

Use of different Skagit Bay eelgrass habitats by juvenile Chinook salmon, herring, and smelt

Mike Hayes1, Steve Rubin[1], Eric Grossman[2], Reg Reisenbichler[1], Theresa Liedtke[3], Collin Smith[3], Karl Stenberg[1], Lisa Wetzel[1]. [1]U.S. Geological Survey, Western Fisheries Research Center, 6505 NE 65th Street, Seattle, WA 9811; [2]U.S. Geological Survey, Pacific Science Center, 400 Natural Bridges Drive, Santa Cruz, CA 95060; [3]U.S. Geological Survey, Columbia River Research Laboratory, 5501-A Cook-Underwood Road, Cook, WA 98605.

Abstract: Eelgrass (*Zostera marina*) habitats along the outer edge of the Skagit River delta may have been affected by altered flow and sediment transport caused by diking and channelization. The delta margin supports four eelgrass beds that differ in degree of fragmentation or underlying sediment: (1) a “Mud” bed of continuous eelgrass underlain by fine sediment; (2) a “Fragmented” bed directly offshore from the highly channelized North; (3) a “Continuous” bed between the North and South forks and (4) a “Patchwork” bed of eelgrass, offshore from the South Fork. We used a lampara net to sample each area from April to September in 2008 and 2009. In addition, in 2009 we sampled nearby areas without eelgrass. Forage fish (smelt, herring, sandlance) as well as juvenile Chinook salmon, were commonly caught. Catch was highest in the Mud bed and lowest in the Continuous bed but not consistently different between areas with and without eelgrass. Herring catch was $\geq$3x greater in the Mud bed than in other beds and was also $\geq$2x greater in eelgrass than in areas without eelgrass. Differences in fish use between the Mud bed and the other beds may have been related to co-occurring differences in salinity (higher in the Mud bed), temperature (lower), and benthic invertebrate community composition (different). Our ultimate goal is to link management of the lower river to impacts on fish through effects on downstream habitats, including eelgrass.

Temporal and Spatial Patterns of Estuary Occupation by Green Sturgeon in Washington.

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The southern distinct population segment (DPS) of green sturgeon (*Acipenser medirostris*) is considered threatened under the Endangered Species Act, and the northern DPS is a Species of Concern. Green sturgeon exhibit extensive summer aggregations in Washington estuaries, indicating that these are important sturgeon habitats. We used acoustic telemetry to document occurrence of green sturgeon in Willapa Bay and Columbia River estuaries in 2005 through 2008. Over 200 green sturgeon bearing uniquely-coded transmitters were detected, with some fish visiting both estuaries. The fish tended to occupy middle estuary sites in June and July, moving into more interior sites and tidal creeks in August and September. This pattern is likely linked to abiotic conditions, prey availability, and/or predation risk. While we can only speculate about the causal mechanisms for green sturgeon movements, our results have important implications for designation of critical habitat and management of activities that affect estuary function.

Long distance migration and evidence for annual homing in English sole (*Parophrys vetulus*): these flatfish are not so flat.

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English sole are used as a sentinel species for contaminant studies in Puget Sound because they are abundant, easily sampled, and broadly distributed in benthic habitats of this area in the northwestern United States. These small flatfish exhibit relatively sedentary behavior during summer feeding periods, but their movements and habitat use during the rest of the year are largely unknown. Thus, sole tissue contaminant loads may not necessarily reflect contaminant exposure from the capture site alone. We used acoustic telemetry to test this idea. In August 2007 we collected adult English sole from Eagle Harbor, a small, contaminated embayment of Puget Sound, and surgically implanted uniquely-coded acoustic transmitters in 19 adult fish (> 27 cm). To document sole movements, we operated an array of eight submersible receivers inside and near the entrance to Eagle Harbor. In addition, we obtained detection data from over 200 other receivers maintained throughout Puget Sound by a consortium of regional researchers. All of the tagged fish were detected on our receiver array immediately after release, and 16 were detected outside of Eagle Harbor at a variety of locations in Puget Sound. Some of these fish made dramatic movements across the Sound and traveled minimum distances of 32 – 106 km. Half of the fish that were detected outside Eagle Harbor returned to their capture site in the spring of 2008. These data elucidated surprisingly extensive and rapid movements by these relatively small flatfish and a strong seasonal fidelity to summer capture locations. Consequently, the exposure of English sole to sediments outside their capture area may be much greater than previously thought. In addition, these results illustrate the tremendous value of pooling resources to maintain large arrays of acoustic receivers and the power of data sharing.

SIZING A HATCHERY COHO PROGRAM USING HSRG RECOMMENDATIONS

by

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The future lower Cowlitz River hatchery coho program was sized to comply with biological criteria recommendations from the Hatchery Scientific Review Group (HSRG) – an expert panel of independent scientists convened to study salmonid populations in Puget Sound, Coastal Washington and the Columbia River basin. Results from two years of field investigations demonstrates high fidelity to the hatchery at river mile 50.0, and low rates of straying into lower river tributaries. The proportion of hatchery-origin fish on the spawning grounds is <5%, exceeding the pHOS criteria for this natural-origin population as recommended by the HSRG. By maintaining a high natural-origin to hatchery-origin (NOR:HOR) ratio on the spawning grounds, model runs using the All-H Analyzer (AHA) demonstrate that a segregated hatchery program of 1,000,000 smolts is consistent with natural-origin population recovery goals. If innovative rearing practices are successful in the renovated hatchery, the hatchery-origin population may be able to achieve smolt-to-adult survival rates on par with natural-origin coho populations in the Cowlitz River basin, and continue to support the long-term annual average of over 31,000 coho adult returns to the Cowlitz Salmon Hatchery.

Session Name: Technical Innovations for Fisheries Field Work

Presentation Title: **Smolt production assessment using passive integrated (PIT tag) in the Upper Capilano River and Reservoir**

Presenter Name: Jason Ladell

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Abstract: The Capilano River, a major source of drinking water for Vancouver, has been impounded since 1954. A federal hatchery transports coho salmon and steelhead trout for release upstream of the Cleveland Dam. In 2008, a study was initiated to explore the feasibility of capturing outmigrating coho and steelhead smolts in the reservoir and upper river for transport and release below the dam. A portion of these transported smolts have been marked with uniquely coded PIT tags for future evaluation of marine survival. Over two seasons, a total of 41,177 coho and 699 steelhead were captured and released in the lower river. In 2009, mark-recapture methods allowed us to develop production estimates for coho in the upper river and reservoir. We calculate that our operations moved approximately 37% of the coho smolt production that would have been exposed to high mortality moving over the Cleveland Dam. Our study suggests a cost effective way to capture, transport and enumerate salmonid smolts across an impoundment.

Student Presenter?: No

Presentation Type:
2. Poster presentation only

Do surgically-implanted radio transmitters alter the climbing ability of adult Pacific lamprey (*Lampetra tridentata*)?

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Adult Pacific lamprey have difficulty navigating fishways at large hydroelectric dams during their spawning migrations in the northwestern United States. However, the effects of smaller, low (< 2m) elevation structures on Pacific lamprey passage is unknown. We used radio telemetry to assess adult lamprey movements at low-head irrigation diversion dams. A key assumption of this study was that lamprey bearing radio transmitters were able to swim and climb normally. Pacific lamprey have the ability to climb vertically and we predicted that they would use this climbing behavior to ascend low elevation obstacles. We tested the effects of surgically-implanted radio transmitters on lamprey climbing performance in the laboratory. We observed tagged (n = 36) and untagged (control, n = 36) fish as they volitionally climbed a 1.4 m high vertical aluminum weir. There was no significant difference in climbing ability of tagged and control lampreys. Both groups exhibited similar numbers of attempted ascents, percentage of successful ascents, average ascent time, and climbing kinematics. These results help justify the use of surgically-implanted transmitters in our study, although caution should always be exercised when translating the results of experimental studies to field settings.

Heavy infections of *Anisakis simplex* (Nematoda: Anisakidae) larvae in the muscle of maturing chum salmon

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Abstract:

Heavy infections with 3rd-stage larvae of *Anisakis simplex* (sensu strico) were observed in the muscle of maturing chum salmon caught in the central Bering Sea (53-54ºN, 180º) and the Chitose River, Hokkaido, Japan. In adult chum salmon returning to the Chitose River, the abundance of *A. simplex* larvae was less than 20 parasites/fish in 2002 and before, while it increased rapidly since 2003, reaching to 167 parasites/fish in the 2006 fall run season. A heavy parasite infection was also observed in maturing chum salmon caught in the central Bering Sea in June 2006. The complex life cycle of *A. simplex* includes paratenic crustacean hosts and final cetacean hosts especially mink whale. The unusual mass infection of *A. simplex* may reflect changes in the North Pacific ecosystems. This is also a concern for human health, because *A. simplex* larvae occasionally cause gastric anisakiasis when humans consume the infected fish.

Presentation Type: Oral