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PROCEEDINGS OF THE 25TH NORTHEAST PACIFIC PINK AND CHUM SALMON WORKSHOP 2012

Centennial Hall, Juneau, AK

13-15 February 2012

Compiled by

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Preface

The Northeast Pacific Pink and Chum Salmon Workshop, first held in Juneau, Alaska in 1962, has been convened on a near biennial basis among three regions: Alaska; British Columbia, Canada; and Washington State. The purpose of these Workshops is to bring resource managers, researchers, and stakeholders together to review the status of pink and chum production in and around the northeast Pacific. The Workshops provide a forum to share issues and information relevant to pink and chum salmon resource management and help maintain resource sustainably for the mutual benefit of stakeholders, thus helping to promote healthy marine and terrestrial ecosystems.

On 13-15 February 2012, the 25th Northeast Pacific Pink and Chum Salmon Workshop was held at Centennial Hall in Juneau, Alaska. There were a total of 109 attendees at the Workshop. The major sponsors of this Workshop were the Alaska Fisheries Science Center's (AFSC), Auke Bay Laboratories and the Alaska Department of Fish and Game (ADFG). Other Workshop sponsors included: Douglas Island Pink & Chum, Inc. (DIPAC), the Pacific Salmon Commission (website: http://pinkandchum.psc.org/), and St. Hubert Research Group. The next Pink and Chum Salmon Workshop is scheduled to be held in the winter-spring of 2014, hosted by the Northwest Fisheries Science Center (NWFSC) in Seattle, Washington.

Session topics at the 25th Northeast Pacific Pink and Chum Salmon Workshop were as follows: Habitat Restoration Projects; Genetics; Fisheries Management Strategies, and Challenges; Conservation Biology, Stocks of Concern, and Endangered Species; Contributed Papers; Resource Stakeholder Perspectives; Salmon Forecasting and Modeling in Ecosystems; Freshwater and Marine Ecology; and Poster Presentations. There were also keynote, banquet, and wrap-up speakers.

The Workshop included 36 oral presentations and 18 poster presentations. Most presenters submitted short abstracts and these constitute the body of this report. Copies of oral presentations and posters (in PDF format) are currently available on the Pacific Salmon Commission (PSC) web site: http://pinkandchum.psc.org/Abstracts.html. The online posting on the PSC web site of all material presented in 2012 was a novel approach in the history of Northeast Pacific Pink and Chum Salmon Workshops but may not serve as a viable long-term record for the Proceedings. Consequently, this report serves as a permanent record of the Proceedings of the 25th Northeast Pink and Chum Workshop.

Abstracts presented in this report were submitted by Workshop participants for oral and poster presentations and do not necessarily represent the opinions of NOAA, NMFS. Only minor editorial corrections (punctuation and spelling) were made to these submissions. The authors of this report are grateful to the many contributors to this workshop who travelled from around the Pacific Rim.

Logo of the 25th Northeast Pacific Pink and Chum Salmon Workshop 2012

The Workshop chairs Joe Orsi, Emily Fergusson, and Steve Heinl would like to thank the Workshop Organizing Committee members: Andres Araujo – Department of Fisheries and Oceans Canada (DFO), Malika Brunette - ADF&G, Rick Focht – DIPAC, Jeff Guyon - NOAA/AFSC, Jeff Hard - NOAA/NWFSC, Sheila Jacobson - USDA Forest Service, Orlay Johnson - NOAA/NWFSC, Chris Kondzela- NOAA/AFSC, Megan McPhee – University of Alaska, Kathleen Neely - NOAA/NWFSC, Andy Piston - ADF&G, Steve Reifenstuhl – Northern Southeast Regional Aquaculture Association (NSRAA), Molly Sturdevant - NOAA/AFSC, and Marc Trudel- DFO. We appreciate the help of Kathleen Neely for the graphic design of the logo for the 25th Northeast Pacific Pink and Chum Salmon Workshop. We are grateful to the PSC for hosting our webpages on their website. Finally, we thank Liz Cote, Florence Johnson, Sarah Ballard, and Bekah Olson for their help with programs and registration.

Workshop Agenda

FISHERIES MANAGEMENT STRATEGIES AND CHALLENGES
Moderator: Andy Piston

ENHANCEMENT HISTORY, ECONOMICS, AND CHALLENGES
Moderator: Rick Focht

CONSERVATION BIOLOGY, STOCKS OF CONCERN, AND ENDANGERED SPECIES
Moderator: Jeff Hard

CONTRIBUTED PAPERS
Moderator: Steve Heinl

RESOURCE STAKEHOLDER PERSPECTIVES
Moderator: Steve Reifenstuhl

SALMON FORECASTING AND MODELING IN ECOSYSTEMS
Moderator: Andres Araujo

FRESHWATER AND MARINE ECOLOGY
Moderator: Molly Sturdevant

INVITED SPEAKERS

HABITAT RESTORATION PROJECTS

Climate change and the freshwater habitats of pink and chum salmon

Gordon H. Reeves, Richard T. Edwards, and David D'Amore

The freshwater habitats of pink and chum salmon throughout their distributional ranges are likely to be affected by climate change, with the specific impacts and their magnitude likely to vary widely. A major impact is expected to be elevated water temperatures and increased flows in the winter. The latter will result from the transition from snow to rain as temperatures rise. Elevated winter water temperatures will increase development rates of eggs and fry, resulting in smaller fry emerging earlier. These effects will likely be most pronounced in more northerly areas that are currently cold. Higher, more variable flows could increase scouring of developing eggs and displacement of newly emerged fry. The scour impacts will likely be exacerbated if the size of returning adults decreases as a result of decreased marine growth rates, which in turn result from elevated marine temperatures and increased acidification. Stream flows at the time of adult returns may also decline, which would potentially limit access to spawning areas. These effects could be compounded when low flows are accompanied by elevated water temperatures, which in the past have resulted in extensive fish kills in some areas such as in southeast Alaska. Rises in sea level will potentially decrease available spawning areas. The reduction in quantity and quality of current habitat could be offset if areas that are currently marginal or unsuitable become more productive as a result of climate change. Such changes are most likely to occur in the northern extent of the range of these species. The significance of the changes will also vary between the two species. The small size and fixed life-history of pink salmon will make them more vulnerable than chum salmon to these potential impacts.

Wood, water, and fish: Large wood restoration in the Harris River watershed 2005 to 2011

Bob Gubernick

Historically the Harris River watershed on Prince of Wales Island provided high-quality spawning and rearing habitat for coho, pink and chum salmon, steelhead and cutthroat trout, and Dolly Varden char. Between approximately 1956 through the mid-1970s, industrial logging along the riparian corridor and uplands of the Harris River accounted for approximately 25% of the watershed being harvested, including nearly half of the stream riparian area. During the next 45 years following harvest significant impacts to the channel and uplands occurred. Channel widening, loss of deep pool habitat, loss of channel complexity, loss of cover, canopy closure in the uplands, and increased susceptibility to landslide effects from the loss of large wood in the riparian zone and the channel.

These morphologic changes illustrate the importance of large old growth wood in Southeast Alaskan river systems and the role it plays for stream function and biotic health. Between 2005 and 2011 the USDA Forest Service Tongass National Forest conducted an aggressive large-scale watershed restoration comprising: The restoration 11 miles of productive salmonid mainstem and tributary stream, and enhanced access to an additional 9 miles of stream and 8 acres of ponds for coho salmon and steelhead trout through manipulation of natural passages; Storage or decommissioning 8 miles of road to improve hydrologic connectivity and road fill stabilization to reduce sediment delivery to streams; Thinning 350 acres of riparian habitat to restore stream riparian functions and accelerate the long-term recovery of in-stream habitat and stream processes; Thinning of 150 acres of upland young growth to re-establish understory vegetation and multi-storied forest structure for wildlife; and placement and construction of log jams and other wood structures consisting of more than 2,300 logs (old and young growth) with and without rootwads attached in the Harris River and its key tributaries to improve fish habitat.

Effectiveness monitoring displays the success of the in-stream projects through increases in fish production and improved physical habitat conditions. Based on screw trap results from Fubar Creek Phase I project monitoring, coho salmon smolt outmigrant numbers increased 147% and steelhead 185% from 2007 to 2009. Based on habitat capability estimates, the Harris River restoration effort will also provide a significant increase in coho salmon escapement. More importantly, the Harris River restoration provides for long-term stability in all fish stocks and the maintenance of important geomorphic processes integral to healthy channel function.

The "resurrection" of Resurrection Creek near Hope, Alaska

Brian Bair

In 2005 and 2006 the U.S. Forest Service initiated a large-scale watershed restoration project on Resurrection Creek, near Hope, Alaska. Beginning at the turn of the past century, placer mining operations had adversely affected stream function and fish habitat. Prior to restoration, the channel was deeply entrenched creating poor fish habitat, had little sinuosity or large woody debris, few pools and side channels, and was artificially straightened and confined limiting its interaction with the riparian and flood plain areas. To design the new channel, a previously undisturbed reach upstream of the recovery area was surveyed and used as a template. Using heavy construction equipment, the U. S. Forest Service constructed a new stream channel corridor that approximated the reference reach morphology. The results were an increase in the overall channel length from 1,097 m to 1,392 m, channel sinuosity from 1.1 to 1.3, average slope from 1.7% to 1.4%, the amount of pool habitat from 1% to 17%, run type habitat from 0% to 26%, and riffle area from 99% to 57%. The results in fish use were seen immediately with large increases in adult Chinook (*Oncorhynchus tshawytscha*), adult pink (*O. gorbuscha*), chum (*O. keta*), and coho salmon (*O. kisutch*). From 2005 to 2011 fish use and spawner abundance has continued on increasing trends.

The making of Marx Creek rehabilitation project

Jessica Davila

Marx Creek, located approximately 4 miles north of the town of Hyder, Alaska, is a groundwater-fed, artificial salmon-spawning stream that was constructed from an existing stream to enhance the habitat of larger than average summer chum salmon. Marx Creek was initially formed by natural upwelling groundwater after the Salmon River dike was constructed in 1972. Marx Creek was enhanced in 1974 as a drainage channel to allow construction of a series of flood control dikes. Marx Creek channel prior to construction activities in 1985 was suitable for only a small number of spawning chum salmon.

In 1985, 4,000 feet of the mile-long Marx Creek channel were reconstructed with the objective of producing more spawning habitat for chum salmon. Twelve redwood weir structures were installed in a series of stepped down reaches for grade control. Each weir was notched and allowed up- and downstream movement of fish. After reconstruction, chum salmon were transplanted into Marx Creek from Fish Creek by the ADF&G. The two creeks also provide habitat for pink salmon, Dolly Varden char, and a small run of fall coho salmon.

In 1989 the Marx Creek spawning channel was extended upstream for an additional 1,600 feet. Unfortunately, this extension was constructed in direct contact with a flood control dike. Due to the porosity of the dike, silty glacial water passed through the dike and entered Marx Creek. Chum salmon tend to avoid the spawning area adjacent to the dike, but they do spawn downstream of it. The possible reasons chum salmon do not use the area are due to the increase in fine sediment, subtle changes in groundwater temperature or subtle change in chemical composition, that is, greater Salmon River water influence closer to the dike.

In 2006, the Tongass National Forest, Ketchikan-Misty Fiord Ranger District began working to address the fine sediment issue. A groundwater study indicated ground water was sufficient to construct a second channel approximately 500 feet to the east of the 1989 channel. In 2008, construction of 1,500 feet of new groundwater spawning channel, rehabilitating 900 feet of established spawning channel and decommissioning of 1,200 feet of the original channel began. Construction of coho rearing habitat was also completed by deepening and adding large wood to the upper reach of Marx Creek. Wood was taken from the new channel construction location. This phase of Marx Creek work was completed in 2010.

GENETICS AND FISHERY BYCATCH

Earlier migration, reduced phenotypic variation, and genetic changes in Auke Creek salmon

David Tallmon, Ryan Kovach, John Joyce, and Tony Gharrett

Changes in the timing of important biological events such as migration influence the persistence and ecological interactions of wild populations. An important phenotypic trait in salmonids is migration timing because it influences individual fitness, population dynamics, and harvest management, and is likely to be sensitive to climate change. We used ~40 years of weir census data to investigate trends in migration timing and population dynamics of multiple salmonid species and life histories in Auke Creek, Alaska. Auke Creek temperatures have increased over the past few decades, and our modeling results suggest temperatures have influenced observed trends toward earlier migration and reduced phenotypic variation in migration timing of most species and life histories. Pink salmon show some of largest changes toward earlier migration and the late-run portion of the odd-year population has been lost. However, evidence is mixed for genetic changes associated with these phenotypic changes in pink salmon. An experimental, selectively neutral allozyme marker allele provides strong evidence of genetic changes over time, but this pattern is not evident in microsatellite markers linked to migration timing candidate genes. The odd-year Auke Creek pink salmon population has lost biocomplexity, but remains quite abundant. How salmonids will adjust and adapt as increasing temperatures continue to influence migration timing remains an open question that deserves management attention.

Genetic structure of Japanese pink salmon populations inferred from nucleotide sequence analysis of mitochondrial DNA

Shunpei Sato and Shigehiko Urawa

To estimate genetic structure of Japanese pink salmon populations (*Oncorhynchus gorbuscha*) in Hokkaido, we analyzed nucleotide sequence of about 600 bp in a variable portion of the 5’ end of the mitochondrial (mt) DNA control region. Even-year bloodline (n = 354) and odd-year bloodline (n = 426) pink salmon in nine river populations were examined. A total of 62 haplotypes were detected in the examined individuals. Among these haplotypes, 27 haplotypes were unique to the odd-year bloodline, while another 27 haplotypes were also unique to even-year bloodlines. The remaining eight haplotypes were common to both bloodlines. The haplotypes were grouped about six clades, and the distribution pattern of the six haplotype clades was different between odd-year and even-year bloodlines. The haplotype diversity of even-year populations was higher than that of odd-year populations, suggesting a greater genetic variation in the populations of even-year bloodline than those of odd-year bloodline. A neighbor-joining tree showed strong divergence between even-year and odd-year populations. ANOVA and pairwise FST values also demonstrated strong genetic differentiation between even-year and odd-year bloodlines, although there was no genetic differentiation among populations within the same year bloodline. These results suggest that strong genetic differentiation between even- and odd-year bloodlines may reflect the reproductive isolation of the bloodlines. On the other hand, no genetic differentiation among Japanese pink salmon populations within bloodline may relate to biological features of pink salmon; for example low rate of homing migration to a natal river and/or high straying rate among populations.

Advantages and limitations of genetic stock identification applied to pink salmon stocks

Andrea Araujo, John Candy, and Terry Beacham

Genetic stock identification (GSI) relies on comparing genetic variation among baseline populations to identify the stock composition of an unknown mixture. FST is a commonly used measure of genetic distance between populations and can be used to evaluate how well a particular baseline will be able to resolve stocks in mixtures. Lower FST values among pink salmon populations (*Oncorhynchus gorbuscha*), compared to other species that share the same geographic area, make correct identification of stocks in the mixture challenging. The number of loci used and the mathematical approach, either Bayesian (cBayes) or conditional maximum likelihood (ONCOR), could contribute to the accuracy of the mixed stock estimates. With the purpose of assessing the reliability of GSI estimates in pink salmon populations, we analyzed 46 pink salmon populations of southern British Columbia, the Fraser River, and Puget Sound with both 13 and 16 microsatellite loci. Using known mixtures, we demonstrated that the additional loci did not increase intra-regional accuracy but did increase inter-regional accuracy. Second, we simulated baselines (using the software platform Easypop) with average FST ranging from 0.0007 to 0.04 covering the domain of FST values found in the pink salmon baseline. The results suggested that the accuracy at the population level is subject to significant biases when the average FST among baseline populations is less than 0.02. In addition, ONCOR performs better than cBayes at low FST values (< 0.02), but there was no significant difference between the software platforms at larger genetic distances. This research can help improve GSI methods and defines their limitations, especially for salmonid populations with small genetic separation such as pink salmon.

Historical perspectives on hatcheries and population structure of chum salmon in Prince William Sound, Alaska

Chris Habicht, Jim Jasper, and Bill Templin

Hatcheries releasing chum salmon for ranching into Prince William Sound (PWS), Alaska, started in the 1970s and increased dramatically in the late 1980s. Currently, returning hatchery-produced chum salmon outnumber wild-produced fish by about 4 to 1 for a total return of 3.2 million hatchery-produced chum salmon. Some of these hatchery-originating fish were detected in wild chum salmon streams in recent years. One concern is that these strays may be homogenizing among-population genetic structure, a key ingredient to local adaptation and long-term persistence. During the 1990s, population structure among chum salmon populations in PWS was detected using allozyme data. We proposed to examine population structure among 4 populations distributed in PWS from archival scale samples taken before the hatchery program was established and from contemporary samples screened for 188 SNP loci. Preliminary results suggest that structure among chum salmon populations prior to the establishment of the hatchery program was similar in depth to that observed in other places of similar scale. This structure is still present in contemporary populations, however these populations are slowly becoming more similar to the hatchery population. Populations geographically closest to hatcheries have become more similar to the hatchery population than populations more distant from the hatcheries, a pattern that is consistent with hatchery straying observations.

POSTER PRESENTATIONS

Infestation of metacercaria on juvenile pink and chum salmon in Southeast Alaska

Elizabeth Cote, Emily Fergusson, and Joe Orsi

Environmental stressors, such as parasites, may affect condition or growth of seaward migrating juvenile salmon and their survival. Therefore gaining better understanding of potential negative effects caused by parasites is important. Metacercaria (a larval trematode) has been observed on the skin of juvenile salmon caught during the Southeast Coastal Monitoring project sampling in strait and coastal habitats in Southeast Alaska over the past 15 years. In the summer of 2011, a pilot study was started to quantify the degree of metacercaria infestations on the skin of pink and chum salmon caught in surface trawls. Infestation was categorized into four categories: none, low (n = 1-10 cysts), medium (n = 11-20 cysts), and high (n > 20 cysts). A total of 908 pink and 696 chum salmon were examined during this study. Overall, infestation rates were found to be 14% for pink and 25% for chum. Monthly infestation rates for June, July, and August were 8, 15, and 16% for pink and 1, 18, and 13% for chum, respectively. Condition residual was also examined for the different infestation rates. Fish are currently being processed for whole body energy content and stock identification (hatchery vs. wild). Results from this study may give insight to potential mechanisms of early marine mortality of juvenile pink and chum salmon.

Annual trends in biophysical factors associated with juvenile pink and chum salmon

Emily Fergusson, Joe Orsi, Molly Sturdevant, Bill Heard, and Ed Farley Jr.

The Southeast Coastal Monitoring (SECM) project annually collects data on juvenile Pacific salmon, ecologically-related species, and associated biophysical parameters in Southeast Alaska. The 15-year time series of data (1997-2011) is used to document annual trends in juvenile salmon abundance, identify relationships with biophysical parameters, and support models to used to forecast adult pink salmon returns. We present annual biophysical anomalies as deviations from the long-term means (values shown) for six of these regional trends. Long-term monitoring of juvenile salmon will enable researchers to understand how growth, abundance, and ecological interactions affect year-class strength of salmon and to better understand their roles in North Pacific marine ecosystems during climate change. For more information on SECM time series: http://www.afsc.noaa.gov/ABL/MSI/msi_secm.htm

Regional and seasonal food habits of adult salmon in the Gulf of Alaska and implications for mortality of age-0 marine fish

Wyatt Fournier and Jamal Moss

The Upper Trophic Level (UTL) Gulf of Alaska Project conducted fisheries oceanographic cruises during summer and fall months in the southeastern and central GOA. Immature and maturing salmon comprised the majority of piscivorous predators in the surface 20-m's of Gulf of Alaska (GOA). Stomachs from all five species on Pacific salmon were collected from each region and across seasons to quantify predation pressure on five target species of age-0 marine fish, provide data for ecosystem modeling efforts, and to determine spatial and temporal differences adult salmon have on ecosystem structuring in the GOA.

Salmon bycatch in the federally managed groundfish fisheries

Gretchen Harrington and Mary Grady

All five species of Pacific salmon are caught as bycatch in the federally managed groundfish fisheries off Alaska. The federal fishery management plans classify salmon as a prohibited species and, as such, groundfish fishermen must avoid salmon bycatch. NMFS monitors and estimates the number of each species of salmon caught in the groundfish fisheries. In both the Bering Sea and the Gulf of Alaska, the walleye pollock fisheries take the majority of salmon bycatch. In both areas, the North Pacific Fishery Management Council (Council) has recommended and NMFS has implemented measures to minimize, to the extent practicable, Chinook salmon bycatch in the walleye pollock fisheries. The Council is now considering measures to minimize bycatch of chum and other non-Chinook salmon in the Bering Sea walleye pollock fishery. This poster provides estimates of the magnitude of bycatch of each salmon species in the groundfish fisheries in recent years and describes the tools currently used to monitor and control salmon bycatch in the groundfish fisheries.

Species contractions and the impacts of climate and habitat change on chum salmon at the southern edge of their range - Why did the salmon cross the road?

Orlay W. Johnson, Anna Elz, Jeffrey J. Hard, and David Stewart

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 chum 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 populations may represent remnants of historical populations with characteristics essential to the successful restoration of depleted present day populations. New information developed in 2010-11 in conjunction with ODFW, WDFW, and USFWS, includes population, genetic, and life history data, such as presence or absence of spawning populations, age structure, and timing of migrations. Preliminary microsatellite genetic data indicate population structure among coastal populations and differences from interior and Puget Sound runs. Coastal populations may also contain unique genotypes and adaptations which may be important 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.

How biophysical dynamics predict differences in juvenile chum salmon (*Oncorhynchus keta*) physiology

Michael Kohan, Megan McPhee, Joe Orsi, Franz Mueter, and Phil Mundy

Chum salmon are an important commercial fishery in Southeast Alaska; therefore, gaining a better understanding about mechanisms affecting their recruitment is needed. By identifying biophysical indicators that affect physiological status of seaward migrating juvenile chum salmon, this project may provide valuable ecosystem metrics to help refine forecasts for hatchery and wild chum salmon as well as other salmon species in Southeast Alaska.

Over the past 2 years, two NOAA projects, the Gulf of Alaska Integrated Research Project (GOAIERP) and the Southeast Alaska Coastal Monitoring project (SECM), have sampled stations offshore and inshore of Southeast Alaska to collect juvenile chum salmon and biophysical data. Stations sampled correspond to a major migratory pathway juvenile chum salmon utilize each summer from the northern region of Southeast Alaska out to the Gulf of Alaska. Collecting samples along transitional habitats will allow us to determine if biophysical parameters predict differences in the physiological status of juvenile chum salmon. Additionally, we will be able to examine stock-of-origin differences in juvenile chum salmon physiology between offshore and inshore marine environments. This graduate study is partially supported by the University of Alaska Fairbanks, the Alaska Sustainable Salmon Fund, and three regional aquaculture associations in Southeast Alaska: Douglas Island Pink & Chum, Inc., the Northern Southeast Regional Aquaculture Association, Inc., and the Southern Southeast Regional Aquaculture Association, Inc.

Genetic analysis of chum salmon bycatch samples from the Bering Sea groundfish trawl fisheries

Chris M. Kondzela, Andy K. Gray, Colby T. Marvin, W. Tyler McCraney, Hanhvan T. Nguyen, Sharon L. Wildes, and Jeff R. Guyon

Protection of western Alaska chum salmon populations are of primary concern for salmon bycatch managers of the Bering Sea groundfish fisheries because this area is a known feeding habitat for multiple brood years of chum salmon (*Oncorhynchus keta*) from many different localities in North America and Asia. Because large numbers of chum salmon are incidentally caught in the federally managed Bering Sea groundfish fisheries in some years, it is important to determine the geographic origin of salmon caught in these fisheries to better understand whether management could address conservation concerns. A genetic analysis of samples of the chum salmon bycatch from the 2005–2010 Bering Sea groundfish trawl fishery was undertaken to determine the overall stock composition of the sample sets. Samples were genotyped for 11 microsatellite markers and results were estimated by using the chum salmon microsatellite baseline developed by Fisheries and Oceans Canada. Stock compositions are provided for six geographic regions. Overall, genetic samples were predominately from Asian stocks, although substantial contributions were also from the eastern Gulf of Alaska/Pacific Northwest, followed by western Alaska and the upper and middle Yukon River. Relative contributions shift over the course of the fall "B" groundfish fishing season with a tendency for the Asian contribution to increase and the North American contribution to decrease.

Contribution of Yukon River juvenile chum salmon to the eastern Bering Sea shelf

Chris M. Kondzela, Colby T. Marvin, Jim M. Murphy, Ed V. Farley, Bonnie M. Borba, Katherine G. Howard, Bill D. Templin, and Jeff R. Guyon

The Yukon River has two distinct runs of chum salmon: an earlier and typically more abundant summer-run and a later fall-run. Summer chum salmon generally spawn in the lower to middle reaches of the Yukon drainage while fall chum salmon are typically larger and generally spawn in spring-fed regions of the middle to upper reaches in Alaska and Canada. Concern about fall chum salmon abundance in some years has resulted in reduced subsistence fishing opportunities and has created challenges in fulfilling treaty obligations with Canada. To date, there is very little information regarding the survival of Yukon River chum salmon in their fresh or saltwater environments. Juvenile chum salmon outmigrate from the Yukon River in the spring and are found in the pelagic waters on the eastern Bering Sea shelf during summer and fall months. Juvenile chum salmon have been collected as part of annual Bering-Aleutian Salmon International Surveys (BASIS) in the northeastern Bering Sea since 2002. A genetic stock composition analysis of the 2002 juvenile chum salmon with allozyme markers revealed that Yukon River fall-run populations were predominantly located north of 60°N latitude. Our current project has three objectives. First, by using DNA-based markers, determine the stock contribution of juvenile chum salmon samples collected during 2003-2007 on the eastern Bering Sea shelf off the mouth of the Yukon River. Second, develop a relative abundance index of Yukon River summer- and fall-run juvenile chum salmon on the eastern Bering Sea shelf. Third, examine the potential to correlate juvenile relative abundances with adult Yukon River returns.

Genetic stock identification of overwintering chum salmon in the North Pacific Ocean

W. Tyler McCraney, Edward V. Farley, Christine M. Kondzela, Svetlana V. Naydenko, Alexander N. Starovoytov, and Jeffrey R. Guyon

Understanding stock and age-specific seasonal migrations of Pacific salmon during ocean residence is essential to both the conservation and management of this important resource. Based upon 11 microsatellites assayed on 265 individuals collected aboard international research surveys during winter 2009, we found substantial differences in the age-specific origin of chum salmon (*Oncorhynchus keta*) in the North Pacific Ocean. Overall, Asian stocks dominated the collections; however, ocean age-1 fish were primarily of Japanese origin and ocean age 2-3+ fish were predominantly of Russian origin. These results suggest that cohorts of chum salmon stocks migrate nonrandomly in the North Pacific Ocean and adjacent seas.

Straying of hatchery pink and chum salmon in Prince William Sound

Steve Moffitt

Large increases in hatchery production of pink and chum salmon have occurred in Prince William (PWS) since releases began in 1979. Almost all of these fish are harvested in commercial fisheries. Alaska has statutes and policies designed to protect wild salmon and limit the deleterious impacts of hatchery practices. The Alaska Department of Fish and Game (ADF&G) has established sustainable escapement goals (SEG) in PWS index streams to ensure that wild salmon returns are sustainable. All fish in aerial index counts of escapement are assumed to be of wild origin.

Studies conducted by ADF&G from 1997 to 1999 documented streams with high proportions (>95%) of hatchery pink salmon in western PWS and lower, but still substantial, proportions in other areas of PWS. Recent studies by ADF&G have confirmed these results for hatchery pink salmon, and have documented streams containing substantial proportions of hatchery chum salmon.

Hatchery salmon straying in PWS has impacts on escapement goals, inseason salmon management, the health of wild salmon stocks, and the certification of Alaskan salmon as sustainable.

Counter-gradient variation in juvenile chum salmon growth

Jim Murphy, Joe Orsi, Jamal Moss, and Ed Farley

Counter-gradient variation occurs when genetic and environmental influences on phenotypes oppose one another and diminish the change in mean trait expression across environmental gradients. Coherent trends in growth rate and latitude in fish populations is a common example of counter-gradient variation. Although day length plays a key role in increased growth capacity of fish at higher latitudes, experimental studies have revealed that counter-gradient growth is generally the result of growth compensation for shorter growing seasons at higher latitudes and overwinter size selection. Juvenile chum salmon in the eastern Bering Sea exhibit a high rate of growth (an average of 5.1% body weight per day over most of their summer growing season), with no significant differences observed between the northern and southern shelf regions. Juvenile chum salmon from southeast Alaska have marine growth rates that are lower than eastern Bering Sea chum salmon (3.75% body weight per day over a similar time period), yet marine habitats are warmer in southeast Alaska, no evidence exists for forage limitation in southeast Alaska chum salmon, and juvenile chum salmon from southeast Alaska migrate over latitudes similar to southern Bering Sea chum salmon. Growing season length may be the key difference between these juvenile populations as southeast Alaska chum salmon begin their summer growth approximately 1.5 months earlier than Bering Sea chum salmon. We suggest that Bering Sea chum salmon compensate for shorter growing seasons through higher marine growth rates and that these data provide evidence for counter-gradient variation in juvenile chum salmon growth.

The Southeast Alaska Coastal Monitoring (SECM) project: Milestones from research at sea over the past 15 Years

Joe Orsi, Molly Sturdevant, Emily Fergusson, Alex Wertheimer, Bill Heard, and Ed Farley Jr.

Researchers from the Auke Bay Laboratories of the Alaska Fisheries Science Center have conducted the Southeast Alaska Coastal Monitoring (SECM) project in the vicinity of Icy Strait, a principal migration corridor for salmon in Southeast Alaska (SEAK), since 1997. The SECM project helps to integrate basin-scale climate observations, regional oceanographic monitoring, and fisheries research to provide a sound scientific basis for understanding marine ecosystems. This effort also supports Ecosystem-Based Management by providing data to resource managers. This poster highlights some significant milestones from SECM research on biological interactions of salmon, ecologically-associated species, and biophysical oceanography in order to better understand climate effects and mechanisms influencing regional salmon productivity.

Forecasting pink salmon harvest in Southeast Alaska using ecosystem metrics from the Southeast Alaska Coastal Monitoring (SECM) project

Joe Orsi, Molly Sturdevant, Emily Fergusson, and Alex Wertheimer

Researchers from the Auke Bay Laboratories (ABL) of the Alaska Fisheries Science Center have provided forecasting information to stakeholders of the pink salmon resource of Southeast Alaska (SEAK) since 2004. The forecasting parameters used by ABL are derived from an ongoing time series of data collected by the Southeast Coastal Monitoring (SECM) project. Initiated in 1997, the SECM project primarily samples eight stations in the vicinity of Icy Strait. This annual research consists of monthly oceanographic sampling in May, June, July, and August, with surface trawling for juvenile salmon in the latter 3 months. The SECM pink salmon forecasts enable stakeholders to anticipate the harvest with more certainty than previous forecasting methods have allowed. In seven of the past 8 years, these forecast estimates have deviated from the actual harvests by an average of only 7%. Data from juvenile pink salmon catches are also shared with the Alaska Department of Fish and Game to help refine their SEAK pink salmon harvest forecast that is developed by a different method. By providing accurate pre-season pink salmon harvest forecasts to the resource stakeholders, ABL has helped to increase the economic efficiency of commercial salmon fishing industry and helped to ensure the sustainability of the regional pink salmon resource. For more details about the SECM pink salmon forecasting please visit our web site: http://www.afsc.noaa.gov/ABL/MSI/msi_sae_psf.htm.

Hatchery chum salmon straying in Southeast Alaska

Andrew W. Piston

Hatchery production of chum salmon in Southeast Alaska increased dramatically over the last three decades, from 8.7 million fry released at 8 locations in 1980, to 458 million fry released at 19 locations in 2010. Hatchery fish accounted for an average of 85% of the common property commercial harvest of chum salmon—28 million fish—over the 5 years, 2006–2010. The State of Alaska has numerous policies designed to minimize impacts of the salmon enhancement program on wild stocks, including a genetics policy, disease policies, a policy for the management of sustainable salmon fisheries (5 AAC 39.222), and a policy for management of mixed stock salmon fisheries, which gives the conservation of wild stocks, consistent with the sustained yield principle, the highest priority (5AAC 39.220). 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)." Chum salmon spawning abundance in Southeast Alaska is monitored though a series of peak survey estimates at 88 index streams upon which escapement goals are based. From 2008 to 2010, ADF&G collected otoliths from chum salmon at index streams throughout Southeast Alaska in an effort to document the presence of hatchery fish in wild stock index streams, determine the geographic extent of hatchery chum salmon straying, and to determine whether hatchery strays were affecting wild chum salmon escapement indices. Sample sizes of greater than 50 fish were collected from 33 of the 81 summer chum salmon index streams in Southeast Alaska. Hatchery fish were found in nearly every stream that was sampled, and the proportion of hatchery fish was over 5% in 21 streams. The proportions of stray hatchery fish were generally highest in streams closest to release sites, but stray proportions greater than 10% were detected in six streams at distances more than 50 km from the nearest release site. We detected significant year-to-year variability in the proportions of hatchery fish in several streams with high proportions of strays. ADF&G is currently working with the University of Alaska, PNP Aquaculture Corporations, and the National Marine Fisheries Service to develop a project to address concerns about straying and genetic interactions between hatchery and wild stocks.

Trends in harvest and escapement for Southeast Alaska pink and chum salmon stocks

Andrew W. Piston and Steven C. Heinl

Annual commercial harvests of pink and chum salmon in Southeast Alaska increased dramatically in the 1980s and reached their highest levels in the 1990s: pink salmon harvests averaged 49 million, and chum salmon harvests averaged 11 million, including peak harvests of 16.0 million chums in 1996 and 78 million pinks in 1999. Nearly all of the pink salmon harvested in Southeast Alaska are of wild origin: hatchery-produced pink salmon contributed an average of only 3% of the annual harvest since the late 1970s. In contrast, however, the harvest of chum salmon has been composed primarily of hatchery fish (average 73% over the last 10 years). Estimated harvests of wild chum salmon did not rebound to the same degree as pink salmon and have recently declined to levels similar to those of the 1970s. Pink salmon harvests have also declined over the most recent 10 years, from an average of 49 million per year in the 1990s, to an average of 40 million fish per year since 2001, but remain at historically high levels. The decline in overall pink salmon harvest during the past decade was due primarily to very poor even year runs in 2006 and 2008, and a below average run in 2010. The Alaska Department of Fish and Game maintains escapement indices for aggregates of pink and chum salmon runs in three broad subregions in Southeast Alaska; Southern Southeast Subregion, Northern Southeast Inside Subregion, and Northern Southeast Outside Subregion. Escapement indices are based on peak aerial survey estimates and do not provide estimates of total escapement, but rather an index of abundance useful for assessing trends. Escapement indices for chum salmon increased in the late 1980s and 1990s and remained stable through the mid-2000s, but have recently dropped to low levels similar to those of the 1970s. The 2011 summer chum salmon escapement index in the Southern Southeast Subregion, however, was well above average. Pink salmon escapements in all three subregions increased dramatically from low levels in the 1960s and 1970s and have generally remained at high levels since the mid-to-late 1980s; the notable exception was a very poor escapement to the Northern Southeast Inside subregion in 2008.

Salmon as predators and prey in marine waters of Alaska

Molly Sturdevant, Emily Fergusson, Joe Orsi, Rich Brenner, and Bill Heard

Predation during the early marine critical period is thought to determine year-class strength for juvenile Pacific salmon, but predation impact is hard to document because it requires consistent sampling over extended periods to capture infrequent or episodic events. Juvenile salmon are among the most abundant daytime forage species available in summer to epipelagic predators in marine waters of Southeast Alaska (SEAK) and returning adult salmon are among the most abundant potential fish predators. Because of the spatial and temporal overlap of juveniles and adults of the 5 species, the potential for cannibalistic interactions to influence subsequent returns has long been of interest. To identify levels of predation on juvenile salmon, we examined the 15-year time series (1997-2011) of adult salmon and other potential predators captured in surface trawls by the Southeast Coastal Monitoring (SECM) project in SEAK, and 2 years of predation by adult pink and chum salmon captured in purse seines near shore in Prince William Sound. Here, we focus on the degree of piscivory and incidence of predation on juvenile salmon by adult/immature Chinook, coho, sockeye, chum, and pink salmon, address the potential for cannibalism by alternate year brood lines of pink salmon to depress returns the following year, and provide an example of the impact of an abundant episodic predator, immature sablefish, on salmon.

Adult pink salmon in the California Current system

Marc Trudel, Sean Hayes, Strahan Tucker, and John Candy

The southern edge of pink and chum salmon in North America extends to the Columbia River with small runs, with typically less than 100 individuals of each species returning to the Bonneville Dam each year. Trawl surveys conducted in the fall of 2011 revealed the presence of adult pink salmon off the southern Oregon and northern California coasts. It was initially thought that these fish originated from the Fraser River, as adult returns to this system have been typically above 20 million in odd years during the last decade, and the cooler temperature associated with the La Niña condition in 2011 may have pushed their landing farther south than normal. To determine their origin, we performed DNA analyses using a microsatellite baseline developed for British Columbia and Puget Sound stocks. Stock assignments were spread equally among numerous stocks spanning the entire baseline, an unlikely scenario suggesting that the source population was not present in the baseline used to assess their origin. Given the anomalously high return of adult pink salmon to the Columbia River in 2011, we hypothesize that they originated from the Columbia River, and that ocean conditions they encountered during their smolt year were favorable to their survival. Extension of the microsatellite to the Columbia River stocks will help to resolve this question.

Hatchery salmon and ecosystem productivity

Benjamin Van Alen

The put-and-take business of "ocean ranching" of hatchery salmon extracts nutrients from the ocean and lowers the carrying capacity for all biota. A sizeable proportion of wild salmon runs spawn and die in thousands of watersheds which helps maintain the natural marine-terrestrial-marine nutrient cycle. In contrast, nearly all salmon returning to hatcheries and remote release sites are caught (and should be) and their tons of marine-derived nutrients are removed from the nutrient cycle. Thus, not only are wild fish and shellfish facing direct competition from 5 billion-plus hatchery salmon now released into the North Pacific each year but the ocean's productivity is declining from the nutrient mining inherent with these industrial-scale ocean ranching hatchery programs. Of all the anthropogenic and climate change challenges we face, at least we have complete control over this one.

FISHERIES MANAGEMENT STRATEGIES AND CHALLENGES

An overview of pink and chum salmon fisheries management around the North Pacific

Randy Ericksen

Chum and pink salmon are widely distributed in the north Pacific. Spawning populations occur as far south as Oregon in North America, and Japan and Korea in Asia. They spawn in rivers draining into the Arctic Ocean from the Mackenzie River in Canada to the Lena River in Siberia. Commercial fisheries occur throughout most of their range. However, the methods and strategies used to manage salmon populations vary greatly between geographical regions. The intent of this presentation is to provide an overview of management of pink and chum salmon around the North Pacific. Key differences in fishing gear, fishers, hatchery practices, and management strategies will be highlighted.

Challenges to monitoring wild chum salmon in Southeast Alaska

Andrew W. Piston

Chum salmon (*Oncorhynchus keta*) are the most valuable species in Southeast Alaska commercial fisheries, with an average ex-vessel value of $32 million a year from 2001 to 2010—well ahead of the next most valuable species, pink salmon (*O. gorbuscha*), at $23 million a year. Despite the importance of chum salmon to the region's fisheries, relatively little stock assessment information is available for this species (e.g., total escapements, harvest rates, survival rates). In Southeast Alaska, chum salmon are harvested primarily in commercial net fisheries and to a lesser extent by commercial troll fisheries, as well as sport, personal use, and subsistence fisheries. Chum salmon harvests increased dramatically in the 1990s, primarily due to the production of hatchery fish, which accounted for an average of 73% of the commercial common property harvest of chum salmon from 2001 to 2010. Wild chum salmon are harvested primarily in mixed stock fisheries, typically some distance from spawning areas, and it is usually not possible to account for stock-specific harvests. Chum salmon spawning abundance in Southeast Alaska is monitored though a series of peak survey estimates at 88 index streams upon which escapement goals are based. The maximum survey counts used to evaluate wild chum salmon underestimate the true escapement and can only be considered a relative indicator (or index) of escapement level. In addition, it is often not possible to estimate numbers of chum salmon in streams that have substantial populations of pink salmon, and recent high pink salmon abundance may have masked chum salmon escapements in many areas. The ADF&G has recently conducted work to groundtruth aerial survey counts in the Ketchikan area and has applied for funding to conduct helicopter surveys of large Ketchikan-area mainland river systems. Helicopter surveys will allow surveyors to obtain improved views of these streams, validate observations of chum and pink salmon abundance, identify primary chum salmon spawning areas, and improve managers' ability to identify chum salmon during routine aerial surveys of other index streams in the area. The level of uncertainty already inherent in aerial survey counts is exacerbated by the straying of hatchery fish into Southeast Alaska chum salmon index streams. From 2008 to 2010, ADF&G collected otoliths from chum salmon at index streams throughout Southeast Alaska in an effort to document the presence of stray hatchery fish in wild stock index streams. Sample sizes of greater than 50 fish were collected from 33 of the 81 summer chum salmon index streams in Southeast Alaska. Hatchery fish were found in nearly every stream that was sampled, and the proportion of hatchery fish was over 5% in 21 streams. ADF&G is currently working with the University of Alaska, PNP Aquaculture Corporations, and the National Marine Fisheries Service to develop a project to address concerns about straying and genetic interactions between hatchery and wild stocks.

Southeast Alaska chum salmon (*Oncorhynchus keta*) thermal mark identification and agreement

Lorna Wilson

Thermal-marked salmonid otoliths are used to identify specific release groups in mixed stock fisheries and are applied to a range of research projects, including hatchery chum salmon straying in Southeast Alaska. Accuracy of thermal mark detection and identification is essential to the success of a project that uses thermal mark readings. To assess accuracy in the chum salmon stray study otolith readings, a subsample of otoliths was read independently by the Alaska Department of Fish and Game (ADF&G) Thermal Mark Lab, Southeast Southern Regional Aquaculture Association (SSRAA) and the Douglas Island Pink and Chum, Inc. (DIPAC) otolith laboratories for thermal mark presence and identification from recoveries made in 2009 and 2010. Recoveries were grouped into study areas (1) Southern Southeast quadrant, (2) Lynn Canal and Stephens Passage area, (3) Chatham and Icy Straits area, and (4) Northern Outside quadrant. Two agreement measures, latent class model (LCM) coefficients, which assess reader ability to detect the mark, and kappa (κ) values, which assess thermal mark identification agreement, were used to quantify the reliability and accuracy of thermal mark readings. LCM estimates suggested high reader ability to detect hatchery fish when they are hatchery, $p(H|H) > 0.97$, and wild when wild, $p(W|W) > 0.95$, with low SE among all reader pairs and locations. Percent agreement on thermal mark identifications was high, furthermore, individual κ values for thermal marks among reader pairs and study areas was generally high ($\kappa > 0.5$ for samples recovered from study areas 2 and 3 from both 2009 and 2010 and $\kappa > 0.5$ in 2010 and $\kappa < 0.5$ in 2009 for samples recovered from study areas 1 and 4) suggesting accurate mark identification. Overall, detection and identification of thermal-marked chum salmon southeast Alaska was found to be highly accurate among all readers, suggesting successful research projects.

Cross–species spawner–recruit analysis at Ford Arm Creek

Leon Shaul and Hal Geiger

The coho salmon population in Ford Arm Creek in Southeast Alaska was studied as an indicator stock for fishery management during 1980 –2009. A doubling of the average adult return between 1982–1991 and 1992–2009 resulted from a 48% increase in average presmolt production and a 37% increase in average presmolt-adult survival. The increase in freshwater production occurred concurrent with a quadrupling of both average pink salmon spawner abundance and average all-species carcass biomass. Relationships were explored using independent variables that included the pink salmon peak escapement survey count and total MDN loading in the common brood year, the following year, and an average for both years, with the average for both years producing the best statistical fit with coho salmon production. Average pink salmon escapement in the coho brood year and the following year explained 58% of variation in the survival-adjusted return of coho salmon. A logistic hockey stick model predicts an increase of 127% in the coho salmon return as pink salmon escapement increases from zero to an inflection point at a peak count of 79 thousand spawners, with a further 18% increase in coho production to a nominal saturation point at 116 thousand pink salmon spawners, above which further response was nil. Both reference points fall within the current pink salmon escapement goal of 48 –156 thousand spawners, established using single-species yield analysis. On an area-density basis, the relationship between MDN and coho salmon production in Ford Arm Creek was consistent with the observed growth response by coho salmon fry to the addition of pink salmon carcasses reported from other research based on a controlled experiment in an artificial stream. These observations further support inter-species relationships and the response to MDN as important considerations in setting escapement goals for salmon.

ENHANCEMENT HISTORY, ECONOMICS, AND CHALLENGES

A brief history of the Salmon Fishery Enhancement Program in Alaska

Samuel Rabung

In 1971, the State of Alaska initiated its modern salmon fishery enhancement program in response to severely depressed commercial salmon fisheries. The state took two approaches: commercial fisheries management changes were made to provide for adequate escapements of spawners; and the newly formed Fisheries Rehabilitation, Enhancement and Development (FRED) Division focused on developing the knowledge, infrastructure and support systems necessary for rehabilitation and enhancement of salmon fisheries through hatchery production and other means. Legislation enabling the creation of the private nonprofit (PNP) hatchery program was passed in 1974, and private sector investment in salmon fisheries enhancement began with the first PNP hatchery permit issued in 1975. Protection of wild stocks has been foremost since the inception of the program; and statutes, regulations and policies are in place to provide for this priority. Alaska's salmon fishery enhancement program is stakeholder driven, with provisions for planning and oversight by representatives of regional user groups. As the program matured, the state withdrew from most of its production programs, contracting the operation of many hatcheries to the private sector. Today there are 34 active salmon hatcheries in the State of Alaska, and the success of the program is illustrated by hatchery fish providing approximately 25% of the annual common property harvest of salmon over the past 10 years; while having little or no demonstrable detrimental effects on natural salmon production.

Can we put a million eggs in the closet? (Challenges for pink and chum salmon enhancement)

John Burke

In the early 1970s there were a number of challenges facing those who were charged with the design of a program to effectively enhance pink and chum fisheries in Alaska. These stretched across a full spectrum from politics and economics to fish culture. For the culturist, how to design an incubation system for 30 million eggs in a room not much larger than a two-car garage. Could you collect sufficient broodstock in a special harvest area while harvesting at the level required to meet production costs and allowing enough common property opportunity to meet the expectations of the fleets. Several years later, as state programs lost funding, could those programs be moved to the private sector and sustained; some could not. These challenges were left behind as sustainable effective programs evolved. Today, what seemed difficult and sometimes unlikely 30 years ago has become usual standard practice. While those early optimistic goals are now relatively easily met or exceeded; there are new issues, seemingly more difficult and nebulous than those that came before. While programs have attracted the fleets they have also started to attract a different set of large and difficult natural predators. Are there effective strategies that will minimize the impact of predation? There is growing sentiment among the fleets that hatcheries are similar to factories where production outcomes are consistent and assured? Can too much be expected from the programs? There is an anti-enhancement bias in the current fisheries community stemming in part from the failure of hatchery programs in the "lower 48"; this is now impacting the permitting and management of enhancement programs and the fish they produce. Are the perceived problems real? Are there reasonable scientific means to answer the questions about Alaska programs arising from this bias? There are still a few involved who can remember how difficult it was to produce a million healthy fry with 18 gallons a minute of water.

Allocation of enhanced salmon in southern Southeast Alaska

Susan Doherty, Rick Focht, Chip Blair, and Bruce White

On January 17, 1994, the Alaska Board of Fisheries adopted 5 AAC 33.364 Southeastern Alaska Area Enhanced Salmon Allocation Management Plan into regulation. The purpose was to provide a fair and reasonable distribution of the harvest of salmon from enhancement projects among the seine, troll and drift gillnet commercial fisheries. The Board established the following value allocations: seine, 44-49%; hand and power troll, 27-32%; and drift gillnet, 24-29%. Many projects have reached maturity and enhancement values have exceeded 35 million dollars in 3 of the last 4 years. We present enhancement values by species and gear group from 1994 through 2011 to evaluate the current trends in allocation value. We will demonstrate how principles in the Report of the Southeast Alaska Allocation Taskforce (SATF), incorporated by reference as finding in regulation 3 AAC 33.364 can be used to address the challenges of meeting the agreed allocation percentages.

CONSERVATION BIOLOGY, STOCKS OF CONCERN, & ENDANGERED SPECIES

Genetic and environmental effects on development time in even and odd broodlines of pink salmon (*Oncorhynchus gorbuscha*) and their third generation of outbred hybrids

Dion S. Oxman, William W. Smoker, and Anthony J. Gharrett

Full and half-sibling families of odd and even broodlines of pink salmon from Auke Creek, Alaska, and of 3rd generation outbred hybrids between Auke Creek females and Pillar Creek males from Kodiak Island, Alaska (1,000 km distant) were incubated in ambient, chilled, and warmed Auke Creek water to determine how inheritance, environment, and outbreeding influenced development timing. Additive and maternally inherited genetic factors played a role in the development time of embryos from the odd-year broodline, but this timing was genetically conserved in the even-year run. Genotype-by-environment (GxE) effects were observed among odd-year families, which suggested that locally adapted genes might have influenced larval development. No GxE effects were observed in the even-year broodline, indicating that the observed variation in development time was likely the result of phenotypic plasticity. Outbreeding significantly prolonged development time in both broodlines and it altered the proportions of additive and environmental variation possibly by influencing the canalization process. The apparent outbreeding depression in these hybrids of geographically separated populations demonstrated that introgression of nonnative fish may erode fitness by altering locally adapted traits, and that these effects can last at least three generations, a potential concern to some aquaculture and enhancement programs.

Pink salmon genetics: worth another look?

Lisa W. Seeb, Ryan K. Waples, and James E. Seeb

Genetic studies of pink salmon have consistently revealed high divergence between broodlines but relatively little divergence among populations within broodlines. In North America, odd-year broods predominate in the south, with even-year pink salmon predominating in the more northerly latitudes. In many streams, even- and odd-year lineages occupy the same habitat, but experience no gene flow providing a naturally-occurring replicate experiment to test for genomic signals of adaptation. Here we present next-generation sequence results using restriction site associated DNA (RAD tags) to compare three paired populations of even- and odd-year pink salmon. Our population pairs originate from widely-separated locations in North America and include Norton Sound in Northwest Alaska, Prince William Sound in Southcentral Alaska, and Puget Sound in Washington State. We compare sequence divergence and identify outlier loci between population pairs as well as within and between the lineages and test for signals of neutral and adaptive markers across the genomes. We identified over 5,000 putative SNPs likely reflecting both neutral and adaptive variation. Consistent with earlier studies, the greatest amount of diversity exists between broodlines with more diversity among the odd-year lineage. We also found that populations from the same location from different broodlines were more divergent in the south than in the north. Finally, using the RAD approach, we were able to identify at least 27 SNPs that may reflect local adaptive variation and a number of SNPs showing significant divergence within broodlines.

Geographic variation in a clock gene polymorphism in pink and chum salmon

Jeffrey J. Hard, Kathleen G. O'Malley, and Michael J. Ford

Seasonal timing of life-history events is often under strong natural selection. The Clock gene is a central component of an endogenous circadian clock that senses changes in photoperiod (day length) and may mediate seasonal behaviors. Among Pacific salmon (*Oncorhynchus* spp.), seasonal timing of migration and breeding is influenced by photoperiod. To expand a study of 42 North American Chinook salmon (*O. tshawytscha*) populations, we tested whether duplicated Clock genes are correlated with population differences in reproductive timing in other highly migratory Pacific salmon species. Specifically, we examined geographical variation along a similar latitudinal cline in the polyglutamine domain (PolyQ) of OtsClock1a and OtsClock1b among 53 populations of pink (*O. gorbuscha*), chum (*O. keta*) and coho salmon (*O. kisutch*). We found no evidence for polymorphism in the OtsClock1a allele among the populations of any of these species. However, we detected geographical patterns in the OtsClock1b allele that, unlike those for putatively neutral allozyme alleles, correspond in varying degree to clinal variation in reproductive timing in these species. We evaluated the contribution of day length and a freshwater migration index to OtsClock1b PolyQ domain variation using regression trees and found that day length at spawning appears to explain much of the variation in OtsClock1b allele frequency among chum and Chinook, but not coho and pink salmon populations. Our findings suggest that OtsClock1b could influence seasonal adaptation as reflected by geographical variation in reproductive timing in some of these species, but alternative explanations for the clinal variation in OtsClock1b and its interspecific variability—especially patterns of historical recolonization—cannot be ruled out.

Research program to address interactions of wild and hatchery pink and chum salmon in Prince William Sound and Southeast Alaska

Steve Reifenstuhl, John Burke, Dave Bernard, John H. Clark, Jeff Hard, Ron Josephson, Bill Smoker, Bill Templin, and Alex Wertheimer

Extensive salmon ocean-ranching is practiced by private non-profit (PNP) sector corporations in Alaska for the purpose of enhancing the common property fisheries (CPF). These efforts are currently producing large numbers of hatchery salmon for harvest, especially in Prince William Sound (PWS) and Southeast Alaska (SE), and to a smaller degree in Kodiak and Cook Inlet. The scale of the Alaska hatchery programs has raised concerns that hatchery fish may detrimentally impact the productivity and sustainability of wild stocks of Alaska salmon. Recent studies have demonstrated large proportions of hatchery-bred salmon in some wild-spawning populations in Alaska (Eggers and Heinl 2008). These observations have raised several priority questions:

- What is the genetic stock structure of pink and chum salmon in each region?
- What is the extent and annual variability in straying of hatchery pink salmon in PWS and chum salmon in PWS and SE?
- What is the impact, if any, on fitness (productivity) of wild pink and chum salmon stocks due to straying of hatchery pinks and chum salmon?

The scope of research will attempt to answer these questions using single nucleotide polymorphisms (SNPs) markers and discrete otolith marks via a multi-generational study. Replicate salmon streams with populations of less than 3,000 spawners will be chosen with high (~50%) and low (<20%) stray rates in each region. Adults will be sampled to determine origin; the progeny (eggs) will be sampled in situ the following year to determine cross types (WxW, WxH, etc.) and abundance; finally the returning adults will be sampled to determine survival of crosses for a full pedigree. Two full life cycles are proposed for pinks and chum, 6 and 11 years, respectively. Fitness can be measured as the number of adults produced per spawner of each sex (survival). If hatchery-origin fish are less fit and breed with natural-origin fish, the natural-spawning populations will lose productivity as a consequence of the presence of strays among the breeding population. Contrary and neutral outcomes are possible. Work is expected to begin summer 2012.

CONTRIBUTED PAPERS

A test of local adaptation in hybrids of temporally isolated pink salmon (*Oncorhynchus gorbuscha*) in the same stream

Chris Manhard, Jesse Echave, William Smoker, Milo Adkison, and A. J. Gharrett

Differences in marine survival and time of return to Auke Creek in Juneau, AK for spawning adult pink salmon (*Oncorhynchus gorbuscha*) were observed between first generation (F1) control and hybrid lines of temporally distinct subpopulations. Hybrid crosses were made between early- and late-run pink salmon, which are partially genetically isolated by the time at which they return to Auke Creek to spawn. The experiment was performed in 2005 and 2006 to evaluate the even year and odd year broodlines, which are completely genetically isolated. Crosses from each broodline were cultured in a common freshwater environment, released to sea together, and recovered at the Auke Creek weir as adults. Control and hybrid individuals were determined in returning adults by parentage analysis with microsatellite markers. Marine survival of F1 controls exceeded that of hybrids for the even-year broodline. No difference in marine survival between controls and hybrids was detected for the odd-year broodline, although sparse returns resulted in low statistical power for that experiment. Hybrids expressed intermediate phenotypes for time of return relative to controls for each broodline. Our results indicate extrinsic outbreeding depression in F1 hybridized pink salmon, and suggest that early- and late- run pink salmon are locally adapted to unique environmental regimes.

Abundance and growth of juvenile pink, chum and sockeye salmon in Eastern Pacific coastal waters

Strahan Tucker and Marc Trudel

Pink salmon are the most abundant species of the five Pacific salmon, representing approximately 60% of all salmon. Given their abundance, pink salmon may be the dominant salmonid in interspecific competitive interactions. In this study, we tested the hypothesis that high abundances of juvenile pink salmon might result in decreased abundances and/or growth of other planktivorous juvenile salmon species migrating on the continental shelf of the west coast of North America through direct competition for food. Furthermore, we evaluated the effects of potential environmental drivers and food web process on salmonid abundance and growth. Catch-per-unit-effort (CPUE) of all salmon species were positively correlated demonstrating very similar trends in the direction and magnitude of their abundance in each year, region and season. CPUE varied significantly with sea surface temperature and indices of ecosystem productivity (i.e., nutrient concentration, phytoplankton and zooplankton biomass). Growth rates varied seasonally, regionally and annually for all species. Growth rates were positively correlated between pink and chum salmon; there were no significant relationships with sockeye salmon. We found no effects of biological or physical oceanographic variables on growth rate. Results of this study suggest that interspecific competition is not manifested within salmon going to sea in the same year, at least during the first marine growing season. Rather, abundances appear driven by physical oceanographic features and processes at the base of the food chain. It is unclear, however, why we found no direct effects of these same factors on growth.

RESOURCE STAKEHOLDER PERSPECTIVES

Certification programs – What do they do for Alaska Fishermen?

Ray Riutta

Recently we have found that some markets for seafood in the world are requiring independent certifications of many types. These labels and certifications come in many types: labels of origin, traceability, claims of sustainability and responsible fisheries management, and the list goes on to the point where today we have literally hundreds of options to choose from. In this talk we will discuss the value of certifications in terms of economics and healthy oceans as well as take a look at how Alaska's fishermen can best take advantage in the marketplace.

Market development of salmon by-products

Richard Riggs

The Alaska seafood industry has experienced a relatively recent and on-going transition from the conversion of "seafood waste" to "seafood by-products". This conversion applies to pink and chum salmon as well. In January 2009, the Alaska Fisheries Development Foundation (AFDF) published a 276 page report prepared by Anthony P. Bimbo entitled "Alaska Seafood By-Products: Potential Products, Markets and Competing Products – Revised 2008". In addition to being a source document for the attendees of the Pink and Chum Workshop, it is a documented source of this presentation. While the report does not focus on pink and chum salmon specifically, many of the by-products identified in the report do apply to pink and chum salmon. Historically, the processing industry has utilized the flesh (canned, fresh, and frozen markets) and roe of harvested pink and chum salmon to supply the world market, with the remnants from the processing activity (heads, fins – in the case of canning, and viscera) being considered “seafood waste” and directed to outfalls or other means of disposal. However, there has been a recent transition in the industry to convert pink and chum salmon “seafood waste” (as well as other seafood waste) to “seafood by-products” that, similar to the flesh and roe, are being marketed across the globe in various applications. In many cases the global markets for seafood by-products, and specifically pink and chum salmon by-products, are still being fostered and developed, and revenues from the sales of seafood by-products are largely, if not entirely (depending on factors such as economies of scale and physical location), offset by capital, production, and logistic costs associated with the resulting by-products. With that being said, there is reason for optimism that the industry will continue to grow the global market for these by-products to the point that rather than having an adverse effect on the round pound value of Alaska pink and chum salmon, these same by-products will actually have a positive contribution to the value of the resource. This presentation will identify many of the pink and chum salmon by-product markets being developed and pursued by the Alaska seafood industry.

Alaska pink and chum salmon markets

John Garner

Seafood consumption has increased through the past four decades, driven primarily by aquaculture production, as sustainable capture fisheries have been fully exploited. Growth in aquaculture is projected at 10 to 15 percent annually for the next 20 years, much of that in Norwegian and Chilean farmed salmon. Fresh whole farmed is the fastest growing product form. Increased salmon consumption in the European Union, United States, and Russian has driven demand, while supply is fairly stable in Alaska, declining somewhat in Japan, and increasing in the Russian Far East. Pink salmon in Alaska fluctuate on an odd-even year cycle between 125,000 and 200,000 metric tons; chum salmon is far more stable at 50,000 metric (t) annually through the past decade. Since 2001, frozen pink and chum exports have increased steadily with the greatest quantities now going to China and the EU. Roe sales have a distinctly different distribution, somewhat driven by recent economic factors. Canned salmon similarly has undergone a shift in demand and demographic shift. A gradual decline in Japan pink and chum salmon consumption since 2007 will be discussed, as imports of chum salmon have remained stable. Prices for Alaska pink and chum salmon have increased dramatically since 2000; economic, demographic, and market influences will be considered.

Pink and chum market history – A decade of fundamental change

Tyson Fick

There is no doubt the world of pink and chum salmon fishing and processing has seen quite a bit of change over the last decade. We have seen tremendous value growth in the past 10 years, but why? The many reasons for this will be explored along with a peek into what the future may hold for pinks and chums in the global marketplace.

Market trends for Alaska pink and chum salmon: What the data show

Gunnar Knapp

This presentation will review what publicly available data suggest about market trends for Alaska pink and chum salmon, particularly over the past decade. In particular, the presentation will review trends over time in harvests; ex-vessel prices; production of different products (canned, frozen H&G, frozen fillets, fresh H&G, fresh fillets, roe); first wholesale prices; exports to different markets; and estimated U.S. domestic consumption. The focus of the presentation will be on describing trends, setting the stage for discussion by other speakers in the session of the underlying reasons for the trends and how markets may change in the future.

Pinks and chums, the best biters: Perspective of a longtime "hooker"

Eric Jordan

Pink and chum salmon are becoming more important to the troll fleet as their value rises and trollers are increasingly successful at targeting them. Multi-year observations demonstrate how trollers have pioneered the round troll fishery, faced the challenge of discovering techniques for getting bites, handling large volumes of gear and catch, and a look at future implications for management, conservation, and sharing.

SALMON FORECASTING AND MODELING IN ECOSYSTEMS

Pink salmon forecasting with ecosystem metrics from the Southeast Alaska Coastal Monitoring project and implications of climate trends on regional pink productivity

Joe Orsi, Emily Fergusson, Molly Sturdevant, and Alex Wertheimer

Pink salmon, which are part of a highly valued fisheries resource in Southeast Alaska (SEAK), command a high commercial ex-vessel value currently exceeding $90 M in the region. Effective management of this resource is challenging because dramatic and unanticipated fluctuations occur in annual pink salmon returns. Predicting these fluctuations is problematic because no leading indicator information of year-class strength is available from sibling pink salmon due to their discrete one ocean year life cycle. Consequently, historical pre-season pink forecasts have been woefully inaccurate, leaving managers with a "wait and see" dilemma that cripples pre-season harvest strategies, reduces economic efficiencies, and jeopardizes resource sustainability. Ocean surveys in SEAK conducted by the Auke Bay Laboratories' Southeast Coastal Monitoring project (SECM) have revealed encouraging relationships between ecosystem metrics and pink salmon harvests. The SECM project has developed forecast models specific to the region and are based on ocean sampling since 1997 in the northern region of SEAK. Each year, monthly biophysical data from oceanographic instruments, plankton nets, and fish surface trawls are collected from May to August. This SECM biophysical data, such as juvenile pink salmon catch, temperature, etc., are evaluated to forecast adult pink salmon harvest in SEAK. Since 2004, the SECM project has provided resource stakeholders pre-season forecasts that have generally been remarkably accurate and have deviated by an average of only 7% from actual harvests in 7 of the past 8 years. However, climate change variability since the mid-1970s, both in SEAK (air temperatures) and the Northeast Pacific Ocean (PDO and ENSO), has affected both regional and intra-regional productivity of pink salmon. Anomalously warm ocean temperatures in 2005 resulted in poor regional returns in 2006, and in 2011 harvest was largely due to unusually high production from the northern portion of SEAK. Future challenges in forecasting pink salmon in SEAK revolve around the ability of the SECM sampling in the northern region to continue to adequately represent harvest for the entire region. Unless the mechanism responsible for this productivity shift is adequately parameterized, future forecast accuracy may be reduced.

Does abundance of Asian pink salmon affect survival of Bristol Bay sockeye salmon?

Alex Wertheimer and Edward Farley

The high abundance of pink and chum salmon in recent years has raised concerns that these species may be negatively affecting survival of other species of Pacific salmon. Comparisons of average smolt-to-adult survival between odd- and even-year smolt migrations of Bristol Bay sockeye salmon stocks for smolt years 1977-1997 have been used to infer a strong effect of Asian pink salmon on the sockeye survival rates. However, these comparisons did not take into account the annual variation in abundance of Asian pink salmon. We used time series models and linear regression to examine the impact of Asian pink salmon abundance on marine survival of three important stocks (Kvichak, Egegik, and Ugashik) of Bristol Bay sockeye salmon for smolt years 1977-1997. We also used juvenile salmon data from the Bering-Aleutian Salmon International Survey and corresponding adult returns of Bristol Bay sockeye salmon for smolt years 2002-07 to evaluate the effects of Asian pink salmon in more recent years. For the 1977-1997 smolt years, there was no consistent trend in the survival of the three sockeye salmon stocks, and no net reduction in sockeye salmon smolt survival, in relation to increased pink salmon abundance. For smolt years 2002-2007, average Bristol Bay sockeye salmon returns were higher from even-year smolts, even though odd-year pink salmon they encountered in their first ocean winter were also more abundant. An index of juvenile sockeye salmon survival was higher for even-year juveniles, and was positively correlated with pink salmon abundance. These results are contradictory to the hypothesis that even-year smolts encountering more abundant odd-year pink salmon will have reduced survival due to density-dependent interactions. We conclude, based on our results from both time periods, that there is no discernable negative impact of Asian pink salmon on smolt-to-adult survival of Bristol Bay sockeye salmon.

Hitchhiker's guide to forecasting salmon returns with ocean conditions

Marc Trudel, Strahan Tucker, Andres Araujo, Steve Baillie, Chuck Parken, and Bill Peterson

Stock assessment models currently used to manage salmon fisheries often fail to accurately predict run-size for adult salmon returning to British Columbia. Differences between predicted and actual returns are often attributed to biophysical processes related to changing ocean conditions, indicating the need to integrate information on climatic and biological drivers into the annual stock assessment process for Pacific salmon. In this presentation, we examine the predictive power of different approaches to forecast salmon returns in the northern California Current system, including simple linear regression models, "stop-light" tables, multivariate statistical analyses, and Bayesian Beliefs Networks. Strengths and limitations of these approaches will be discussed.

Growth of Western Alaska and Asian chum salmon (*Oncorhynchus keta*) in relationship to climatic factors and inter- and intraspecific competition

Beverly Agler, Greg Ruggerone, and Lorna Wilson

Correlation analyses, stepwise generalized least squares regression, and Mantel's tests were used to examine factors influencing mean annual scale growth of western Alaska and Asian chum salmon from adult scales collected 1965-2007. We found significant negative effects of Asian chum salmon abundance on 83% of age 0.3 sites, and 75% of age 0.4 sites examined, indicating significant intraspecific competition within the North Pacific. Third year growth was negatively impacted by

North Pacific annual sea surface temperature (SST), and the North Pacific Index (NPI). We found significant effects of interspecific interactions due to Russian pink salmon abundance, but the effects were smaller than the effects of Asian chum salmon abundance and SST on third year growth. Contrary to our hypothesis, we found that warmer large-scale SSTs were associated with reduced third year growth. It is possible that the abundance of Asian chum salmon has created a masking effect, overwhelming other effects that might promote growth in the North Pacific. First year scale growth was significantly affected by warmer regional temperatures, NPI, and less ice cover. We found strong correlations among all six systems in third growth year, suggesting these populations experienced similar environmental variation. More synchronous growth was observed among populations from close rivers than from distant ones, indicating the importance of regional scale over ocean-wide studies.

FRESHWATER AND MARINE ECOLOGY

Humpback whale predation on released salmon smolts and fry at enhancement facilities

Ellen Chenoweth, Jan Straley, Elena McCauley, Tommy Sheridan, Lon Garrison, John Moran, Heather Riley, Frank Thrower, and Ben Contag

In Southeast Alaska, Salmon Enhancement Facilities (SEF) have reported humpback whales targeting newly released salmon fry and smolts. This poses a threat to the economic, social and cultural benefits provided by these programs to Southeast Alaska's coastal communities. In spring of 2010, five organizations collaborated to evaluate the relationship between salmon releases and humpback whale presence. Whales were reported at all release sites; however, the likelihood of sighting a whale differed significantly among SEF. Whales were more likely to be seen on the day after a release than after non-release days. The same whale was observed feeding at Hidden Falls during releases in 2008 and 2010 indicating that targeting released fish is a learned and repeated behavior. These results provided baseline guidance to understand the impact of predation upon salmon enhancement programs and to develop release strategies to prevent or minimize humpback whales feeding on this anthropogenic food source. We propose to expand upon this pilot study to try to better understand the impact of humpback whales on released salmon, the impact of this novel prey source on humpback whales and project the potential spread of this behavior through the population of humpback whales. We will use traditional methods such as photographic identification and prey sampling as well as novel methods such as acoustic monitoring, animal-borne tags, and tissue sampling to accomplish these goals.

Spatial variation in juvenile chum salmon marine growth: tales from the NE Bering Sea to British Columbia

Brian Beckman, Joe Orsi, Jim Murphy, Jamal Moss, and Marc Trudel

Pearcy (1992) suggested that overall marine survival of anadromous salmonids was related to marine growth rates of juvenile fish. This hypothesis has been tested by measuring the hormone insulin-like growth factor 1 (IGF1) from blood samples of juvenile coho salmon taken over a 10-year time series from fish collected off the Oregon/Washington Coast. IGF1 has been shown to be positively and significantly related to the growth rate of juvenile salmon in a series of controlled laboratory experiments. Significant inter-annual variation in growth was found over the 10-year period and higher growth rates were related to higher adult return rates. The extent to which IGF1 is a powerful indicator of growth and survival of other salmon species is unknown. In an attempt to understand the processes regulating the production of chum salmon we have obtained samples from juvenile chum salmon collected in marine surveys in the NE Bering, Gulf of Alaska, Icy Strait (Southeast Alaska) and the coast of British Columbia (2009 – 2010). None of these data sets are currently long enough to provide data on any possible relationships between early marine growth and adult survival. Data collected to date does demonstrate: increased growth of fish in the Gulf of Alaska (off-shore) as compared to Icy Strait (in-shore), significant south (BC) to north (Gulf of Alaska) differences in growth in 2010 and positive relations between temperature and growth in the NE Bering Sea.

Effects of pink salmon on growth, age, and survival of Fraser River sockeye salmon and Western Alaska Chinook salmon

Gregory T. Ruggerone and Beverly A. Agler

Abundances of Fraser River sockeye salmon and Western Alaska Chinook salmon have declined in the recent decade or more, whereas abundances of pink salmon have increased in most regions. Previous research indicated that pink salmon can affect growth and survival of sockeye and Chinook salmon; therefore, we tested the hypothesis that pink salmon may also affect Fraser River sockeye salmon and Nushagak River Chinook salmon (Bristol Bay, Alaska). Mean productivity of 16 Fraser River sockeye salmon populations during brood years 1965 to 2005 was inversely correlated with abundance of North American pink salmon. The unexpectedly low return of Fraser sockeye salmon in 2009 (2005 brood year) and the unexpectedly high return in 2010 (2006 brood year) were consistent with the alternating-year pattern of pink salmon abundance, but other factors were also prominent. Furthermore, in support of this hypothesis, adult length-at age of Fraser sockeye was inversely related to abundances of adult sockeye and pink salmon, and mean sockeye age-at-maturation was delayed in response to increasing pink salmon abundance in North America. Growth and survival of Nushagak Chinook salmon were also influenced by pink salmon (primarily Russian stocks). Chinook scale growth during the second year at sea was positively correlated with spring SST, and growth was higher in odd-numbered years apparently in response to the cascading trophic effect of pink salmon. Chinook growth during the fourth year at sea and adult length-at-age were negatively correlated with abundance of Russian pink salmon. A multi-variate model indicated that productivity of Nushagak Chinook salmon during the past 35 years was positively correlated with spring SST during early marine life and negatively correlated with mean abundance of Russian pink salmon 3 to 5 years after each Chinook brood year. These findings are consistent with previous findings indicating that high abundances of pink salmon can affect growth, age-at-maturation and survival of salmon.

Hatchery salmon and ecosystem productivity

Benjamin Van Alen

The put-and-take business of “ocean ranching” of hatchery salmon extracts nutrients from the ocean and lowers the carrying capacity for all biota. A sizeable proportion of wild salmon runs spawn and die in thousands of watersheds which helps maintain the natural marine-terrestrial-marine nutrient cycle. In contrast, nearly all salmon returning to hatcheries and remote release sites are caught (and should be) and their tons of marine-derived nutrients are removed from the nutrient cycle. Thus, not only are wild fish and shellfish facing direct competition from 5 billion-plus hatchery salmon now released into the North Pacific each year but the ocean’s productivity is declining from the nutrient mining inherent with these industrial-scale ocean ranching hatchery programs. Of all the anthropogenic and climate change challenges we face, at least we have complete control over this one.

INVITED SPEAKERS

The Great White Shark: Ruthless Man-eater or Crazed Killing Machine?

Banquet Speaker: Andrew Piston

Andy Piston, a self-described "shark expert," has been studying sharks since the age of 5, and is considered by several people to be one of Ketchikan, Alaska's, foremost authorities on shark attacks. He will try to dispel some of the myths that surround the Great White Shark, such as the widely-held belief that they don't consider humans a primary food source, and the insane belief that you are more likely to be struck by lightning than eaten by a shark. Having read parts of several articles about sharks and having seen the movie "Jaws" numerous times, Andy has developed a deep understanding of shark behavior and feeding habits, as well as a paralyzing fear of becoming shark prey. Through the use of technically-advanced theoretical modeling too complicated for the human mind to understand, Andy will present findings that will revolutionize thinking about sharks and bring widespread paranoia to the swimming public.

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Past Northeast Pacific Pink and Chum Salmon Workshops

Year	Location	Chair	Organization
1962	Juneau, AK	T. Merrell	BCF
1964	Juneau, AK	D. Bevan	FRI
1966	Ketchikan, AK	C. Meacham	ADFG
1968	Juneau, AK	T. Merrell	BCF
1970	Prince Rupert, BC	A. Hartt	FRI
1972	Sitka, AK	R. Roys	ADFG
1974	Vancouver, BC	T. Bird	CDE
1976	Juneau, AK	J. Helle, K Koski	NMFS
1978	Parksville, BC	J. Mason	FMS
1980	Sitka, AK	A. Kingsbury	ADFG
1983	Orcas Island, WA	K. Fresh, S. Schroeder	WDFW
1985	Harrison Hot Springs, BC	B. Shepherd	CDFO
1987	Anchorage, AK	P. Mundy, K. Tarbox	ADFG
1989	Port Ludlow, WA	D. Phinney	WDFW
1991	Parksville, BC	D. Bailey, J. Woodey	CDFO, PSC
1993	Juneau, AK	B. Smoker	UA-Fairbanks
1995	Bellingham, WA	G. Graves, H. Fuss	NWIFC, WDFW
1997	Parksville, BC	P. Ryall	CDFO
1999	Juneau, AK	S. Hawkins	NMFS
2001	Seattle, WA	J. Hard, O. Johnson, K. Myers	NMFS, UW
2003	Victoria, BC	B. White, G. Bonnell	PSC, CDFO
2005	Ketchikan, AK	S. Heinl, R. Focht, A. Wertheimer	ADFG, DIPAC, NMFS
2008	Bellingham, WA	O. Johnson, K. Neely, L. Weitkamp, J. Hard, K. Adicks	NMFS, , WDFW, UW, NWIFC
2010	Nanaimo, BC	J. Candy, M. Trudel	CDFO
2012	Juneau, AK	J. Orsi, E. Fergusson, S. Heinl	NMFS, ADFG

ADFG: Alaska Department of Fish and Game; BCF: Bureau of Commercial Fisheries (U.S.); CDE: Canada Department of Environment; CDFO: Fisheries and Oceans Canada; DIPAC: Douglas Island Pink and Chum, Inc.; FMS: Undefined acronym; FRI: Fisheries Research Institute; NMFS: National Marine Fisheries Service; NWIFC: Northwest Indian Fisheries Commission; PSC: Pacific Salmon Commission; UA-Fairbanks: University of Alaska-Fairbanks; UW: University of Washington; WDFW: Washington Department of Fish and Wildlife.