Today's Technology for Tomorrow's Resources

American Fisheries Society

The 26th Meeting of the Alaska Chapter
November 8-12, 1999
Kodiak, Alaska

The American Fisheries Society (AFS), founded in 1870, is the oldest and largest professional society representing fisheries scientists. AFS promotes scientific research and enlightened management of resources for optimum use and enjoyment by the public. It also encourages a comprehensive education for fisheries scientists and continuing on-the-job training. The AFS publishes some of the world's leading fisheries research journals: the Transactions of the American Fisheries Society; North American Journal of Fisheries Management; North American Journal of Aquaculture (formerly The Progressive Fish Culturist); The Journal of Aquatic Animal Health, and Fisheries. It organizes scientific meetings where new results are reported and discussed. In addition to these primary functions, the Society has many other programs in areas such as professional certification, international affairs, public affairs and public information.

AFS Mission Statement

The mission of the American Fisheries Society is to improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing fisheries and aquatic science and promoting the development of fisheries professionals.

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8:00-12:00	Resource Selection Workshop	8:00	Registration	8:15	Telemetry	8:15	Shellfish Research/ Management
		8:15	Welcome				
		8:40	Who Will Watch The Watchers?				
		10:15	Hydroacoustic Applications	10:15	Instream Techniques		
						11:40	Lunch
12:00	Lunch	12:00	Lunch	12:00	Past Presidents Luncheon		
1:00–5:00	Workshop (cont'd)	1:15	Hydroacoustic App. (cont'd)	1:10	Genetic Techniques	1:15	Ecosystem Approaches
		3:00	Subsistence Fisheries	3:45-5:30	Chapter Business Meeting	4:00	Awards
5:30-7:30	Registration/ Social					4:15	Adjourn
		7:00	Poster Session/ Social	6:30	Social	6:00-9:00	Executive Comm. Meeting
7:00–10:00	Executive Comm. Meeting	7:00	Aquatic Ed.	7:00-10:00	Banquet		

AGENDA

Theme: **Today's Technology for Tomorrow's Resources**
Location: **All events held at the Kodiak Elks unless otherwise indicated.**

MONDAY, NOVEMBER 8

8:00 am – 12:00 pm **Continuing Education Workshop**, Kodiak Inn
Resource Selection by Animals: Applications for GIS Data
Dr. Trent McDonald, Western EcoSystems Technology, Cheyenne, WY

12:00 pm – 1:00 pm **LUNCH** - Catered Buffet Available at Workshop

1:00 pm – 5:00 pm **Workshop** (Continued) – Kodiak Inn

5:30 pm – 7:30 pm **Registration and Social** – Kodiak Inn

7:00 pm – 10:00 pm **Executive Committee Meeting** – Kodiak Inn (Everybody Welcome)

TUESDAY, NOVEMBER 9

8:00 am **Registration**

8:15 am **Welcome and Opening Remarks**

8:20 *Cindy Hartmann, Chapter President*

8:30 *Ken Hashagen, Western Division President*

8:40 am **Plenary Session - Comments From the Users; Who Will Watch the Watchers?**

8:40 **Resources, Markets, and Sustainability** - *Laine Welch*

9:10 **Bridges among Industry, Research, and Management –** *Chris Blackburn*

9:30 **A Personal Perspective From a Resource User –** *Oliver Holm*

9:50 **Discussion/Questions**

10:00 **BREAK**

10:15 am **Session Hydroacoustic Applications and Horizons** – *Chair Debby Burwen*

10:20 **Inter-Seasonal and Annual Changes in the Distribution and Abundance of Pacific Herring *Clupea harengus* in Prince William Sound, 1993-1999** - *Gary Thomas*

10:40 **The Problem with Large Rivers: Sonar Challenges and Anomalies of the Yukon River** - *Suzanne Maxwell*

11:00 **The Wood River Sonar Project** - *Harold J. Geiger, Debby Burwen, Peter Dahl, Deborah A. Hart, Dan Huttunen, and Ken Tarbox*

11:20 **Advancements in Riverine Fish Counting using Fixed-Location Sonar** - *David Daum*

11:40 Aiming Techniques Using Split-Beam Sonar in the Chandalar River - *Bruce Osborne*

TUESDAY, NOVEMBER 9 (Continued)

12:00 pm **LUNCH** (on your own)

1:15 pm **Hydroacoustic Applications and Horizons (Continued)**

1:20 **The Use of Split-Beam Sonar as an Assessment Tool for Chinook Salmon Runs in the Kenai River, Alaska (A Day in the Life of a Split-Beam Sonar Jockey) -** *Daniel Bosch*

1:40 **Researching a New Sonar Site on the Kuskokwim River -** *Steve Parry*

2:00 **Correcting for Two sources of Position-Related Bias in Estimates of the Acoustic Backscattering Cross-Section -** *Steven J. Fleischman and Debby Burwen*

2:20 **Acoustically Tagged Juvenile Salmonids Approaching a Dam on the Columbia River -** *Tracey W. Steig, Thomas C. Torkelson, Mark A. Timko, and Bruce H. Ransom*

2:40 **BREAK**

3:00 pm **Session - Subsistence Fisheries and Dual Management in Alaska** *– Chairs Jerry Berg and Tom Kron*

3:05 **Subsistence Salmon Fisheries of the Arctic-Yukon-Kuskokwim Region of Alaska -** *Tom Kron*

3:20 **Safeguards Assuring Sustainability in AYK Subsistence Fisheries -** *Dan Senecal-Albrecht and Jude Henzler*

3:35 **Subsistence Permitting and Data in the Westward Region of Alaska -** *Jim Blackburn*

3:40 **Dual Management: Cooperation or Conflict? -** *Kelly Hepler*

3:55 **Implementing Federal Subsistence Fisheries Management in Alaska -** *Tom Boyd, Jerry Berg, and Chuck Krueger*

4:10 **Discussion**

4:30 **DINNER** - (on your own)

7:00 pm **Aquatic Education Committee Meeting** – Kodiak Inn

7:00 – 9:00 pm **Poster Session and Social –** *Chair Robert Ourso*, Kodiak Inn

- **Site Fidelity in Pacific Halibut *Hippoglossus stenolepis* -** *Philip N. Hooge and S.J. Taggart*
- **Using GIS to Analyze Spatial Patterns of Commercial Bottom Trawl Effort: "Hot Spots" in the Gulf of Alaska and the Aleutian Islands -** *Catherine Coon, Thomas C. Shirley, and Jonathan Heifetz*
- **Integrating Ecosystem Considerations into Groundfish Fisheries Management off Alaska, USA-** *David Witherell, Clarence Pautzke, and David Fluharty*
- **The Use of Sonar to Manage Chinook Salmon Fisheries on the Kenai River, Alaska -** *Daniel Bosch*
- **The Wood River Sonar Project – Results to Date -** *Deborah A. Hart, Donald J. Degan, Tim Mulligan, Peter Dahl, James J. Dawson, and Harold J. Geiger*
- **Estimating Freshwater Survival of Yukon River Chum Salmon -** James E. Finn, Raymond F. Hander, and Scott H. Maclean

TUESDAY, NOVEMBER 9 (Continued)

- **Quantification of Upwelling as a Determinant of Spawning Site Selection and Quality for Yukon River Chum Salmon** - *Scott H. Maclean, James E. Finn, and Raymond F. Hander*
- **The Effect of Urbanization on Streams in the Municipality of Anchorage, Alaska: Current Project Status** - *Robert T. Ourso*
- **Salmon Carcasses Subsidize Aquatic-Riparian Food Webs in Southeast Alaska** - *Mark S. Wipfli, John P. Hudson, Dominic T. Chaloner, Kristine Martin, Maria Lang, and John P. Caouette*
- **Salmon Carcasses Increase Growth of Stream-Dwelling Salmonids in Southeast Alaska** - *Mark S. Wipfli, John P. Hudson, Dominic T. Chaloner, Kristine Martin, Maria Lang, and John P. Caouette*
- **Red King Crab Ecology and Podding Behavior** - *Braxton Dew*
- **Settling Behavior and Substrate Preference of Red King Crab (*Paralithodes camtschaticus*) Glaucothoe** - *Bradley G. Stevens and Jiro Kittaka*
- **The Red King Crab Fishery of the Kodiak Archipelago** - *Francine J. Bennis*
- **The Feeding Ecology of Maturing Sockeye Salmon During Their Final Nearshore Migration** - *Bruce McIntosh, Albert Tyler, and Charles Swanton*

WEDESDAY, NOVEMBER 10

8:15 am **Session - Telemetry for Y2K and Beyond –** *Chair Doug Palmer*

8:20 **A New Paradigm for Rainbow Trout Population Ecology in a Southwest Alaska Watershed** - *Julie M. Meka, Dave C. Douglas, and E. Eric Knudsen*

8:40 **Variations in Movement Patterns of Rainbow Trout in Several Southwest Alaska Watersheds** - *E. Eric Knudsen, F. Jeffrey Adams, Mark J. Lisac, and Douglas E. Palmer*

9:00 **Estimation of the Abundance of Chinook Salmon in the Kenai River Based on Exploitation Rate and Harvest** - *James J. Hasbrouck, Steve L. Hammarstrom, and Robert A. Clark*

9:20 **Use of Radio Telemetry to Describe Life History Characteristics of Dolly Varden in the Kenai River, Alaska** - *Douglas E. Palmer and Larry L. Larson*

9:40 **Migratory behavior and seasonal distribution of Dolly Varden *Salvelinus malma* in the Togiak River watershed, Togiak National Wildlife Refuge** - *Mark J. Lisac*

10:15 am **Session - Instream Innovation and Discovery –** *Chair Mason Bryant*

10:20 **Using Remote Video and Time-Lapse Recording Technology to Improve Salmon Escapement Monitoring** - *Ted Otis and Mark Dickson*

10:40 **Kametolook River Coho Salmon Restoration Project** - *James McCullough and Lisa Scarbrough*

11:00 **Ecological Effects of Salmon Carcasses on Several Southcentral Alaska Streams** - *Robert Piorkowski*

11:20 **It's Summertime and the Livin' is Easy (for Juvenile Salmonids in the Kenai River)** - *Bill Hauser, Mark Fink, Bob Clark, Pat Hansen, Dean Hughes, and Mark Kuwada*

WEDESDAY, NOVEMBER 10 (Continued)

11:40 **Addressing Sustainability: A Population Model for Steelhead Trout of the Karluk River, Alaska** - *Robert N. Begich*

12:00 pm **PAST PRESIDENTS LUNCHEON (**Everybody Welcome**)**

1:00 pm **Session - Potentialities and Limitations of Applying Gene Detection Techniques for the Conservation of Highly Exploited Fishes –** *Chair James Seeb*

1:10 **The Limits of Genetic Methods for Defining Stocks of Marine Fishes** - *Stewart Grant*

1:30 **Comparison of Spatial and Temporal Genetic Diversity in Walleye Pollock Using Allozyme, mtDNA, and Microsatellite Data** - *Jeffrey B. Olsen, James B. Seeb, and Susan Merkouris*

1:50 **Genetic Population Structure of Rougheye Rockfish (*Sebastes aleutianus*) Inferred From Allozyme Variation** - *Sharon Hawkins, Jonathan Heifetz, John Pohl, and Richard Wilmot*

2:10 **High Resolution Analysis of Walleye Pollock Stock Structure Using Microsatellite DNA Markers** - *M. F. Canino, P.T. O'Reilly, K.M. Bailey, and Paul Bentzen*

2:30 **BREAK**

2:40 **Combining Molecular Genetic and Ecological Data for Characterization of Salmonids** - *Carol Ann Woody, Jeff Olsen, Paul Bentzen, Joel Reynolds*

3:00 **Allozymes Discriminate Discrete Stocks of Sockeye Salmon Inhabiting the Chignik Lake Drainage on the South Alaska Peninsula** - *Bill Templin*

3:20 **Differences in Genetic Diversity in Marine and Landlocked Steelhead Populations in Southeast Alaska** - *Jennifer L. Nielsen*

3:40 **BREAK**

3:45-5:30 pm **CHAPTER BUSINESS MEETING**

6:30 pm **SOCIAL**

7:30 – 10:00 pm **BANQUET**

THURSDAY, NOVEMBER 11

8:15 am **Session - Advances in Shellfish Research and Management, -** *Chairs Gordon Kruse and Dan Urban*

8:20 **Moonlight Madness: Timing of Hatching and Mound Formation in Tanner crabs, *Chionoecetes bairdi*, in Relation to Environmental Factors** - *Bradley G. Stevens, Claire Armistead, Jan Haaga, Sharon Loy, and Rich MacIntosh*

8:40 **Development of a Computer-Based Imaging System for Crab and Groundfish Identification** - Dan Urban and Doug Pengilly

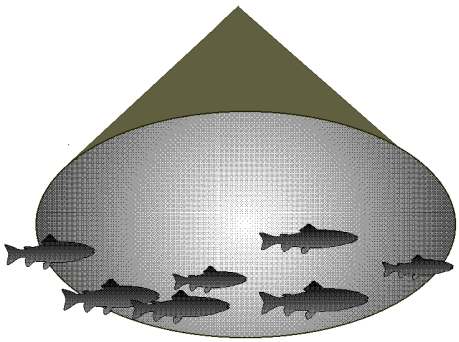
THURSDAY, NOVEMBER 11 (Continued)

9:00	**Application of Underwater Time-Lapsed Video Technology to Observe King and Tanner Crab Behavior in and Around Commercial Crab Pots** - *Donn Tracy*
9:20	**Evaluation of Modified Cod Pots to Reduce Tanner Crab Catch in the Gulf of Alaska Pacific Cod Fishery** - *Leslie Watson and Douglas Pengilly*
9:40	**Testing the Feasibility of Using an Underwater Laser Line Scanning System for Marine Fishery and Habitat Assessment** - *Robert S. Otto*
10:00	**BREAK**
10:20	**Maximum Likelihood Estimation of Scallop Abundance using Catch-Effort and Fishery Observer Data** - *Gregg Rosenkranz*
10:40	**Comparison of Fishery and Survey Indices of Abundance for Snow Crab, *Chionoecetes opilio*, in the Bering Sea** - *Laurence C. Byrne and Claire Armistead*
11:00	**Development of a Management and Stock Assessment Program for the Pot Shrimp Fishery for *Pandalus platyceros* in Southeastern Alaska** - *Gretchen H. Bishop, Timothy M. Koeneman, and Catherine A. Botelho*
11:20	**Analysis of Minimum Size Limit for the Red King Crab Fishery in Bristol Bay, Alaska** - *Gordon H. Kruse, Laurence C. Byrne, Fritz C. Funk, Scott C. Matulich, and Jie Zheng*
11:40 am	**LUNCH –** (on your own)
1:15 pm	**Session - Fisheries Conservation, Reserves, and Holistic Ecosystem Approaches** – *Chair Eric Knudsen*
1:20	**Legal Framework for Marine Protected Areas** - *Amy L. Browning*
1:40	**The Phase-Out of Commercial Fishing and the Opportunities for Testing the Effectiveness of Marine Reserves in Glacier Bay National Park** - *S. James Taggart and Philip N. Hooge*
2:00	**Kachemak Bay National Estuarine Research Reserve: A Local-State-Federal Partnership for Long-Term Research and Education** - *Glenn Seaman*
2:20	**BREAK**
2:40	**Developing a Long-Term Marine Science Program for the Exxon Valdez Oil Spill Trustee Council** - *Phillip R. Mundy*
3:00	**Towards Ecosystem-Based Conservation and Management using a Balanced Trophic Model of Prince William Sound, Alaska** - *Thomas A. Okey and Daniel Pauley*
3:20	**Discussion**
3:40	**AWARDS –** *Nicky Szarzi*
4:00	**ADJOURN**
6:00-9:00 pm	**Executive Committee Meeting/Dinner -** (Everybody Welcome)

ABSTRACTS

HYDROACOUSTIC APPLICATIONS AND HORIZONS

Session Chair – Debby Burwen



INTER-SEASONAL AND ANNUAL CHANGES IN THE DISTRIBUTION AND ABUNDANCE OF PACIFIC HERRING *CLUPEA HARENGUS* IN PRINCE WILLIAM SOUND, 1993-1999

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A series of hydroacoustic-purse seine surveys were conducted from 1993-1999 to assess the abundance and distribution of the Pacific herring *Clupea harengus pallisi* in Prince William Sound (PWS). Between late fall and early spring, over 95% of the adult population was found in a just a few large school groups (>1000 mt). The vertical distribution of the adult varied significantly between night (20-50 m) and day (100-150 m). Small (>100 m tons) schools of adult and juvenile herring were observed in nearshore areas of PWS from the spring and summer. A fall 1995 survey showed that over 80% of the juvenile herring were rearing in two areas of the Sound. The biomass of adult herring was estimated at 20,000 mt in the fall of 1993, 13,000 mt in fall and spring of 1994-95, 24,000 mt in fall and spring of 1995-96, 38,000 mt in spring of 1997 and 17,000 mt in the springs of 1998 and 1999. There was a high incidence of VHS associated with the 1993-94 decline in herring biomass. Commercial fishing was closed from 1994-1996 and the population biomass increased. Commercial fishing resumed in the spring of 1997 and subsequently, in the spring 1998, another major decline in herring biomass was observed along with another outbreak of VHS.

THE PROBLEM WITH LARGE RIVERS: SONAR CHALLENGES AND ANOMALIES OF THE YUKON RIVER

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Sonar operators face numerous challenges in their assessment of fish passage on the Yukon River. The project currently ensonifies approximately 400-450 m of the roughly 1000 m wide river at the Yukon River sonar project located just upstream from Pilot Station. The sonar project uses 120 kHz single elliptical beam, user-configurable hydroacoustic systems deployed in a side-looking mode on both sides of the Yukon River. The primary challenges include aiming the transducers to obtain the highest detection levels across the majority of range, compensating for highly dynamic range-dependent signal loss, and monitoring the bottom profile and movement of local sandbars. A variety of assessment techniques are employed to deal with these challenges including frequent reaiming, frequent adjustments of the sonar parameters, a variety of environmental monitors, target work, and equipment checks. Charted anomalies (electronic noise and reverberation from various sources) include known and unknown factors.

THE WOOD RIVER SONAR PROJECT

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During the last two years, the Alaska Department of Fish and Game established a research site on the Wood River system within Bristol Bay, Alaska, to test split-beam sonars that may eventually replace the Bendix sonar systems currently in use today. The new system must be easy to use, must operate in remote wilderness environments, and must be able to estimate fish passage over a wide range of actual fish passage values. Wood River was chosen because it is a clear water system, with sockeye salmon passage rates that vary several orders of magnitude within a few days. Towers were constructed at the river's edge to permit visual estimates of fish passage that were paired with sonar estimates. At the inception of the project, we intended to investigate alternate passage-rate estimators, with particular emphasis on estimators that will reduce bias at very high passage rates. Initially we hoped to use a new system to target track fish at densities below 3000 per hour, and then use echo-counting methods at greater densities, and for very high passage rates, use echo-integration hybrid techniques. With two years of acoustic data, we now have results on beam geometry, ping rate, pulse width, and the accuracy of two automatic tracking algorithms. Here we present some initial conclusions about a final Bendix replacement sonar system, and comment on the importance of a procedure for setting the tracking parameter values and the importance of visualizing fish tracks as a diagnostic measure.

ADVANCEMENTS IN RIVERINE FISH COUNTING USING FIXED-LOCATION SONAR

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In recent years, the art of counting upstream migrating fish in rivers using acoustic methods has advanced tremendously. This presentation will briefly discuss the evolution of sonar fish counting; from echo counting, to echogram/chart interpretations, and finally target tracking in four-dimensions (time and 3-D space).

AIMING TECHNIQUES USING SPLIT-BEAM SONAR IN THE CHANDALAR RIVER

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Acoustic aiming techniques which helped to establish, monitor, and maintain the desired aim of the sonar beam were implemented on the Chandalar River. Specific characteristics of the sonar site made it possible to refine the techniques. A remote-controlled dual-axis rotator with real-time visual displays from a digital echo processor was used to accurately position the sonar beam out into the river from shore in the vertical and horizontal plains. The high acoustic reflectivity of the river bottom on the left bank enabled us to aim using small cobble as reference points. Due to the low acoustic reflectivity on the right bank a man-made target was used for aiming as a reference point. An acceptable position of the beam was obtained during transducer deployment by aiming the beam off these known reference points. This allowed us to "see" how well the beam fit relative to the rivers' profile. The beam orientation could be checked by horizontally sweeping the beam passed a stationary standard target. During routine sonar operation three-dimensional fish locations were used to confirm proper beam positioning.

THE USE OF SPLIT-BEAM SONAR AS AN ASSESSMENT TOOL FOR CHINOOK SALMON RUNS IN THE KENAI RIVER, ALASKA (A DAY IN THE LIFE OF A SPLIT-BEAM SONAR JOCKEY)

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Fishing effort on the Kenai River represents about 13% of the total recreational effort throughout Alaska. Because of the intense sportfishing effort directed at Kenai River chinook salmon stocks, sonar has been used to estimate chinook salmon escapement since 1987. Estimates of the inriver return and associated estimates of variance are produced daily for inseason management of the fishery. Recent advancements in sonar technology (split-beam sonar) provide extensive information for monitoring fish behavior and evaluating the performance of the sonar system. Information examined on a daily basis includes acoustic size, range, and vertical distributions of fish as they pass through the sonar beam.

RESEARCHING A NEW SONAR SITE ON THE KUSKOKWIM RIVER

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Research on a new salmon management sonar site was conducted during the summer of 1999 on the Kuskokwim river several miles upstream from Bethel, Alaska. Based on river topography and bottom transects taken in 1998 and 1996, a location was chosen just downstream of the village of Kwethluk. The river is 550 meters wide at the site with a sandy bottom and a favorable profile on one side. Profiles taken of the left bank show a more challenging bottom that may force us to ensonify up to 500 meters from the other side. All five species of Alaskan salmon run up the Kuskokwim, necessitating a gill net species apportionment program. This past summer we placed an HTI 244 split-beam echo-sounder in the river and began beam mapping and detectability tests. Limited data was collected towards the end of the season, giving us a head start on fish distribution, direction of travel and automatic tracking studies. Gill netting was conducted during part of the season giving us limited species and distribution information.

CORRECTING FOR TWO SOURCES OF POSITION-RELATED BIAS IN ESTIMATES OF THE ACOUSTIC BACKSCATTERING CROSS-SECTION

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Accurate estimation of the acoustic backscattering cross-section (σ), or target strength (TS=10 log(σ)) of individual targets is essential for many fisheries hydroacoustic applications. Unfortunately, measurements of σ are affected not only by intrinsic acoustic "size", but also by extrinsic factors such as target position, orientation, and behavior. This paper addresses the effect of target position on estimates of acoustic size. Measurements of σ often increase as a target moves away from the maximum response axis (MRA), leading to potential overestimation of σ for targets located off-axis. We describe a simple mechanism by which measurement error in estimates of position leads to the observed phenomenon. We show how this effect, combined with threshold-induced bias, can cause substantial overestimates of σ for off-axis targets. We demonstrate how smoothed estimates of position remove much of the bias. Finally, we propose a straightforward correction for threshold-induced bias, which removes much of the remainder.

ACOUSTICALLY TAGGED JUVENILE SALMONIDS APPROACHING A DAM ON THE COLUMBIA RIVER

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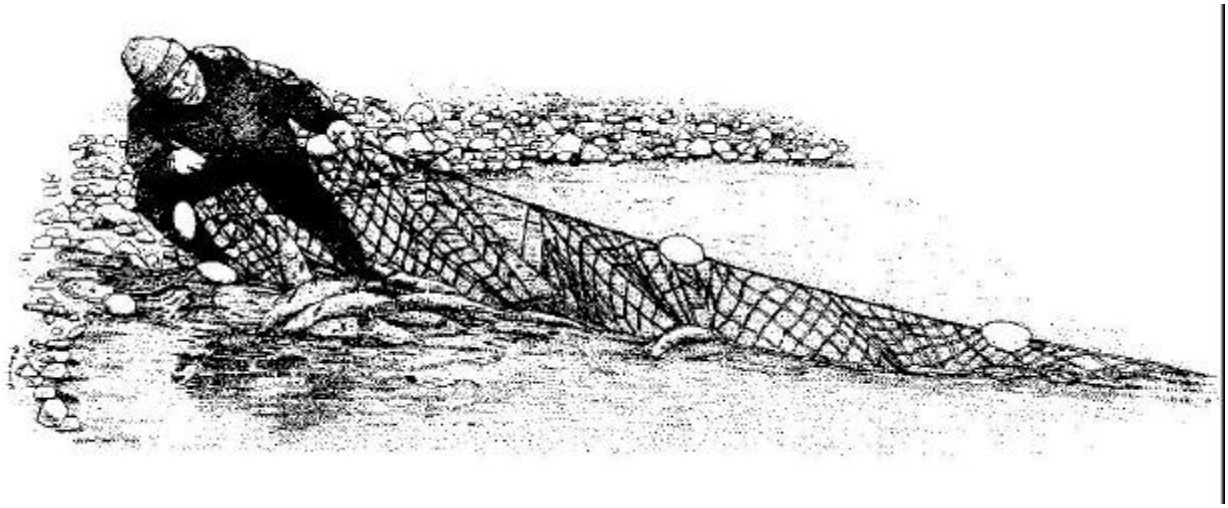
Acoustic tags were used to monitor the swimming patterns of downstream migrating salmonid smolts approaching Rocky Reach Dam on the Columbia River. Fish were tracked in three-dimensions with sub-meter resolution as they approached and passed into the turbine intakes and bypass channel entrances at the dam. Additional tests were conducted at Lower Granite Dam on the Snake River to confirm resolution. Nearly 400 chinook and steelhead smolts were gastorically and surgically implanted with 307 kHz acoustic transmitters during the 1998 and 1999 spring and summer outmigrations. Tags were approximately 7 mm in diameter by 20 mm in length, and weighed approximately 1 gram in freshwater. Tag life was 10-14 days. In 1999, 12 passive hydrophones were used to track tagged fish over time. The arrival time of the transmitted signal at each hydrophone was used to estimate the three-dimensional position of each tracked fish. Release sites were just upstream of the dam forebay. Up to 10 fish were tracked simultaneously. A variety of fish behaviors was observed, with most fish passing the dam within 6 hours of release. Three-dimensional tracks of fish approaching the turbine intakes and juvenile bypass channel are presented. Fish tracks were also superimposed with fine-scale water velocity and flow data from hydraulic modeling, to draw inferences for improving the design, and thus bypass effectiveness, of the surface bypass system.

SUBSISTENCE FISHERIES AND DUAL MANAGEMENT IN ALASKA

Session Chairs – Jerry Berg and Tom Kron



SUBSISTENCE SALMON FISHERIES OF THE ARCTIC-YUKON-KUSKOKWIM REGION OF ALASKA

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Since their original immigration into the Arctic-Yukon-Kuskokwim region of Alaska, indigenous peoples have relied on salmon stocks for food. The subsistence salmon fisheries of the region are the largest of their kind in the world. Historically, the largest and most reliable subsistence food resource of the Kuskokwim, Yukon, Norton Sound and Kotzebue areas has been the Pacific salmon. Subsistence salmon catches have varied depending on needs of the local people, the strength of the salmon runs and government regulation. Alaskans have depended on salmon for both food and transportation, and salmon are key to their cultures and way of life. During the summer and fall each year, thousands of fishing households across this region are involved in the harvesting, processing and preserving of salmon for subsistence use. Subsistence salmon harvest in this region probably peaked in the 1920s and is thought to have exceeded several million salmon annually in some years. In 1998, the estimated subsistence salmon harvest for the Kuskokwim, Yukon, Norton Sound and Kotzebue Sound was just over 580,000 fish. Subsistence use of salmon has priority over commercial, sport, and personal use in both state and federal law. Subsistence salmon fisheries can be expected to continue to be very important to Alaskans in this region for generations to come.

SAFEGUARDS ASSURING SUSTAINABILITY IN AYK SUBSISTENCE FISHERIES

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Fishery managers often view fishermen as an obstruction and threat to effective resource conservation. In the AYK region however two safeguards are in place that work in tandem with agency efforts to ensure sustainable fisheries. The first is the mixed subsistence market economy of the region and the high degree of overlap between commercial permit holders and subsistence users. The second is the active cooperative management mechanisms in research and management and that is strengthening bonds between users and managers and between different users. The first safeguard is a built-in characteristic of these remote, artisanal fisheries while the second has developed only in the last decade.

Management agencies and policymakers such as the Alaska Board of Fisheries and the Federal Subsistence Board and its Regional Advisory Councils must bear in mind these safeguards and regulate accordingly. Cooperative efforts, whether escapement monitoring projects or meetings to hammer out a consensus on management plans, build mutual understanding and challenge the need for and effectiveness of statutory regulation and research in isolation. The overlap of AYK subsistence and commercial users negate tendencies towards short-term overexploitation of the resource. Furthermore, subsistence activities and harvests in many villages would not be possible without commercial fishing income. New management and policy measures can have unforeseen consequences and may reopen old animosities between users and government and between users from different villages destroying the effective cooperative management mechanisms developed through years of practical experience in joint problem-solving and sharing the conservation burden.

SUBSISTENCE PERMITTING AND DATA IN THE WESTWARD REGION OF ALASKA

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Subsistence fishing permits are issued to any person who qualifies. Permits provide a means for reporting harvest levels, locations, and dates. Permits returned to Alaska Department of Fish and Game have been recorded in a database, are used as a basis for automatic permit reissue the following year, and are summarized in catch reports. Possession of a permit is legally required when subsistence fishing. Returns of subsistence fishing permits issued are not validated.

DUAL MANAGEMENT: COOPERATION OR CONFLICT?

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On October 1, 1999 federal land managing agencies in Alaska began to implement a subsistence fishery management program creating a dual management system. The State of Alaska will continue to manage based on inseason assessment of fish stock run strength and fisher success to ensure sustained yield of the resource and provide for the subsistence priority and all other uses including commercial, sport, and personal use. Coordinated efforts between the Department of Fish and Game and the federal program are necessary to maintain the health of the state's fisheries resources and to avoid disruptions of traditional fisheries. Efforts are underway to establish protocols for interactions between the department and the federal program, including coordination. The success of these efforts depends on the willingness of the Federal Subsistence Board to commit to an integrated management and research system. It is truly up to the Federal Subsistence Board whether there will be *cooperation or conflict* in the dual management of the state's fisheries resources.

IMPLEMENTING FEDERAL SUBSISTENCE FISHERIES MANAGEMENT IN ALASKA

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Federal land managing agencies in Alaska began to implement a subsistence fishery management program on October 1, 1999. After 10 years, a U.S. Ninth Circuit Court decision (*Alaska v. Babbitt*) led the Secretaries of Interior and Agriculture to include all inland navigable waters on and adjacent to Federal conservation system units as Federal jurisdiction for implementing a subsistence rural priority. Differences in Federal and State laws have resulted in the current dual management system that requires increased coordination between the Federal agencies and the Alaska Department of Fish and Game. This expanded role for Federal managers in subsistence fisheries management emphasizes the need for information sharing between the Federal and State agencies. This also creates unique opportunities to increase information gathering and analysis to complement the existing information base used as input to regulatory decision making. The Federal subsistence program is developing an integrated information/data gathering system designed to supplement existing information. Over 60% of new federal funds will go towards supplementing existing fishery information statewide. These new fishery projects will include cooperative efforts with Tribal, State, and other natural resources groups.

TELEMETRY FOR Y2K AND BEYOND

Session Chair – Douglas Palmer

A NEW PARADIGM FOR RAINBOW TROUT POPULATION ECOLOGY IN A SOUTHWEST ALASKA WATERSHED

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This study was designed to determine whether the prized rainbow trout populations of the Alagnak National Wild River and the various streams, lakes, and tributaries of the watershed consist of a single population with interbreeding spawning groups, or whether there are discrete, independent spawning populations. Another goal was to describe any variations in migration patterns among possible population groups. During 1997 and 1998, 133 adult rainbow trout over 440 mm were radio-tagged in the Alagnak River drainage and radio-tracked for various periods until March 1999. Range of the total detected upstream and downstream movement varied between less than 1 km to 122 km. The telemetry data indicate that multiple migratory and non-migratory groups may exist. Migratory groups apparently move independently, suggesting different life-history patterns. Rainbow trout within the watershed may have evolved observed seasonal movement patterns to optimize food availability during the summer and thermal refugia in the winter. This work is helping to establish a new paradigm for rainbow trout population structure and movement patterns in southwest Alaska and could have significant management implications.

VARIATIONS IN MOVEMENT PATTERNS OF RAINBOW TROUT IN SEVERAL SOUTHWEST ALASKA WATERSHEDS

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Adult rainbow trout movement patterns were studied using radio telemetry in seven different Southwest Alaska watersheds over the past 10 years. We compared and contrasted results among the watersheds to determine whether there were general similarities in seasonal movement and to reveal possible ecological explanations for observed movements. Telemetry data provided information on distance traveled from overwintering, to spawning, to summer feeding, and back to overwintering habitats. The data also generally indicated the number of population groups having similar life history patterns within each watershed. These biological characteristics were then related to various watershed features to discern ecological/habitat relationships. In general, we found wide variation in movement patterns among the watersheds although there was noteworthy seasonal movement in all watersheds. Movements appeared to be influenced by watershed features such as presence or absence of lakes, turbidity patterns, salmon runs (as a food source), and possibly thermal refuge for overwintering. Rainbow trout in some watersheds exhibited multiple life history groups as related to configuration and availability of the various watershed features. The implications for fishery management are that each watershed must be managed with an understanding for the movement patterns, population structuring, reproductive rates, and aggregation in critical habitats that have evolved within that watershed.

ESTIMATION OF THE ABUNDANCE OF CHINOOK SALMON IN THE KENAI RIVER BASED ON EXPLOITATION RATE AND HARVEST

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Standard approaches to determine the abundance of adult chinook salmon *Oncorhynchus tshawytscha* in the Kenai River in southcentral Alaska are not feasible or provide estimates that may be biased and/or imprecise. In 1996 and 1997 we estimated the inriver return of chinook salmon as a function of harvest by sport anglers divided by exploitation rate from the sport fishery. Sport harvest between river kilometer 13.5-34.0 was estimated with a roving-access onsite creel survey. We estimated exploitation rate by capturing a sample of fish with drift gillnets downstream of the sport fishery and marking them with an external radio transmitter. Sample individuals were then monitored to determine their fate. Exploitation rate was estimated by applying failure time models to the radio telemetry data. Sport harvest was estimated as 5,682 (SE = 358) fish in 1996 and 9,809 (SE = 704) fish in 1997. Marked chinook salmon were combined into groups based on time of entry into the river. Exploitation rate did not differ ($P > 0.05$) by sex, length, or time-of-entry group in either year. A total of 47 marked chinook salmon were harvested by the sport fishery in 1996 and 53 in 1997. The estimated exploitation rate was 0.14 (SE = 0.02) in 1996 and 0.25 (SE = 0.03) in 1997. The estimated inriver return was 39,356 (SE = 5,927) fish in 1996 and 39,080 (SE = 6,049) fish in 1997. Evaluation of model assumptions associated with the estimates of harvest and exploitation rate indicates that all estimates are accurate.

USE OF RADIO TELEMETRY TO DESCRIBE LIFE HISTORY CHARACTERISTICS OF DOLLY VARDEN IN THE KENAI RIVER, ALASKA

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The Kenai River supports the largest road accessible sport fishery for Dolly Varden *Salvelinus malma* in Alaska. Participation in this fishery has increased substantially in recent years with catches frequently exceeding 60,000 fish annually. Increased participation in this fishery combined with declining catches for some of the major fishing areas upstream of Skilak Lake generated concerns regarding the health of Dolly Varden populations in the Kenai River. To assist in developing a stock assessment program, a

radio telemetry study was initiated during 1996 to describe the migratory behavior and seasonal distribution of Dolly Varden in the upper Kenai River watershed. Radio transmitters were surgically implanted in 280 Dolly Varden captured in the mainstem Kenai River, Kenai Lake, and four tributary streams. Our findings from the telemetry data indicate that Dolly Varden upstream of Skilak Lake are comprised of multiple subpopulations. Spawning occurred primarily during September and October in Quartz Creek, Snow River, Cooper Creek, and the mainstem Kenai River. Lacustrine habitats were selected for winter refuge with Kenai and Skilak lakes providing the majority of overwinter habitat. Movement from overwintering locations to summer feeding areas in the Kenai River or tributary streams occurred primarily during June. Patterns of movement during summer were highly correlated with the timing and location of spawning salmon. With the exception of one radio-tagged fish which overwintered in Tustumena Lake, movements of all radio-tagged fish were confined to the Kenai River watershed suggesting that most Dolly Varden above Skilak Lake are freshwater residents.

MIGRATORY BEHAVIOR AND SEASONAL DISTRIBUTION OF DOLLY VARDEN *SALVELINUS MALMA* IN THE TOGIAK RIVER WATERSHED, TOGIAK NATIONAL WILDLIFE REFUGE.

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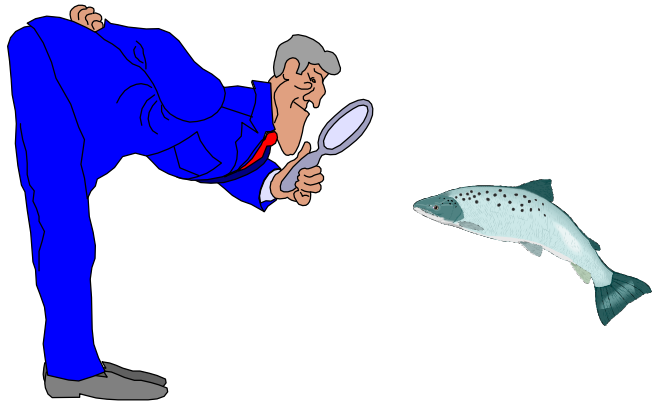
Dolly Varden *Salvelinus malma* populations in southwest Alaska are an important subsistence and sport fish resource. The Togiak River supports one of the more heavily utilized populations where the annual subsistence harvest has been estimated at over 10,000 Dolly Varden. Sport harvest is low and sport catch has ranged from 800 to 3,400 Dolly Varden annually. Both subsistence and sport fishers have expressed concerns regarding declines in abundance and size of char in the stream. In 1997 the Alaska Board of Fisheries reduced the sport fish daily bag and possession limit from 10 to 3 char per day throughout southwest Alaska, however very little biological data exist for Dolly Varden.

To provide direction for development of management strategies for Dolly Varden in the Togiak drainage the Togiak National Wildlife Refuge began a multi-year assessment of Dolly Varden in the Togiak River. Preliminary results from the first full year of radio tracking and the methodology used are presented. This study employed the use of digitally coded radio tags with a programmed duty cycle to extend the tags battery life, and the use of clove oil as an anesthetic. In addition, microchemical analysis for strontium levels across saggital otoliths were investigated as a potential method to determine anadromy.

Dolly Varden in the Togiak drainage were determined to be primarily anadromous while their time in saltwater is relatively short. These fish have an apparent affinity to specific tributaries and suspected spawning locations have been identified. All known live radio tagged Dolly Varden overwintered in the main Togiak River and Togiak Lake in concentrations consisting of mixed tributary stocks. Several fish traveled great distances after leaving the Togiak River during spring and summer.

INSTREAM INNOVATION AND DISCOVERY

Session Chair – Mason Bryant



USING REMOTE VIDEO AND TIME-LAPSE RECORDING TECHNOLOGY TO IMPROVE SALMON ESCAPEMENT MONITORING

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Aerial survey has been used to monitor salmon escapement in clear streams throughout Alaska for over 35 years. However, observer experience, water clarity, timing and periodicity of survey flights, and stream residency of target species are just a few factors shown to influence the accuracy and precision of aerial survey estimates of salmon escapement. Video and time-lapse recording technology has proven effective for capturing images of adult salmonids in controlled field situations in the Pacific Northwest and Alaska. We are developing a stand-alone system that will not require frequent maintenance and can reliably record images of migrating adult salmon in small Alaskan streams. The system includes a camera mounted above the stream that provides bank to bank coverage to facilitate total escapement enumeration and an optional second camera mounted underwater to apportion species composition for multispecies applications. The camera and time-lapse videocassette recorder are powered by 12-V batteries charged by solar, wind, or hydropower generators, depending on site characteristics. Up to 12 days of fish passage can be captured on a single 160-minute VHS tape when recorded in 180-hr time-lapse mode (i.e., 1.5 sec/frame). During June-October 1999 we operated our video system concurrently with an adult fish weir to evaluate the camera's performance under varying stream and escapement conditions. Project results and further improvements to streamline the data acquisition and reduction aspects of remote video monitoring of salmon escapement are discussed.

KAMETOLOOK RIVER COHO SALMON RESTORATION PROJECT

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Subsistence users from the remote South Alaska Peninsula Native Village of Perryville noted declines in the coho salmon (*Oncorhynchus kisutch*) run in the Kametolook River since the *Exxon Valdez* oil spill (EVOS). The EVOS Trustee Council funded this project with the intent of restoring the run to historic levels. Although salmon run data were not available or limited before the salmon decline, it was determined that instream incubation boxes in conjunction with harvest restrictions were the preferred restoration alternatives.

Involvement by the villagers of Perryville is an integral part of restoring the Kametolook River coho salmon as a subsistence resource. As part of the community involvement, an aquarium has been set up where students participate in incubating eggs and releasing fry into the Kametolook River. Since 1997, about 150 coho salmon fry have been released annually. In addition, the Perryville Village Council has hired local assistants that assist ADF&G with fieldwork including: genetic and pathological sampling, incubation box installation and monitoring, egg takes and incubation techniques, and year around monitoring of the environment.

Annually, since November 1997, coho salmon eggs have been placed in two Kametolook River instream incubation boxes. Since 1997, the Kametolook River coho escapement has shown some improvement. The increased escapement is believed to be partially attributed to self imposed inriver harvest restrictions by the villagers and commercial fishing restrictions in marine waters. All facets of this project should provide sufficient escapement within two coho life cycles for subsistence and spawning requirements.

ECOLOGICAL EFFECTS OF SALMON CARCASSES ON SEVERAL SOUTHCENTRAL ALASKA STREAMS

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The ecological effects of salmon carcasses (*Oncorhynchus sp.*) on southcentral Alaskan streams were studied by: (1) observing salmon carcass decomposition and use; (2) comparing macroinvertebrate community structure of streams receiving different inputs of salmon carcasses; (3) quantifying the amount of marine-derived nitrogen (MDN) entering stream food webs using stable isotope analysis. Abiotic mechanisms, such as large woody debris and the slow waters of stream margins and eddies were important in initial retention of salmon carcasses. Once entrained, carcasses decayed rapidly due to intense microbial processing. Stream insects and fishes were observed consuming carcasses, eggs and

smolts. Macroinvertebrate communities, either in streams receiving salmon runs or in lake outlet streams, were more diverse taxonomically. One functional feeding group, filterers, increased as a whole in relative abundance. Although many taxa responded positively to enrichment, some taxa did respond negatively. While a significant difference existed in del 15N values between MDN and terrestrial sources, the contribution of natural dissolved inorganic nitrogen to stream food webs often overwhelmed the marine signal. The del 15N values generally suggested that some MDN entered into food webs after its incorporation into algal biomass. The del N values for certain macroinvertebrate taxa, salmon fry (*Oncorhynchus sp*.), grayling (*Thymallus articus*), rainbow trout (*O. mykiss*) and American dippers (*Cinclus mexicanus*) suggest these biota directly consume substantial amounts of salmon protein. The del 15N values in individual macroinvertebrate taxa usually cycled seasonally. All three elements of this investigation support the hypothesis that salmon carcasses can be important in structuring aquatic food webs.

IT'S SUMMERTIME AND THE LIVIN' IS EASY (FOR JUVENILE SALMONIDS IN THE KENAI RIVER)

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The purpose of this project was to evaluate fish habitat and habitat use by fish at selected study locations in the Kenai River during conditions of ordinary high water (i.e., August). Habitat parameters measured included: small and large woody stems, shoreline complexity, undercut bank, overhanging vegetation, and water velocity slower than 18 cm/sec. We attempted to index fish usage of the habitats with a modified depletion sampling method by minnow trapping - but with only limited success. Results are preliminary; however, some observations suggest that habitat parameters at undisturbed sites are more complex than at other sites. Juvenile chinook and coho salmon were found in all locations that we sampled. We believe that one possible explanation for the widespread distribution of juvenile salmon may be a complex, dynamic interaction of shoreline habitat features, water velocity, turbidity, food availability, and predator behavior. It appears that food for juvenile salmon is not limited in late summer, and that predators of juveniles are targeting other food sources; hence, young fish may not be restricted to areas of shoreline cover. We encourage your comments and suggestions about this speculation.

ADDRESSING SUSTAINABILITY: A POPULATION MODEL FOR STEELHEAD TROUT OF THE KARLUK RIVER, ALASKA

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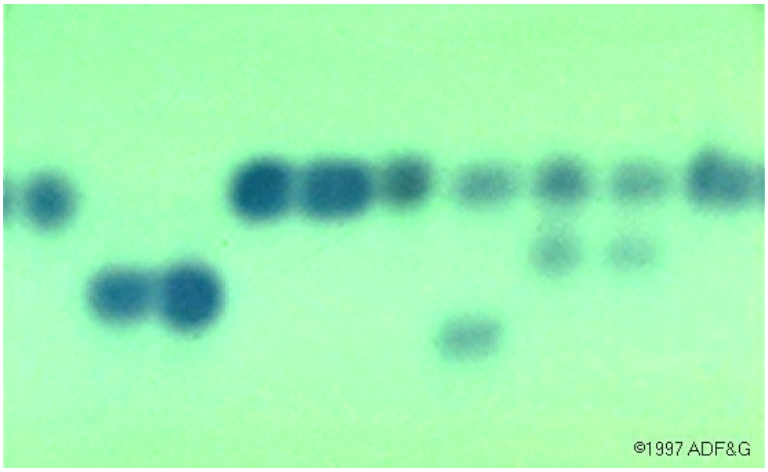
During 1991 through 1997 a study provided annual abundance information for steelhead returning to, overwintering, and spawning in the Karluk River. Estimated statistics included spawner abundance and survival from pre-spawn capture to post-spawn weir emigration, as well as marine and inriver fishing mortality rates. Capture-recapture data collected during these years allowed for definition of repeat spawning life history behaviors. From study results a stochastic adult life history model was constructed and used in simulation to evaluate sustainability of the 5-year mean fishing mortality rate. The mean rate of 0.095 was sustainable. The mean average annual yield was 822 fish and projected mean average spawning population size at 75 years was 10,088 fish. Additionally, sustainability was evaluated in scenarios that represented diverse patterns of increased fishing mortality rates in both fisheries. It was concluded that the Karluk River steelhead population responded favorably to rates up to 0.289, mean average annual yield of 2,194 fish. In contrast, recruitment diminished at rates of 0.375 and 0.395 with corresponding mean average annual yields of 2,463 and 2,674 fish respectively. It is recommended that the fishing mortality rate of Karluk River steelhead not exceed 0.30 to ensure stock maintenance.

POTENTIALITIES AND LIMITATIONS OF APPLYING GENE DETECTION TECHNIQUES FOR THE CONSERVATION OF HIGHLY EXPLOITED FISHES

Session chair – James Seeb



THE LIMITS OF GENETIC METHODS FOR DEFINING STOCKS OF MARINE FISHES

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Managers agree that the identification of demographically independent populations in a harvested species is essential for devising a sound management strategy to ensure the perpetuation of the population. However, the identification of independent population units is still uncertain for many species, especially marine fishes. Phenetic (e.g., scale analysis, growth) and genetic (e.g., allozymes, DNA analysis) methods have been used successfully for species with small population sizes and low levels of migration between populations, but have yielded variable results with marine fishes with large populations and high potentials for gene flow. The probability of success in detecting population structure depends on matching the sensitivity of a particular method with the spatial and temporal scales on which population processes shape the population structure of a species. Most genetic methods are backward looking, detecting the effects of past (sometimes ancient) population events. As a result, genetically defined stocks may not necessarily coincide with stocks defined by contemporary migration, demography, and life history variability. The useful time scales for molecular genetic methods are varied, depending upon the mutation rate of the kind of genetic material being surveyed and the amount of random genetic drift in a population. A problem in fisheries management has been to recognize the limitations of some methods in defining independent population units and to match the time scales of phenetic and molecular genetic methods to management requirements.

COMPARISON OF SPATIAL AND TEMPORAL GENETIC DIVERSITY IN WALLEYE POLLOCK USING ALLOZYME, MTDNA, AND MICROSATELLITE DATA

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Genetic studies of Walleye pollock suggest population structure is weak even among aggregations from different sea basins. This conclusion is consistent with studies of other gadid fishes. Nevertheless, the number of genetic studies of pollock is few and more evidence is needed to confirm the paucity of inter-population genetic diversity in this species. In this study we attempt to extend our knowledge of pollock population structure by addressing three important assumptions that may have been violated in one or more of the earlier studies. The first assumption is that the population samples are representative of spawning aggregates. Here we sample three populations (Bogoslof Island, Shelikof Strait and, Prince William Sound) during the reproductive cycle in late winter/early spring. The second assumption is that the genetic markers are selectively neutral. This assumption is most relevant to studies using only allozyme loci. Here we examine genetic variation using three classes of genetic markers (allozymes, mtDNA, and microsatellites), compare intra- and inter-population genetic diversity among loci and marker classes, and test for evidence of selection. The third assumption is that population structure is stable over time. Here we sample each population in subsequent years (1997 and 1998) and compare spatial and temporal genetic diversity.

GENETIC POPULATION STRUCTURE OF ROUGHEYE ROCKFISH (*SEBASTES ALEUTIANUS*) INFERRED FROM ALLOZYME VARIATION

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Rougheye rockfish (*S. aleutianus*) is currently managed in a co-assemblage with Shortraker rockfish (*S. borealis*) in the northeast Pacific Ocean. Both are highly prized as commercial species for their large size and red color. However, both are particularly sensitive to overexploitation because they are slow growing, have a high age at maturity, and are long lived. The annual catch quota for rockfish is partitioned into relatively large regions, determined geographically with little biological basis. Accordingly, adult Rougheye rockfish were sampled throughout their range (n=850) and analyzed for allozyme variation. Results show allelic frequencies to be nearly fixed at alternate alleles at 5 separate loci, potentially indicating sibling speciation. The two types (designated A and SE) were found sympatrically and in equal percentages in southern Southeast Alaska. Northward up the Southeast Alaskan coastline, fish type SE occurred in increasingly greater numbers, reaching 100% at Cape Suckling. Near Prince William Sound, a sharp transition is found from 100% occurrence of type SE to nearly 100% of type A. Only type A was found in the Aleutian Islands. Heterogeneity exists between the two types ($p<0.001$), but not within types, suggesting a single panmictic group of each type with gulf-wide gene flow, possibly by way of juvenile or larval drift.

HIGH RESOLUTION ANALYSIS OF WALLEYE POLLOCK STOCK STRUCTURE USING MICROSATELLITE DNA MARKERS

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The extent of population structure in exploited marine fish species is of critical interest to resource management and conservation. Previous published investigations of genetic structuring of walleye pollock *(Theragra chalcogramma)* populations in the North Pacific Ocean and Bering Sea have been based on either multiple low variability allozyme loci, or a single high variability mtDNA or microsatellite locus. Here, we report the development of a large suite of primarily tetranucleotide microsatellite markers that exhibit minimal PCR induced stutter for population analyses of walleye pollock. Ten microsatellite loci were screened in five putative populations of pollock in the North Pacific and Bering Sea. Preliminary findings of genetic heterogeneity among populations from the western Pacific (Funka Bay, Japan), the Gulf of Alaska (Prince William Sound), Port Townsend (Washington State), and the northwest and southeast Bering Sea are discussed. In addition, we present some recent work using single strand conformational polymorphism (SSCP) to examine DNA variation within a synaptic vesicle protein gene, synaptophysin (SypI). This gene may be affected by selection in walleye pollock and therefore potentially more informative than neutral genetic markers to detect population differences among large, widely-dispersed marine fish species.

COMBINING MOLECULAR GENETIC AND ECOLOGICAL DATA FOR CHARACTERIZATION OF SALMONIDS

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Sockeye salmon (*Oncorhynchus nerka*) spawning in proximate (20 km) tributaries were examined for variation in molecular genetic (six microsatellite loci), morphologic (body length and depth) and ecologic (run time) traits. Run time initiation differed between streams by about one month; duration also differed (26d vs. 43d). Approximately 50 males and 50 females were sampled at the beginning and late portions of each run. *Between stream* comparisons indicated

samples collected at a similar time (9-11 August) exhibited no molecular genetic difference (F_{ST} = 0) yet significant size differences (MANOVA, P<0.001). The greatest difference was observed between the two samples most separated in time (early July vs. mid August; molecular genetic: F_{ST} = 0.011, P = 0.001; morphologic: MANOVA, P < 0.0001). *Within stream* comparisons (early vs. late run) of the population originating from the geologically young (~2,000 y.o.), relatively homogenous habitat did not differ in either genetic or morphologic comparisons. However, early vs. late comparison of the population from the older (14,000 y.o.), more diverse system did differ significantly in both molecular genetic (F_{ST} = 0.006, P = 0.01) and morphologic traits (MANOVA, P < 0.0001). The data indicate that sockeye salmon originating from a common rearing lake may differ in both molecular genetic and adaptive traits, and that differences observed may be subject to bias depending on time of sampling.

ALLOZYMES DISCRIMINATE DISCRETE STOCKS OF SOCKEYE SALMON INHABITING THE CHIGNIK LAKE DRAINAGE ON THE SOUTH ALASKA PENINSULA

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Our laboratory applies gene markers to improve management of highly exploited commercial species. Gene markers are especially useful for identification of sockeye salmon (*Oncorhynchus nerka*) stocks, because the restricted gene flow resulting from comparatively precise homing of sockeye salmon to their natal site often results in genetically identifiable populations. We use variants detected in mitochondrial DNA, microsatellite DNA, and allozyme electrophoresis to describe stock boundaries and to identify component stocks in fishery mixtures. In this paper, we use one of the techniques, allozyme analysis, to investigate the population structure of sockeye salmon inhabiting the Chignik watershed.

The Chignik watershed on the South Alaska Peninsula is a major producer of sockeye salmon with annual runs often exceeding 2 million fish. Sockeye salmon spawn throughout the watershed and spend their early freshwater years in Black Lake and Chignik Lake. Returning sockeye enter the watershed during two different, but overlapping periods, commonly referred to as the early and late runs. The early run spawns mainly in Black Lake tributaries while the late run spawns in the rest of the drainage. Allozyme data from 14 collections demonstrated both temporal and geographic differences. Population groups identifiable in exploratory analyses and simulated mixture analyses included: 1) Chignik Lake, 2) West Fork, 3) Black Lake, Chignik River, and Chiaktuak Creek. This information is potentially useful to detect run timing and manage escapements into the Chignik Lake watershed.

DIFFERENCES IN GENETIC DIVERSITY IN MARINE AND LANDLOCKED STEELHEAD POPULATIONS IN SOUTHEAST ALASKA

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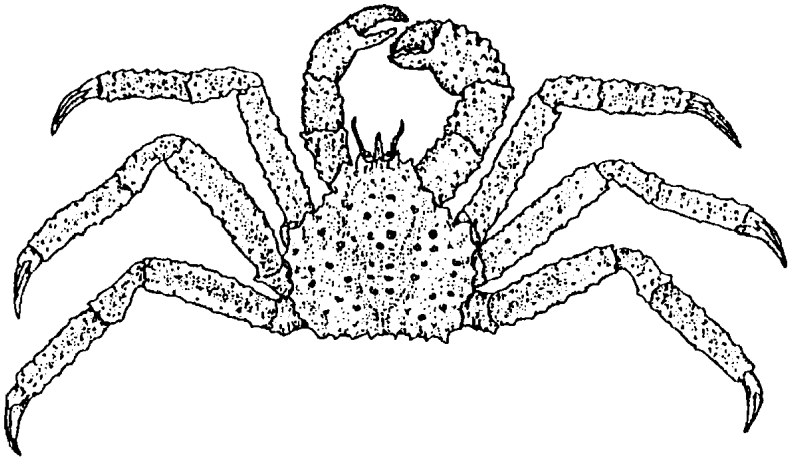
Genetic diversity was studied in trout from 7 southeast Alaska lakes over 60 years after the transfer of juvenile steelhead into previously fishless areas. Resident trout genotypes were compared to anadromous steelhead from Sashin Creek thought to be the donor population. Mitochondrial DNA and microsatellite allelic distributions were generated for 528 fish. Haplotype frequencies were significantly different between anadromous and resident trout. Steelhead carried four divergent haplotypes (MYS1, MYS3, MYS12 and MYS21), while six lake populations were monomorphic for haplotype MYS1. These results probably reflect small effective population sizes following fish transfers. Deer Lake trout were dominated by MYS1 (n=22), but also carried MYS3 (n=3) and MYS10 (n=1) reflecting a more recent (1966) transfer of fish of mixed origins. Microsatellite diversity among populations represented 11.8% of the total allelic variation. Average heterozygosity for 10 loci combined equaled 0.52. Microsatellites also showed less diversity in resident than anadromous trout. We found 49 rare and 29 unique alleles in the anadromous stock. Eight of these rare alleles were shared exclusively with Deer Lake trout. Deer Lake fish also carried 17 unique microsatellite alleles. Paired linearized *Fst* genetic distances calculated between resident trout populations ranged from 0.05 (Sashin Lake and Rezanof Lake) to 0.45 (Rezanof Lake and Deer Lake). Anadromous fish showed their closest genetic affinity to trout in Sashin Lake (*Fst* = 0.037), and trout above a waterfall on Sashin Creek (*Fst* = 0.038), suggesting significant gene flow between the resident portion of Sashin Creek and the anadromous stock (Nm = 6.79).

ADVANCES IN SHELLFISH RESEARCH AND MANAGEMENT

Session Chairs – Gordon Kruse and Dan Urban



MOONLIGHT MADNESS: TIMING OF HATCHING AND MOUND FORMATION IN TANNER CRABS, *CHIONOECETES BAIRDI*, IN RELATION TO ENVIRONMENTAL FACTORS

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Female Tanner crabs form dense aggregations of mounds during mating each spring in Chiniak Bay. From mid-April to June 1999, we investigated the relationship of mound formation to hatch timing and environmental factors on several fronts. A camera sled and ROV were used to monitor aggregation behavior; crabs started forming mounds by 13 April, and continued until June 1, forming the largest mounds ever seen. Female crabs brought into the lab, some captured from mounds, released larvae from 1 May to 6 June. Individual crabs required from 5 to 22 days to release all their larvae. Individual crabs released from 14,000 to 226,000 larvae; the most released in a single day was 106,000. Embryonic heartrate increased steadily until hatching, offering a potential method for determining developmental stage. Median hatching dates corresponded with occurrence of the new moon, and highest spring tide in May. There was no obvious correspondence between hatching or mound formation and Secchi disk depth or water temperature. Nor was there any significant difference in timing of hatching between crabs maintained in filtered or unfiltered seawater. We conclude that mound formation is associated with hatching, and is timed to occur during a period of high tidal current flow.

DEVELOPMENT OF A COMPUTER-BASED IMAGING SYSTEM FOR CRAB AND GROUNDFISH IDENTIFICATION

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A multi-year project undertaken by ADF&G first attempted to address the problem of distinguishing Bering Sea *Chionoecetes bairdi, C.opilio,* and their hybrids using a computer imaging system. Later efforts also addressed the problem of distinguishing northern and southern rock soles, (*Lepidopsetta polyxstra* and *L.bilineata*). The project also had as an objective the development of a rugged system capable of operating under extreme field conditions. Work towards those objectives was performed by a consortium of the Alaska Department of Fish and Game (ADF&G) and researchers at the University of Minnesota (UM) Department of Electrical Engineering. ADF&G biologists set the objectives and provided samples for study while the UM researchers provided technical development expertise under a contract to ADF&G.

The UM researchers were successful in extracting carapace contours from high-noise video images of whole live Tanner and snow crabs but the reliable classification of Tanner and snow crab from the extracted images will still require retraining the prototype classification system. The ability to discriminate between video images of northern and southern rock sole was also demonstrated but the classification algorithm for northern and southern rock sole should still be tested and retrained with a larger sample of video images before deploying into data collection programs. Integration of existing and newly developed software into the field computer will not be accomplished until November 1999.

Despite the partial success in meeting the project objectives, significant advances were made towards applying a computer imaging system to help solve fishery identification problems. The ability to discriminate between video images of the morphologically similar northern and southern rock sole demonstrates that classification to species of video images of other species of flatfish be easily accomplished. The ability to extract crab carapace contours from video-taped images of whole crabs demonstrates that the contour extraction algorithms necessary for image classification can be extended to use in natural settings and other uncontrolled environments.

APPLICATION OF UNDERWATER TIME-LAPSED VIDEO TECHNOLOGY TO OBSERVE KING AND TANNER CRAB BEHAVIOR IN AND AROUND COMMERCIAL CRAB POTS

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Observations of crab behavior in and around crab pots actively fished for extended soak periods have recently been made possible by the advent of an autonomous underwater video recording system. A built-in microprocessor allows time-lapse video event programming for observations over an unlimited time span. During a pilot study in 1998, red king crabs in Bristol Bay, Alaska were observed entering and egressing five pots over soak periods ranging between twenty-four and seventy-two hours. In the 1999 Bering Sea snow crab fishery, observations spanning similar soak periods were made in four commercially fished pots. Future application of this prototype system holds great promise for gaining insight into numerous aspects of crab behavior and the performance of commercial pot gear.

EVALUATION OF MODIFIED COD POTS TO REDUCE TANNER CRAB CATCH IN THE GULF OF ALASKA PACIFIC COD FISHERY

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The use of modified crab pots to catch Pacific cod *Gadus macrocephalus* in the Central Gulf of Alaska has increased from 0% in 1984 to 36% in 1999, with concurrent increases in unwanted catch of Tanner crab *Chionoecetes bairdi*. We conducted comparative fishing trials using a 'standard' cod pot and six types of modified cod pots to evaluate cost-effective pot designs that decrease Tanner crab catch and maintain desired commercial catch rates in Pacific cod pot fisheries. We define a standard cod pot as a rectangular king crab pot with tunnel eyes modified for groundfish fishing consistent with state regulations. The six modified pot types were designed to inhibit Tanner crab entry, and each were fit as a 'standard' cod pot prior to physical alteration. Experiments were conducted seasonally over a two-year period off the coast of Kodiak Island, Alaska in areas where cod and Tanner crabs are located.

Standard cod pots caught significantly ($p<0.05$) more Tanner crabs than did any of the modified pot types. However, multiple comparison tests showed no significant difference between catches of Pacific cod in one modified pot type – the 'false-tunnel' pot- and the standard cod pot. The 'false-tunnel' modification is a standard cod pot fitted with a trapezoidal web panel attached to the lower edge of the tunnel eye, extends horizontally and parallel to the bottom frame of the pot, and outward to the tunnel sides. The false-tunnel pot type as compared to the standard pot and the other five modified pot types not only effectively reduced Tanner crab catches but also maintained commercially acceptable cod catch rates.

TESTING THE FEASIBILITY OF USING AN UNDERWATER LASER LINE SCANNING SYSTEM FOR MARINE FISHERY AND HABITAT ASSESSMENT

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The Alaska Fishery Science Center's Kodiak Laboratory, in cooperation with the Alaska Department of Fish and Game, conducted a feasibility study of using an underwater laser line scanning system (LLSS) to detect trawl-induced physical and biological changes in bottom habitat. Operations consisted of: 1) general observations of organisms, bottom features, and targets such as derelict crab pots (20 tows); 2) targeted tows where sonic-tagged pods of king crabs were observed (5 tows); and 3) observation of 6 separate fresh trawl tracks (8 tows). Images obtained are similar to black and white television pictures and available in still frame or video format. Of 33 tows, the LLSS produced usable images for the entire track in 17 cases, usable images for part of the track in 14 cases and failed to obtain images in 2 cases. Web in lost crab pots, numerous organisms (starfish, crabs, flounders, kelp) and bottom features (rocks, shells, lost line, bottles, cans) were routinely and clearly visible. Observations of trawl tracks were well imaged and repeatable for two tracks, partially observable for two tracks, and failed for two tracks. Trawl tracks were difficult or impossible to observe in well-sorted sand mixed with shell hash, more easily observed in sand/silt-mud bottom and clearly observable in soft bottom. The LLSS fills a gap between side-scanning sonar and ROVs, is easily deployed, and is capable of observing some effects of trawling. The LLSS has considerable potential as a resource assessment tool for macro-invertebrates such as crabs or scallops.

MAXIMUM LIKELIHOOD ESTIMATION OF SCALLOP ABUNDANCE USING CATCH-EFFORT AND FISHERY OBSERVER DATA

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When commercial fisheries proceed in the absence of formal stock assessment surveys, abundance estimation from catch and effort data may be desirable. I explore a maximum likelihood approach to this problem that requires fewer assumptions than commonly-used least squares regression estimators such as the DeLury and Leslie methods. The flexibility of the maximum likelihood approach permits modeling of differences in catch rates due to fishery and environmental covariates. The methodology is applied to data from a commercial scallop fishery near Kodiak Island, Alaska, during 1993-1998. Haul specific information collected by a mandatory observer program for this fishery is used to account for variability in catch rates between vessels and over different parts of the bed.

COMPARISON OF FISHERY AND SURVEY INDICES OF ABUNDANCE FOR SNOW CRAB, *CHIONOECETES OPILIO*, IN THE BERING SEA

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The guideline harvest level for the 1999 Bering Sea snow crab fishery was recently reduced from levels of the last several years due to indications that the stock was overfished. Two detailed sources of information are available on the snow crab resource in the Bering Sea, providing information on location, species, sex, carapace width frequencies, reproductive parameters, parasites and injuries. The Alaska Department of Fish and Game (ADF&G) has required mandatory shellfish observers on all fishing vessels processing snow crab in the annual Bering Sea snow crab fishery since 1991. The National Marine Fisheries Service (NMFS) conducts an annual trawl survey of the eastern Bering Sea to determine the distribution and abundance of crab and groundfish species. Guideline harvest levels set by ADF&G are based solely on results from the NMFS survey that expands its estimates using an area-swept method. The NMFS survey is usually conducted from June to August, while the commercial fishery is prosecuted from January through March. NMFS survey trawl tows are executed at stations located in the center of grid cells 20 nm square. The commercial pot fishery takes place in waters up to 200 m deep along the continental shelf break from northwest to southeast of the Pribilof Islands. The overlap of fishing area is about 30% of the area surveyed by NMFS where harvestable snow crabs occur. For this investigation observer data was summarized and an average CPUE (catch per potlift) calculated per NMFS survey grid cell. Abundance indices were then calculated by dividing cell CPUE by the maximum CPUE for a given fishery season. NMFS indices were calculated in a similar manner: dividing the estimated crab per sq nm at a station by the maximum per stations. By using an index of abundance, estimates generated from NMFS surveys and observer data can be compared.

DEVELOPMENT OF A MANAGEMENT AND STOCK ASSESSMENT PROGRAM FOR THE POT SHRIMP FISHERY FOR *PANDALUS PLATYCEROS* IN SOUTHEASTERN ALASKA

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Southeastern Alaska has the last viable pot fishery for *Pandalus platyceros* in the state. With increasing effort in this fishery, we recognized a need to move towards a harvest rate management strategy. Thus we began conducting pre-season surveys of a limited area southwest of Prince of Wales Island (District 3) in September of 1997 and 1998 and a post-season survey in February of 1999. Pre- and post fishery length frequency and catch-per-pot data are modeled using change in ratio techniques to estimate harvest rate, as described by Clark et al. (*in press*). Also in 1997 and 1998, we initiated a port sampling and observer onboard floating processor program to characterize the commercial harvest.

We examined commercial harvest, port sampling, and survey data for indications that serial depletion of spot shrimp populations was occurring in southeastern Alaska. We looked at the harvest and index of abundance on various geographic scales, and analyzed length frequency and sex composition data for temporal trends. There is evidence for serial depletion within District 1. Percentage of females in the commercial catch has decreased for Districts 1 and 3 between the 1997 and 1998.

We propose a more conservative management strategy be adopted given the current level of capitalization, limited in-season management tools available, and uncertainty in life history parameters, harvest rates, and appropriate harvest level for the species in southeastern Alaska. In addition, we need to continue to accurately characterize the commercial harvest and to expand our survey program.

ANALYSIS OF MINIMUM SIZE LIMIT FOR THE RED KING CRAB FISHERY IN BRISTOL BAY, ALASKA

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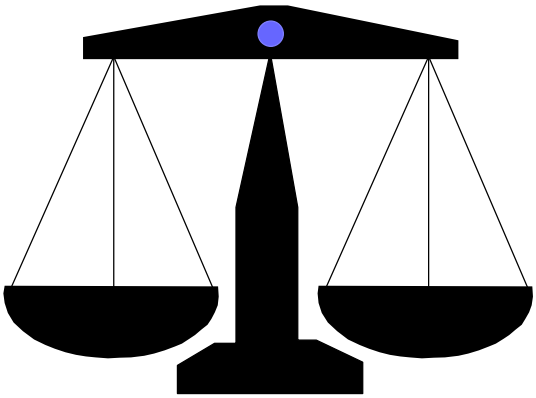
Low stock status of red king crabs in Bristol Bay prompted an industry initiative to reduce the minimum size limit for the commercial fishery from 165 mm (6 ½ in) to 152 mm (6 in) carapace width. The rationale is to reduce non-target handling mortality, a suspected contributor to depressed stocks. We

analyzed biological and economic implications of reduced size limit with a yield-per-recruit analysis and a population dynamic model coupled to an economic break-even analysis. Reduced size limit diminishes sublegal bycatch, increases legal catch rate, and reduces fishing effort needed to attain total allowable catch (TAC) levels. Average TAC (in terms of weight) declines owing to smaller mean size of landed crabs because harvest rate is defined in terms of crab numbers. Size limit has little effect on yield per recruit because of reduced catchability of small crabs. Cumulative catch under the reduced size limit would exceed cumulative catch under the current size limit after two decades of implementation. Net benefits of the reduced size limit are larger and accrue more quickly if handling mortality rates exceed 20%, while the reduced size limit never yields positive economic benefits if handling mortality rates are less than 10%.

FISHERIES CONSERVATION, RESERVES, AND HOLISTIC ECOSYSTEM APPROACHES

Session Chair – Eric Knudsen



LEGAL FRAMEWORK FOR MARINE PROTECTED AREAS

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Marine protected areas (MPA's) come in a variety of types. Each type of MPA offers a different level and/or form of protection, depending upon the primary purpose of the MPA. Within Alaska, marine protect areas may be managed by either state or gederal agencies. A variety of laws form a legal framework for designating and managaging marine protected areas.

THE PHASE-OUT OF COMMERCIAL FISHING AND THE OPPORTUNITIES FOR TESTING THE EFFECTIVENESS OF MARINE RESERVES IN GLACIER BAY NATIONAL PARK

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Collapsing fisheries around the world have caused doubt about the long-term sustainability of certain fisheries. There is an emerging hypothesis that "no-take marine reserves" could enhance the long-term sustainability of many fisheries and marine biodiversity. Scientists, fisheries managers, and even Congress are debating the value and implementation of no-take marine reserves. The importance of this

debate led the National Research Council to initiate a new study in 1998 on "The Evaluation, Design, and Monitoring of Marine Reserves and Protected Areas in the United States."

Although theoretical concepts and simulation models are rapidly developing for marine reserves, their effectiveness has been demonstrated primarily in tropical areas. Data on the effectiveness of marine reserves are very limited from high latitude ecosystems. In I992, the National Park Service (NPS) proposed regulations to close commercial fishing in Glacier Bay National Park. The proposed regulations, however, were never finalized. In 1998, Congress passed new legislation, which closed or phased-out commercial fishing in Glacier Bay. The closures that have recently been implemented and future closures (after the phase-out) could provide significant opportunities to test the effectiveness of marine reserves. We will discuss the research opportunities as well as the limitations of the closures.

KACHEMAK BAY NATIONAL ESTUARINE RESEARCH RESERVE: A LOCAL-STATE-FEDERAL PARTNERSHIP FOR LONG-TERM RESEARCH AND EDUCATION

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Abstract not available.

DEVELOPING A LONG-TERM MARINE SCIENCE PROGRAM FOR THE EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL

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The Exxon Valdez Oil Spill Trustee Council set aside $115 million to provide income for monitoring and research on mechanisms of production of living marine resources of the northern Gulf of Alaska. The new marine research fund, which will function through expenditure of investment earnings only, is expected to be providing funding in perpetuity starting in October 2002. Developing a long-term marine science program will take two years, and it will involve people and institutions that use marine science, that contribute similar science products, or that would potentially benefit from this scientific information. A committee of scientists from federal, state, university and private organizations has helped the Council staff develop an initial draft Gulf Ecosystem Monitoring (GEM) program for Council review on October 22, 1999. After revision and incorporation of comments the Council will refer GEM to the National Research Council on December 16, 1999. The draft, will be the object of a public workshop January 18-19, 2000. During the NRC review period, comment from the public is welcome at any time, and the scientific community is presently being actively pressed to contribute. Based on public comments and the NRC review delivered at a second work shop in January 2001, the revision should go out for final review in June 2001. The final program is to be adopted by the Council in late fall or early winter 2001, for presentation at a third public work shop in January 2002. The first request for proposals is in February 2002.

TOWARDS ECOSYSTEM-BASED CONSERVATION AND MANAGEMENT USING A BALANCED TROPHIC MODEL OF PRINCE WILLIAM SOUND, ALASKA

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Management of wild living resources based on single-species assessments inevitably fails to consider the indirect trophic effects of a fishery, which may be profound. Construction of a mass-balanced Ecopath model of Prince William Sound allows explicit consideration of the influence of a fishery on non-target species through simulations of various fishing scenarios. The indirect trophic effects of other types of anthropogenic disturbances, such as earthquakes and oil spills, on the various ecosystem groups and food web structure can also be simulated. New knowledge about the Prince William Sound food web has emerged from this cohesive synthesis of ecosystem information by a broad collaboration of experts. For example, the existence of previously unknown trophic cascades can be revealed. New developments with Ecosim and Ecospace allow explicit consideration of spatial and habitat features thereby providing tools to help increase understanding of food web structure and function. These new developments also enable quantitative evaluation of various strategies of marine protected areas in a whole food-web context. Natural resource managers could use this approach in conjunction with networks of monitored, marine protected areas to achieve robust and "knowledge-added" precautionary experimental management designs. Whole food web trophic models cannot replace highly detailed, single-species models. Rather, they are a complement to the manager's toolbox to enable ecosystem considerations in decision making. In general, this approach sheds light on the relative importance of trophic and other biological forces in ecosystems, and can be used to help distinguish these biological forces from non-biological forces.

DEMONSTRATION OF A GIS DATABASE FOR THE ANALYSIS OF SPATIAL FORAGE FISH DISTRIBUTION AND ECOLOGICAL ANALYSIS

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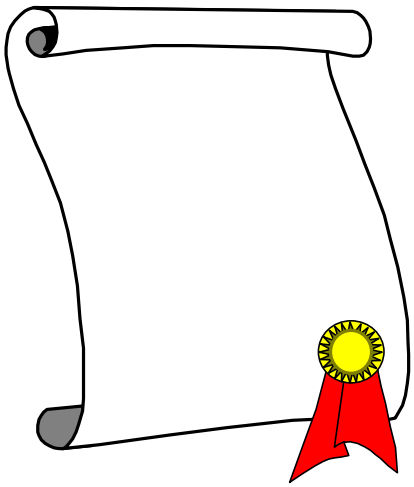
Abstract Not Available.

POSTER SESSION

Session Chair – Robert Ourso



SITE FIDELITY IN PACIFIC HALIBUT *HIPPOGLOSSUS STENOLEPIS*

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Pacific halibut are thought to be a widely migrating and panmictic species, yet communities in Alaska have experienced declining harvests from nearby areas. This "local depletion" has been occurring despite evidence from population models that Pacific halibut in the North Pacific can sustain harvests much higher than current levels. We placed wire tags (N = 1609) and sonic tags (N = 97) on Pacific halibut in Glacier Bay, Alaska, to determine the degree of within- and between-year site fidelity of this species. We found that most halibut exhibit both site fidelity and home range behavior. Home range size decreased with increasing age, and older individuals exhibited increased site fidelity. Sonic-tracking over multiple years demonstrated that many halibut return to the same areas in subsequent years. Data from wire tags corroborated the results from the sonic-tracking study, with 96% of fish tagged in Glacier Bay recaptured within the same or adjacent statistical unit. These results suggest that Pacific halibut exhibit much more attachment to particular areas than previously thought, and that these movement patterns should be considered in the management of this species.

USING GIS TO ANALYZE SPATIAL PATTERNS OF COMMERCIAL BOTTOM TRAWL EFFORT: "HOT SPOTS" IN THE GULF OF ALASKA AND THE ALEUTIAN ISLANDS

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The spatial and temporal patterns of bottom trawl effort in the Gulf of Alaska (GOA) and Aleutian Islands (AI) from 1990-1998 were analyzed using domestic observer data. Areas of high bottom trawl effort within the GOA occur in the Kodiak region where there have been directed fisheries targeting Pacific ocean perch (POP) (*Sebastes alutus*), Pacific cod (*Gadus macrocephalus*), and flatfish. The Aleutian Islands has had high trawl efforts for Atka mackerel (*Pleurogrammus monopterygius*) and POP. GIS was used to determine where concentrations of bottom trawl effort occurred. The resulting data were classified to show areas of low, medium and high trawl effort in both numbers and duration. Bottom trawl effort data were plotted to examine the relationship with bathymetric contours along coastal GOA and AI. Twenty-one regions of the high bottom trawl effort were categorized. The areas of the highest estimated number of bottom trawls were on the continental shelf at a depth of 101-200m in both the Aleutian Islands and the Gulf of Alaska. Density values of trawling (number of trawls per km2) for the GOA overall were 0.35/km2, with the highest density in the Kodiak region at 1.43/km2 in an area of 4,4,657 km2 in 301-500m depth. The highest bottom trawl duration in the GOA was at a depth of 101-200m, with the highest number of days trawled/ km2 in the Chirikof area at 0.74 days/km2 in 301-500m. Density of trawling in the entire AI region was 0.56 trawls/km2. The Eastern Aleutian area had the highest density 1.56 trawls/km2 in an area of 7,909 km2 in 101-200m. Most of the changes in effort occurred in the Eastern Aleutian Islands and Eastern Gulf of Alaska. Project funding was provided by NMFS.

INTEGRATING ECOSYSTEM CONSIDERATIONS INTO GROUNDFISH FISHERIES MANAGEMENT OFF ALASKA, USA

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The Council has been developing an ecosystem-based management approach that involves public participation, reliance on scientific research and advice, conservative catch quotas, comprehensive monitoring and enforcement, bycatch controls, gear restrictions, temporal and spatial distribution of fisheries, habitat conservation areas, and other biological and socioeconomic considerations. The most basic ecosystem consideration employed is a precautionary approach to extraction of fish resources. Off Alaska, all groundfish stocks are considered healthy, while providing sustained yields of over two million metric tons annually. Management measures are also taken to minimize potential impacts of fishing on sea floor habitat and other ecosystem components such as marine mammals and seabirds. This poster reviews the primary principles of the Council's ecosystem approach.

THE USE OF SONAR TO MANAGE CHINOOK SALMON FISHERIES ON THE KENAI RIVER, ALASKA

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Kenai River chinook salmon are among the largest in the world and have sustained an average of 88,747 angler-days of recreational fishing participation annually since 1974. Chinook salmon return to the Kenai River in two temporal components: an early run that enters the river in May and June and a late run which enters the river from 1 July through mid-August. The early run has a biological escapement goal of 9,000 chinook salmon and is harvested exclusively by sport anglers while the late run has a biological escapement goal of 22,300 and is harvested by sport, commercial and personal use fisheries. Both dual-beam (1987 – 1994) and split-beam sonar (1995 – current) have been used to provide daily estimates of inriver return used to manage these two runs. The Kenai river chinook sonar program faces two unique challenges: the intertidal location of the sonar site and the difficulty in discriminating chinook salmon from more abundant sockeye salmon. Management has evolved from a total reliance on sonar, to a system, used in 1998, that evaluates the efficacy of the sonar estimate and incorporates several other indices of chinook abundance.

THE WOOD RIVER SONAR PROJECT – RESULTS TO DATE

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The Alaska Department of Fish and Game has two years (1998-1999) of data looking at various sockeye salmon passage rates in the Wood River, Alaska. In 1998, a test of the BioSonics DT 6000 sonar in side-looking configuration showed poor spatial position for automatically tracked fish. Post processing these data by BioSonics also produced inaccurate estimates of fish location. BioSonics provided no substantiated hypothesis for this inaccurate positional information to ADF&G prior to scheduled sampling in year two. Therefore, we designed a study for 1999 to test the hypothesis that the inaccurate positional structure was due to system settings rather than system hardware or software. We paired a

BioSonics DT 6000 system with an HTI Model 241 to test this hypothesis. We collected paired tests of ping rate, pulse width, and transducer geometry for both systems. Both systems produced similar temporal and spatial tracks in 1999. BioSonics modified their systems in 1999 by reducing the receive sensitivity and power output. The effectiveness of the tracking algorithms was difficult to interpret because of the lack of a standardized procedure for setting tracking parameters. Automatic-tracking estimates and echo-counting estimates linearly correlated to visual tower counts to about 3000 fish/hour, then appeared to reach an asymptote, indicating either the system was unable to track at high densities, or that the tracking parameters would need to be adjusted differently than at lower densities. These results show the need for developing a procedure for setting automatic tracking parameter values, and the need for visual diagnostic software.

ESTIMATING FRESHWATER SURVIVAL OF YUKON RIVER CHUM SALMON

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Compared to more southerly stocks of chum salmon, information about the ecology, behavior, and productive capacity of Yukon River chum salmon is limited. While escapement indices, and in a few cases weir- or sonar-derived population estimates, are available for some of the most significant spawning populations, little is known about factors affecting production and survival during the freshwater portion (from egg deposition until smolt emigration) of the chum salmon life cycle.

We have established two intensive study sites, one summer-run and one fall-run, where we are quantifying spawning intensity, habitat, and survival. The overall goal of the study is to estimate chum salmon survival from spawner to smolt emigration. Nested within the goal are estimates of survival from spawner (potential egg deposition) to actual egg deposition, from egg deposition to pre-emergent fry, from pre-emergent fry to smolt emigration. Spawner abundance is monitored at weirs, which define the upper and lower boundaries of the study areas. Unique color/numerically coded tags allow us to identify individual fish. Individual spawning locations (redds) are mapped (Universal Transverse Mercator coordinates) using a digital theodolite and various habitat characteristics are measured at each redd (e.g., water depth, water velocity, inter-gravel water temperature, and substrate composition). We have tested the feasibility of using a hydraulic redd pump to estimate intragravel survival and density of incubating eggs and alevins (pre-emergent sac-bearing fry). In 1999 we initiated a new sub-study component to assess the spatial distribution of intragravel flow (upwelling) as well as dissolved oxygen, temperature, and conductivity within both study sites. As part of this sub-study, we are deployed artificial incubation baskets containing a known number of fertilized eggs to test for relationships between egg/alevin survival and intragravel conditions. Funnel nets are used to collect emigrating smolts. Mark-recapture techniques are used to evaluate smolt trap efficiency and expand trap catches to estimate total smolt production.

We have had several major successes but still have some difficult sampling challenges ahead. Our observations indicate that operation of weirs on the spawning grounds is possible without disruption of spawning behavior. However, high-water events can result in intermittent weir operations and reduced visibility in our Hodgin's Slough site (e.g., during August 1998). The numbers of spawning fish in the Bluff Cabin Slough site can be highly variable among years (e.g., 107 females during 1997 compared to 6 during 1998). These realities of doing *in situ* research emphasize the need for a multiple year and study site program. Detailed mapping of spawning locations allows examination of inter-annual spawning

patterns and helps determine the degree of redd superimposition. The development of study site maps integrated with environmental characteristics sets the stage for spatial analysis of habitat selection and preference. Intragravel hydraulic pump survival estimates at the study site scale appear to be possible, at least up to the eyed-egg stage. However, intragravel estimates of total production (i.e., in terms of numbers of eyed eggs or alevins per unit area) are not tenable due to high sampling variances. We have successfully instituted a program to assess the intragravel environment and its affect on the survival of incubating eggs and alevins. Based on smolt out-migration estimates for the 1997 brood year, survival from potential egg deposition to smolt out-migration was higher for the summer-run site (15%) compared to the fall-run site (4.5%).

After 5 years of data collection on some of these critical life stages, models relating spawner abundance and environmental drivers to critical life stages may reveal controlling factors and ultimately become useful in refining predictive management models.

QUANTIFICATION OF UPWELLING AS A DETERMINANT OF SPAWNING SITE SELECTION AND QUALITY FOR YUKON RIVER CHUM SALMON

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Although chum salmon in Alaska often use areas of upwelling for spawning, no quantification has been made of the importance of upwelling in terms of defining available spawning habitat or its effect on the survival of incubating eggs and alevins in the Yukon River drainage. Within the framework of ongoing USGS Yukon River chum salmon research, we are evaluating the spatial distribution of upwelling and other intragravel environmental factors in one summer-run (Hodgin's Slough, Chena River) and one fall-run (Bluff Cabin Slough, Tanana River) spawning area. Our overall study objectives are: measure the relative magnitude and distribution of upwelling in one summer-run and one fall-run chum salmon study site from the time of spawning (i.e., fertilization) through emergence; compare the distribution of spawning fish within each study site to the distribution of upwelling; and compare the survival of eggs and alevins incubated across a gradient of upwelling and other environmental conditions.

During 1999 we systematically deployed piezometers (stand pipes) along transects in both summer-run and fall-run chum salmon spawning areas. These piezometers allow us to measure the hydraulic pressure differential between subsurface and surface waters, substrate permeability, and subsurface water velocity. In addition, we are monitoring dissolved oxygen (DO), conductivity, and temperature within each piezometer. At each study site, piezometers have been installed in a geo-referenced (Universal Transverse Mercator (UTM) coordinates) grid pattern along 11 transects, for a total of 44 piezometers at the Chena R. and 48 piezometers at the Tanana R. study sites. Adult fish weirs are used to enumerate adult fish in each study site and the positions of individual spawning females are recorded as UTM coordinates.

Survival of eggs and alevins is being evaluated using *in situ* incubation baskets. At each study site the eggs from three females are pooled and fertilized using three males. Eggs are counted into groups of 100 and each group placed into an incubation basket. The general design is to bury the incubation baskets in clusters of three associated with individual piezometers. A total of 48 (16 clusters of three) and 42 (14 clusters of three) incubation baskets have been placed in the Hodgin's Slough and Bluff Cabin Slough

study sites. Deployment of incubation basket groups was determined after collecting initial hydraulic and water quality measurements during late July (Hodgin's Slough) and mid-September (Bluff Cabin Slough). From each group, one basket will be removed at the eyed-egg stage, one at the pre-emergent stage, and the third will remain in the gravel until emergence and live and dead individuals enumerated.

Our initial measurements in Hodgin's Slough showed large variation in hydraulic variables, temperature, and DO. While relatively distinct patterns were evident for temperature and DO, the variation in hydraulic values were patchy. In contrast, measurements taken in the Bluff Cabin Slough study site indicated a more homogenous environment.

We feel that the techniques that we are employing will provide a quick and relatively inexpensive means to quantify the subsurface environment in remote salmon spawning areas. Measurements from our study sites will begin to describe factors influencing chum salmon spawning site selection and the subsequent survival of incubating eggs and alevins. Certainly our first winter of attempting to take these measurements in the harsh interior Alaska environment will be a test of the overall feasibility of our methods.

THE EFFECT OF URBANIZATION ON STREAMS IN THE MUNICIPALITY OF ANCHORAGE, ALASKA: CURRENT PROJECT STATUS

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The Cook Inlet National Water Quality Assessment (NAWQA) program has begun a study of the effects of urbanization on streams and associated biota in Anchorage. Fourteen sites located in five local watersheds were selected in the summer of 1999. Water chemistry (major ions, nutrients, DOC/SOC, suspended sediments), field properties (specific conductance, dissolved oxygen, pH, and water temperature), bed sediments, invertebrate, and chlorophyll-a data were collected. GIS is currently being used to determine the percent impervious cover upstream from each monitoring site in its respective basin. Winter low-flow and break-up sampling of field properties, water chemistry, and microbiological components (bacteria and coliphages) at the 14 sites is scheduled for March 2000 and April 2000, respectively. High intensity sampling is planned for the summer low-flow period (June to mid-July). Sampling during summer 2000 will include all of the above components in addition to the collection of habitat, fish species composition and abundance, and algae data. Semipermeable membrane devices will also be deployed to assess the occurrence of polycyclic aromatic hydrocarbons (PAH's) in the streams. Data collected during this study will be used for local paired watershed comparisons as well as for use in national syntheses of urban gradient studies. The data will also be used as baseline information for future studies and to determine the effect of urbanization on Dolly Varden and Coho salmon. Preliminary results from the water chemistry analysis show that Chester Creek and Little Rabbit Creek have elevated levels of many major ions and nutrients.

SALMON CARCASSES SUBSIDIZE AQUATIC-RIPARIAN FOOD WEBS IN SOUTHEAST ALASKA

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Pacific salmon (*Oncorhynchus* spp.) elevate the productivity of aquatic-riparian food webs in Alaska via the carbon and nutrients they provide after migrating to fresh water to spawn and die. In Southeast Alaska alone, over 100 million salmon spawn in fresh water every year delivering tons of energy and nutrient-rich biomass to aquatic-riparian ecosystems. Once salmon enter freshwater habitats, floods and bears, along with other scavengers and carnivores, serve as nutrient vectors as they carry and scatter salmon carcasses throughout adjacent riparian habitats. These scavengers and carnivores also consume salmon, subsequently scattering their feces in streams and riparian zones. Consequently, nutrients are often spread throughout aquatic and riparian areas at high concentrations. In streams, the major trophic levels (algae-bacteria-fungi, aquatic invertebrates, salmon-trout-char) dramatically respond to nutrient enrichment from carcasses through increased abundance, growth rates, and production. Salmon carcasses in streams and riparian habitats are colonized and consumed by aquatic and terrestrial invertebrates, facilitating nutrient cycling and potential uptake by microbes and plants. Juvenile salmon, trout, and char benefit from increased aquatic prey abundance, from terrestrial prey that wash back into freshwater habitats, and from feeding directly on salmon carcasses and eggs. Although it is not yet clear the amount of carcasses that are needed to sustain aquatic-riparian productivity, early evidence shows that more nutrients generally means greater productivity. While it is becoming clear that aquatic-riparian food webs along the Pacific coast rely on salmon runs to sustain their productivity, a better understanding of this annual nutrient enrichment (and therefore salmon returns) is needed for better fisheries, wildlife, and ecosystem management. This natural positive feedback mechanism may be crucial for sustaining food webs, fisheries, and wildlife populations in systems receiving salmon and other anadromous fishes.

SALMON CARCASSES INCREASE GROWTH OF STREAM-DWELLING SALMONIDS IN SOUTHEAST ALASKA

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Millions of salmon annually return to streams in the Pacific Northwest to spawn and die. Marine-derived nutrients from salmon carcasses influence freshwater food web productivity by elevating biofilm and benthic invertebrate standing stocks, the latter an important food of stream-dwelling salmonids. We conducted experiments in outdoor artificial and natural streams to determine the influence of salmon carcasses and eggs on growth of juvenile coho salmon *Oncorhynchus kisutch*, cutthroat trout *Oncorhynchus clarki*, and Dolly Varden char *Salvelinus malma*. Growth rates of all species were considerably greater in the presence of carcasses and eggs, and coho salmon growth increased with greater amounts of carcass tissue. Escapement goals (the number of salmon returning to fresh water) should consider the influence of salmon carcasses on stream-dwelling salmonid production.

RED KING CRAB ECOLOGY AND PODDING BEHAVIOR

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Information in these posters adds to our understanding of red king crab behavior and ecology. Importantly, the podding behavior of red king crab causes them to be distributed so that much of the sea floor might contain no crab, and a relatively small area might contain extremely high numbers of crab. Podding behavior is unique to red king crab and results in a degree of spatial patchiness greater than that for other, major target species in the Bering Sea. Podding exacerbates sampling error in resource-assessment surveys, degrades the reliability of stock-size estimates, and increases the potential for massive, undocumented bycatch losses in single trawl-hauls known as "red bags". At present, the understanding of resource managers conforms to the conventional wisdom that podding behavior ceases after age 3-4, when red king crab apparently disperse to a more amenable spatial distribution. These poster photographs, part of a 10-year, in-situ study at Kodiak to document the behavioral ecology of red king crab, support the contrarian hypothesis that podding continues into adulthood, well after the crab become targets of resource-assessment surveys.

SETTLING BEHAVIOR AND SUBSTRATE PREFERENCE OF RED KING CRAB (*PARALITHODES CAMTSCHATICUS*) GLAUCOTHOE

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Young- of- the- year king crab are almost always found on complex substrates. An experiment was conducted to determine if this was the result of chance or choice. Newly hatched king crab larvae were cultured through 4 larval stages to the postlarval glaucothoe stage, during which settlement occurs. 100 glaucothoe were placed into each one of seven 10-l aquaria containing test substrates. Three tanks of mixed substrates contained sand, gravel, and plastic fiber mesh in separate trays; 3 tanks contained only sand, gravel or mesh, and one control tank held no substrate. Numbers of glaucothoe swimming, and settled on each substrate were counted daily until all had molted to first stage crab or died. Glaucothoe preferred mesh (62%) over gravel (17%), and refused to settle on sand (1%), although 20% were observed on the tank bottom or airstones. Percent of glaucothoe settling on mesh increased from 45% on day 1 to 75% by day 20. Glaucothoe with access to preferred habitats settled, on average, one day sooner than those in the sand tank, a significant difference. Glaucothoe on mesh or gravel remained there around the clock, but those in the sand tank showed strong diurnal swimming behavior. The results show that king crab glaucothoe actively select complex 3-dimensional substrates for settlement, and may delay metamorphosis in the absence of preferred substrates.

THE RED KING CRAB FISHERY OF THE KODIAK ARCHIPELAGO

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The red king crab of the Kodiak Archipelago once numbered over thirty million crab in the middle of this century, and now there are fewer than 200,000. A major fishery on these red king crab developed slowly at first, then proceeded rapidly once markets were well established. The chronicling of this fishery through its stages of development, peak, and ultimate crash can provide insight as to the ingredients of a collapsed fishery. It illustrates a pattern of fishery exploitation that is inconsistent with sustainable fisheries, and illuminates some of the elements important for recovery of the stock.

THE FEEDING ECOLOGY OF MATURING SOCKEYE SALMON DURING THEIR FINAL NEARSHORE MIGRATION

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During the summers of 1998 and 1999 the feeding behavior of maturing sockeye salmon (*Oncorhynchus nerka*) was investigated both spatially and temporally. This study focused on fish during the final stages of their spawning migration in the nearshore waters of the Kodiak Archipelago, while approaching their natal streams. Stomach samples from commercially caught sockeye were collected and examined at a shore based processing facility at weekly intervals, from early June until the end of August. Of the seven geographic areas sampled , five were classified as being principally migration corridors, one as a terminal harvest area and one as an inshore transition zone between the terminal and migration areas. Feeding rates for the population were determined by the presence or absence of prey items in the digestive tracts of individual fish for each strata. Whole, intact digestive tracts from feeding individuals were retained for further analysis of prey item content.

A total of 11,830 sockeye were examined during 1998-99. The proportion of actively feeding fish varied with period and area, displaying a positive relationship to the timing and strength of the runs, and to distance from the natal stream. Feeding rate declined gradually, rather than abruptly, as they neared their natal streams. Although prey analysis is in progress, sockeye principally consumed zooplankton (larval decapods and euphausiids), exhibiting little piscivory.

American Fisheries Society, Alaska Chapter

Business Meeting Agenda - November 10, 1999

Kodiak, Alaska

Determination of Quorum
Call to Order

Introductions of Officers, New Members, and Guests
Approval of Minutes from 1998 Alaska Chapter Business Meeting

Treasurer's report

Installation of New Officers
- Vice President
- Secretary

Committee reports (see written reports)

Aquatic Education	Mary Price
Awards	Nicky Szarzi
Chapter Historian	Jim Reynolds
Continuing Education	Pat Hansen
Cultural Diversity	Kate Wedemeyer
Electronic Communications	Allen Bingham
Environmental Concerns	Eric Knudsen
Fishes of Alaska Key	Bill Wilson
International Relations	Fred DeCicco
Local Arrangements	Jim Blackburn
Membership	Carol Ann Woody, Allen Bingham
Oncorhynchus Newsletter	Mike Murphy
Past Presidents	Buck Bryant
Resolutions and By-laws	Dennis Tol
Status of Salmon Stocks	Alex Wertheimer
Student Sub-unit	Lisa Mostella, Karla Granath
Wally Noerenberg Award	Gordon Kruse

Outgoing President's Address

Installation and Comments of New President

New Business

Mentoring Program

New Committee Chairs and Members - Environmental Concerns, Strategic Planning (ad hoc)

Comments on the 1999 Chapter Meeting

Future Meeting Planning
- Consideration of 2004 Parent Society Meeting
- Consideration of Western Division Meeting
- 2000 Chapter Meeting

Adjourn

MINUTES FROM 1998 ALASKA CHAPTER BUSINESS MEETING

American Fisheries Society, Alaska Chapter
Business Meeting - October 2, 1998

Quorum was determined by a show of hands, 26 members of the Alaska Chapter were present. Meeting was called to order at 3:15 PM.

Mason (Buck) Bryant, president introduced the Executive committee of the Alaska Chapter: Cindy Hartmann, president-elect; Bill Bechtol vice-president; Allen Bingham, treasurer; David Wiswar, secretary; Mike Byerly, University of Alaska Fairbanks-Southeast student sub-unit president; incoming vice-president Carol Ann Woody; and incoming treasurer Sue Walker (not present).

Also present and introduced were: Bob Carline, President AFS; Bob Bilby, WD president; Carl Burger, 1st vice president; Carlos Fetterolf, past president AFS; Pete Bisson, WD past president.

Buck Bryant introduced Alaska Chapter historian Dr. Jim Reynolds who gave a brief oral history and slide presentation. Dr. Reynolds prepared a brochure of the Chapter history, which was given out at the meeting (attachment).

A motion was made to approve the minutes from the 1997 Alaska Chapter Business meeting and was seconded. The motion was adopted.

Treasurer's report: Treasurer Allen Bingham reported a net balance of $79,846.34 as of September 27, 1998. Including $27,268.36 in the main Alaska Chapter checking account; $22,788.76 in the cash management interest-bearing account; $7,080.45 in a Certificate of Deposit (CD) for the Cultural Diversity Award Fund; $10,100 in a CD for the Wally Noerenberg Award Fund; $2,742.14 in the Fishes of Alaska Key checking account; $2,849.52 in the Raffle checking account; $9,230.05 in Accounts Receivable; $2,649.50 in Undeposited Funds; and $4,862.44 in Accounts Payable. (Attachment: Treasurer's Report of AK Chapter Annual Business Meeting)

The question was asked as to why there is approximately $27,000 in the Chapter's main checking account. It was explained that it is not unusual to have a lot of money in checking this time of year in that all the bills for the current meeting have not been received as of yet. Also, another contributing factor was that the continuing education courses did well this year and brought in money. Money is kept in reserve to start up the next year's Chapter meeting, initiating special projects such as continuing education, and keeping up with payments for the fish key of Alaska project. Another consideration is that there is a potential debt from the Arctic Fish Symposium to the parent Chapter.

The treasurer's report was accepted and approved.

Local arrangements: Bill Wilson, chair of the local arrangements committee gave special thanks to the staff of the Hilton Hotel for their endeavors in making the meeting a success.

Committee Reports: (see attachments)

Membership - Bill Bechtol reported that as of this meeting there were 438 members. Allen Bingham is in charge of the Chapter's membership database.

Student Sub-unit - Mike Byerly reported that the subunit was active with representation at both the University of Alaska Fairbanks and UAF Southeast, Juneau. Students from the subunit have assisted at this meeting with registration, raffle sales, and video components of the sessions.

Cultural Diversity - Joe Sullivan, chair, announced that a travel award to attend this meeting was presented to Kathleen Menke in the sum of $350. Kathleen is a freelance journalist from Haines, Alaska whose work includes fisheries and fisheries related publications.

Electronic Communications - Norma Jean Sands, chair, reported that the Web Site Home Page had been expanded to include issues of the newsletter Oncorhynchus, continuing education courses, capabilities for graphics, and a link to the Alaska Sea Grant for information about this joint meeting. The web site address is http:\\www.alaska.net\~fishak\. The e-mail address for comments about and contributions to the site is fishak@alaska.net

Fishes of Alaska Key - Bill Wilson, chair, gave a brief synopsis of the key and the work completed to date. The Parent Society office is to receive a draft this summer to ensure that the format is compatible for publication. The completion date for a camera-ready publication is this winter 1998/1999. Title, authorship, number of copies, price per copy, and numerous other details still need to be worked out.

Environmental Concerns - Eric Knudsen, chair, reported that the committee's contribution this past year was to provide comment on the National Marine Fisheries Service's draft recommendations to the North Pacific Fishery Management Council concerning Essential Fish Habitat (EFH).

Wally Noerenberg Award - Gorden Kruse, chair, reported that there were no nominations for the award this year.

Awards - Nicky Szarzi presented the names of people who received an award at the Chapter meeting in Juneau in 1997. Best Poster was awarded to Carol Kerkvliet, Penny Crane and Lisa Seeb; Best Student Paper went to Jennifer Boldt, and Best Paper was by John Hudson, Mark Wipfli and John Caouette.

Stocks at Risk - Alex Wertheimer, chair, said the committee was charged with extending status review of salmon species to the rest of Alaska. The initial report covered southeast Alaska.

Continuing Education - Report not available.

Past Presidents - Dana Schmidt, chair, nothing to report.

Resolution and By-laws - Dennis Tol, chair, said that the wording in the by-laws regarding Chapter dues for students was changed to reflect the way business is actually carried out. No new resolutions were submitted for consideration. Dennis noted that much of what the committee once handled has been taken up by the Environmental Concerns Committee.

Oncorhynchus Newsletter - Mike Murphy, editor, reported that things are going well.

Other Old Business: None

Bob Carline, president AFS, addressed the Chapter with a brief salutation.

Cindy Hartmann thanked AK chapter members and others who helped with the 1998 meeting. Special recognition was given to:

Brenda Baxter, Sea Grant
Bob Bilby, program chair, WD president
Bill Hauser, local arrangements chair
Bill Wilson, local arrangements contact with Hilton Hotel

Allen Bingham, program schedule and meeting budget.

Outgoing President's Address:
Buck Bryant expressed his gratitude at being able to serve as the AK Chapter president this past year. He expressed the importance of fishery biologists being able to communicate their concerns with their constituents. He related the fable of "the Weaver and the Worm" by James Thurber with its moral that a word to the wise is insufficient if the message is not understood.

New President's Comments:
Cindy Hartmann presented her goals for the Chapter for the next year. They are:
continue to integrate upland and marine disciplines in Chapter participation
reevaluate the traditional meeting time to determine if a change would draw more and new people to the meetings
review the Chapter's strategic plan to see if it needs updating to coincide with that of the parent AFS
get the Excom and committee chairs working more closely together, and
strengthen the Chapter's membership and broaden its diversity.

New Business:

Committee Chairs - New chairpersons are needed to head several committees within the Chapter. Cindy asked that people attending the business meeting to help get the word out and recruit new committee chairs and to encourage AK Chapter members to become active committee members.

The 1998 Meeting - Bill Bechtol led a short discussion on the possible timing and location of the 1999 meeting. The members present gave their support to the Excom to decide the time and place of next year's meeting. Dates of the meeting were not announced, but the location will probably be Kodiak.

Adjournment: A motion was made to adjourn, and seconded. Motion to adjourn carried by voice vote. The meeting adjourned at 5:35 PM.

Attachments:
25th Anniversary brochure
Treasurer's report
Committee reports

AQUATIC EDUCATION COMMITTEE MEETING

REACH OUT AND TEACH SOMEONE

Mary Price

The Aquatic Education Committee will be meeting during the 1999 Annual Meeting. The group will gather Tuesday evening at the Kodiak Inn in conjunction with the poster session and social (so you don't miss a thing!). The exact time will be announced during the first session. This informal meeting is open to everyone who is involved with or interested in aquatic education activities in Alaska. Objectives for this meeting are to 1) identify the committees interests and develop some action items, 2) update the directory of fisheries and aquatic educators, and 3) just good old-fashioned socializing...ahem...I mean professional networking.

LOCAL ARRANGEMENTS COMMITTEE

Jim Blackburn - Chair
Brad Stevens
Bob Otto

SESSION PLANNING COMMITTEE

Bill Bechtol
Jerry Berg
Debby Burwen
Eric Knudsen
Tom Kron
Gordon Kruse
Robert Ourso
Doug Palmer
Jim Seeb
Dan Urban

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