Artist's Statement by Robert Davis

Robert Davis is a Tlingit artist from Kake, Alaska. He considers his artwork and writing neo-traditional, as evolutions from traditional forms. Even as art, culture, history and technology are constantly driven forward, they are built on precedent. Contemporary art is as traditional and relevant as its precedent was in its own time, both forms having looked back-ward and forward even as they are conceptualized.

Discipline regards the sustenance of the next seven generations. An artist creating for the sake of innovation only creates useless art. It does not contribute. It is waste—of time, material, and ones own life. Waste accumulates. Technological advances for the sake of profit and progress also waste time, material and lives. They create waste, which accumulates for future generations to clean up. The freedom to create should start to hinge on philosophies of sustenance!

Technology allows more innovation, but we innovate in regard to usefulness. If one employs innovation as an end in itself, one's work has no meaning but to oneself. We have that permission, but does it not require responsibility? The same principle holds for use of any technology. Our ability to innovate must be reined in by visioning in the historical context; we must consider teachers such as Chief Seattle:

> "Whatever befalls the earth befalls the sons of earth. If men spit upon the ground, they spit upon themselves."
> "Man did not weave the web of life - he is merely a strand in it. Whatever he does to the web, he does to himself." – Chief Seattle, 1854.

Ambition is not evil. The artist's salmon border represents salmon whose sole drive is a fight upstream to spawn, die and regenerate. Re-creation with purpose and a theme of sustainability are more likely to keep the streams of art, culture, history and technology not only less wasteful, but also rich food for our bodies, minds and spirits, and those of our children, grandchildren and great-grandchildren.

What is the American Fisheries Society?

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*, *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.

The Alaska Chapter of AFS

The Alaska Chapter is the local organization in Alaska for the American Fisheries Society. Our chapter is one of the larger ones with over 400 members. Major activities include our annual meeting which consists of technical paper presentations, special guest lecturers, and continuing education courses for fisheries professionals. We are also actively supporting the production of a comprehensive taxonomic key to Alaska's fishes. Through resolutions and letters to policy makers, the Chapter has supported continued conservation and stewardship of Alaska's fisheries.

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Schedule at a Glance

NOVEMBER 14-15, 2004 - Continuing Education and Opening Reception
All events are held at Harrigan Centennial Hall

Day/Date	Time Period	Location			
		AUDITORIUM	**ROUSSEAU ROOM**	**MAKSOUTOFF ROOM**	**EXHIBIT ROOM**
Sunday, Nov. 14	All Day	*(No events scheduled for the Auditorium for Sunday)*		CE Course: ArcView for Applications for Fisheries Scientists I 8:30 am - 5:00 pm	
Monday, Nov. 15	Morning		CE Course: Fundamentals of Bayesian Statistics 8:30 am-12:00	CE Course: ArcView for Applications for Fisheries Scientists II 8:30 am - 5:00 pm	
	Afternoon		CE Course: Under the Gavel: Moving Meetings Effectively with Roberts Rules of Order 1:00 - 3:00 pm		
	Late Afternoon	CE Course: Speaker Tips & Guinea Pig Talks 3:00 - 5:00 pm			
		Student Worker Training 5:30 - 6:00 pm			
	Evening	Student Subunit Meeting 7:00 - 7:30 pm			**Registration and Opening Reception** 6:00 - 8:00 pm

<table>
<tr><th colspan="5">NOVEMBER 16-18, 2004 - Conference
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<tr><td rowspan="7">Tuesday, Nov. 16</td><td rowspan="2">Early Morning</td><td>Plenary Session
8:05 - 9:30 am</td><td></td><td rowspan="3">EXHIBIT ROOM
Conference Registration Desk Open
7:30 am - 2:00 pm</td></tr>
<tr><td colspan="2">Break 9:30 - 10:00 am</td></tr>
<tr><td>Late Morning</td><td>Contributed Papers
10:00 am - 11:40 am</td><td>Contributed Papers
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11:40 am - 1:00 pm</td><td>Lunch at Sheldon Jackson College Aquarium for Students and Mentors</td></tr>
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1:00 - 3:00 pm</td><td>Managing Alaska's Fisheries in the Face of Arctic and Sub-arctic Climate Change
1:00 - 3:00 pm</td><td></td></tr>
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<tr><td>Late Afternoon</td><td>Alaska Salmon Enhancement Programs Part 2
3:15 - 4:55 pm</td><td></td></tr>
<tr><td>Evening</td><td></td><td></td><td>EXHIBIT ROOM
Poster Session and Social
7:00 - 9:00 pm</td></tr>
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<tr><td rowspan="8">Wednesday, Nov. 17</td><td rowspan="2">Early Morning</td><td>Coregonid Life History Research: Methods and Application
8:00 - 10:00 am</td><td>Southeast Alaskan Freshwater Fish Ecology
Part 1
8:00 - 10:00 am</td><td rowspan="5">EXHIBIT ROOM
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<tr><td rowspan="2">Early Afternoon</td><td>Advances in Marine Biology
Part 2
1:30 - 3:30 pm</td><td>Contributed Papers
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<tr><td colspan="2">Break 3:30 - 3:45 pm</td><td rowspan="3"></td></tr>
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<tr><td>Evening</td><td>Social and Buffet Banquet
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NOVEMBER 16-18, 2004 - Conference All events are held at Harrigan Centennial Hall				
Day-Date	**Time Period**	**Location**		**Special or "Other" Events & Locations**
		AUDITORIUM	**ROUSSEAU ROOM**	
Thursday, Nov. 18	Early Morning	A Neophyte's Guide to Answering Fishery Management Questions with Genetics Tools 8:35 - 10:00 am		**EXHIBIT ROOM Conference Registration Desk Open** 8:00 - 10:00 am
		Break 10:00 - 10:15		
	Late Morning	Char Life History, Diversity, Distribution and Management in Alaska. Part 1 10:15 – 11:55 am		
	Lunch-Time	**Lunch** - On your own 11:55 am - 1:30 pm		
	Early Afternoon	Char Life History, Diversity, Distribution and Management in Alaska. Part 2 1:30 - 3:10 pm		
		Break 3:10 - 3:30 pm		
	Late Afternoon	**Awards** 4:00 - 4:30 pm		
		Adjourn - 4:30 pm		

Sunday, November 14

Continuing Education Course

Maksoutoff Room

8:30 am – 5:00 pm ArcView for Applications for Fisheries Scientists

Monday, November 15

Continuing Education Courses

Exhibit Room

8:00 am – 4:00 pm Detect, Don't Infect! HACCP Planning to Prevent Aquatic Invaders

Maksoutoff Room

8:30 am – 5:00 pm ArcView for Applications for Fisheries Scientists II

Rousseau Room

8:30 am – 12:00 pm Fundamentals of Bayesian Statistics

1:00 pm – 3:00 pm Under the Gavel: Moving Meetings with Roberts Rules of Order

Auditorium

3:00 pm – 5:00 pm Speaker Tips & Guinea Pig Talks

5:30 pm – 6:00 pm Student Worker Training

7:00 pm – 7:30 pm Student Sub-Unit Meeting

Registration & Opening Reception

Exhibit Room

6:00 pm – 8:00 pm Registration

6:00 pm – 8:00 pm Opening Reception

Tuesday, November 16

Auditorium

8:05 am – 9:30 am **Plenary Session**

8:05 am – 8:10 am Welcome / Opening Remarks – *Molly Ahlgren*

8:10 am – 8:30 am 2005 Meeting Update – *Wlliam Wilson*

8:30 am – 9:30 am Voices of the Past: A Vision for Alaska's Fisheries – *Robert Sam*

9:30 am – 10:00 am **BREAK**

Tuesday, November 16 (*Continued*)

Auditorium – Concurrent Session # 1

10:00 am – 11:40 am Session: Contributed Papers. Part 1 – *Lisa Stuby, Chair*

10:00 am – 10:20 am Linking Western and Traditional Ways of Knowing Regarding Humpback Whitefish in Interior Alaska - *Melissa A. Robinson, Northway Village Council, Randy J. Brown, and F. Stuart Chapin*

10:20 am – 10:40 am Multi-agency Research and Management of Transboundary River Salmon Stocks in Southeast Alaska and Northern British Columbia - *Kathleen Jensen and Sandy R.A.C. Johnston*

10:40 am – 11:00 am Marine Fishery Management in Alaska's Exclusive Economic Zone and the North Pacific Fishery Management Council - An Introduction to the "Council Process" - *William J. Wilson*

11:00 am – 11:20 am Distribution of Resident Salmonids in the Ugashik Lakes in Southwestern Alaska - *Miranda Plumb (presenter) and Joseph F. Margraf*

11:20 am – 11:40 am Understanding the Link between River Features and Habitat for Spawning Chum Salmon - *John P. O'Brien (presenter) and Joseph F. Margraf*

11:40 am – 1:00 pm LUNCH: On Your Own
or *Lunch at Sheldon Jackson College Aquarium for students/mentors*

1:00 pm – 3:00 pm Session: Alaska Salmon Enhancement: State, Federal, and Private Programs. Part 1 – *Steve Reifenstuhl, Chair*

1:00 pm – 1:20 pm Southeast Alaska Coastal Monitoring: An Overview of a Long-term (1997-2004) Research Project Studying the Early Marine Ecology of Juvenile Salmon - *Joe Orsi,*

1:20 pm – 1:40 pm An Overview of the South Central Alaska Sport Fish Hatchery Program - *Jeff Milton and Diane Loopstra,*

1:40 pm – 2:00 pm Effects of Habitat and Predator/Prey Interactions on Stocked Sockeye Fry in Tatsamenie Lake, B.C. Canada - *Renate Riffe and Brian Mercer*

2:00 pm – 2:20 pm Fifty Years of Habitat Enhancement and Restoration on the National Forests in Alaska - *Jim Beard, Don Martin, and Ron Dunlap*

2:20 pm – 2:40 pm Calcium Sensing Receptor (CaR) Reactive Compounds Influence Seawater Adaptation in Chinook Salmon - *Tim Linley,*

2:40 pm – 3:00 pm On-going Studies of Early Marine Life History of Enhanced Chum Salmon Fry in Gastineau Channel, Taku Inlet and Adjacent Waters - *Rick Focht, Craig Farrington, and Carl Reese*

3:00 pm – 3:15 pm BREAK

3:15 pm – 4:55 pm Session: Alaska Salmon Enhancement: State, Federal, and Private Programs. Part 2 – *Steve Reifenstuhl, Chair*

3:15 pm – 3:35 pm The Use of Otolith Marking to Manage Mixed Hatchery/Wild Stock Fisheries in Prince William Sound, Alaska and to Advance Research on the Ecology of Salmon, PWSAC - *Mark Sommerville*

3:35 pm – 3:55 pm Development of a Zero-check Chinook Smolt Strategy at Medvejie Hatchery, NSRAA - *Steve Reifenstuhl*

4:15 pm – 4:35 pm Fisheries Research Programs at the Little Port Walter Research Station - *Frank Thrower*

4:35 pm – 4:55 pm The Enhancement History and Status of Virginia Lake Sockeye Salmon - *Tom Cady*

Tuesday, November 16 (*Continued*)

Rousseau Room - Concurrent Session # 2

10:00 am – 11:40 am **Session: Contributed Papers. Part 2 – *Sara Gilk, Chair***

10:00 am – 10:20 am	Diet of juvenile chum salmon from two Norton Sound watersheds - *Matt Nemeth (presenter), Simon Kinneen, Ben Williams (presenter), and Beth Haley*
10:20 am – 10:40 am	Fecundity of Chum and Coho Salmon from Two Rivers in Norton Sound, Northwestern Alaska - *Matt Nemeth (presenter), Simon Kinneen, Ben Williams, and Beth Haley*
10:40 am – 11:00 am	Salmon Life-History Modeling Approach for Understanding Ecology and Management of Fisheries - *Toshihide "Hamachan" Hamazaki*
11:00 am – 11:20 am	Contaminants in Chinook Salmon and Chum Salmon from the Kuskokwim and Yukon Rivers. - *Keith Mueller*
11:20 am – 11:40 am	Pikmiktalik Salmon Enumeration - *Tim Kroeker and Karen Dunmall*

11:40 am – 1:00 pm **LUNCH: On Your Own**
or *Lunch at Sheldon Jackson College Aquarium for students/mentors*

1:00 pm – 3:00 pm **Session: Managing Alaska's Fisheries in the Face of Arctic and Sub-arctic Climate Change – *Kate Wedemeyer, Chair***

1:00 pm – 1:20 pm	Likely Climate Related Oceanographic Change in Alaska - *Kate Wedemeyer*
1:20 pm – 1:40 pm	Local Climate Changes Observed by Sitka Elders – *George Bennett, Sr.*
1:40 pm – 2:00 pm	Implications of Climate Change on Spawning Timing and Management of Pacific Herring in Bristol Bay, Alaska - *Naoki Tojo and Gordon H. Kruse*
2:00 pm – 2:20 pm	Ecological Changes in Kachemak Bay, Alaska - *Willy Dunne and Bill Bechtol*
2:20 pm – 2:40 pm	Time Series Analysis of Pacific Cod Recruitment and Ocean Temperatures in Canada and Alaska -*Olav A. Ormseth and Brenda L Norcross*
2:40 pm – 3:00 pm	How Do We AFS Members, as Fisheries Professionals, Prepare and Manage in the Face of Climate Changes? – *Panel discussion by above presenters*

3:15 pm – 4:55 pm ***NO SESSION in Rousseau Room – See schedule for Auditorium on previous page***

Tuesday, November 16 (*Continued*)

Exhibit Room

7:00pm – 9:00pm **Poster Session and Social – *Corrine Ferguson, Chair***

Posters:

- Radio Tracking Whitefish Lake Coregonids **-** *Ty W. Wyatt, Ken Harper, and David Cannon*
- Population Structure of Alaska Pacific Ocean Perch (*Sebastes alutus*) - *Katie Palof, A.J. Gharrett, and Jon Heifetz*
- Fall Chum Salmon Abundance Estimation on the Tanana and Kantishna Rivers Using Mark Recapture Techniques - *Peter Cleary*
- Seasonal Changes in the Diet of Walleye Pollock (*Theragra chalcogramma*) around the Chiswell Islands - *C. F. Adams, A. I. Pinchuk, and K. O. Coyle*
- Prey Availability Near Two Steller Sea Lion Haulouts in Alaska - *John F. Thedinga, Scott W. Johnson, and David J. Csepp*
- Barrier Bypasses – Increasing Available Habitat In the Kodiak Island Archipelago - *Steven G. Honnold and Patricia A. Nelson*
- Timing and Origin of Chinook Salmon Stocks in the Copper River and Adjacent Ocean Fisheries Using DNA Markers - *Andrew W. Barclay, Nick A. Decovich, Dan T. Moore, William D. Templin and Lisa W. Seeb*
- Otolith Diagnostics Reveal Older Age Profile of Walleye Pollock - *Kristen M. Munk*
- Engineering for Biologists: Developing New Methods for Collecting Data - *Peter G. van Tamelen and Steve Gebert*
- Modeling Disease Prevalence in Prince William Sound Pacific Herring - *Sara Miller, Terry.Quinn, Gary Marty, and Steve Moffitt*
- Distribution, Diet, and Energy Density of Age-0 Walleye Pollock *(Theragra chalcogramma*) in the Bering and Chukchi Seas, Alaska - *Angela M. Middleton, Edward V. Farley, and Nicola T. Hillgruber*
- Educational Outreach through the Collection of Biological Data - *Kimberly Elkin, Valli Peterson*
- From Derby to Customized Fishery – Factors Influencing Changes in the Dutch Harbor Herring Fishery **-** *Switgard Duesterloh*
- Energy Density Predicts Fish Abundance and Variability in Abundance - *Mike Litzow, John Piatt, Alisa Abookire, and Martin Robards*
- A Straying Assessment of an Introduced Sockeye Salmon Stock on Northern Afognak Island as Determined by Two Methods of Stock Identification - *Robert T. Baer and Steve Honnold,*
- Dynamic in Lake Migration Patterns Observed for Homing Sockeye Salmon - *Daniel B. Young and Carol Ann Woody*
- Fish Surveys of Upper Chester Creek Watershed, Fort Richardson, Alaska, 2003-2004 - *Libby Baney and Carol Ann Woody*
- Keeping Alaskans Involved in Clean Water Protection - *S. Mauger*
- Lacustrine Growth of Juvenile Pink Salmon *(Oncorhynchus gorbuscha)* and a Comparison with Sympatric Sockeye Salmon *(O. nerka) - Josh Robins*

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Wednesday, November 17

Auditorium – Concurrent Session #1

8:00am – 10:00am **Session: Coregonid Life History Research: Methods and Application – *Randy J. Brown and Ken Harper, Co-chairs***

8:00 am – 8:20 am	Colville River Arctic Cisco Population Trends - *Lawrence L. Moulton*
8:20 am – 8:40 am	Seasonal Habitat Use and Movement Patterns of Broad Whitefish (*Coregonus nasus*) in Freshwater Systems of the Central and Western Beaufort Sea - *William A. Morris*
8:40 am – 9:00 am	CPUE Data Lead to New Discoveries in Whitefish Migration and Life History Strategies from the Middle Yukon River - *David W. Daum*,
9:00 am – 9:20 am	Life History and Spawning Movements of Broad Whitefish (*Coregonus nasus*) in the Middle Yukon River - *Bill Carter*
9:20 am – 9:40 am	Spawning Periodicity of Humpback Whitefish *Coregonus pidschian* in the Upper Tanana River - *Randy J. Brown*
9:40 am – 10:00 am	Kuskokwim River Coregonids and Their Use of Whitefish Lake - *Ken Harper, Ty Wyatt, Laura Zabkar, Frank Harris, and David Cannon*

10:00 am – 10:15 am **BREAK**

10:15 am – 11:55 am **Session: Advances in Marine Biology. Part 1 –*Mike Byerly, Chair***

10:15 am – 10:35 am	Reproductive Biology, Spawning Season, and Growth of Female Rex Sole (*Glyptocephalus zachirus*) in the Gulf of Alaska - *Alisa Ann Abookire*
10:35 am – 10:55 am	Reproductive Ecology of Atka Mackerel: Embryonic Developmental Series - *Jared Guthridge, Nicola Hillgruber, Robert Lauth, Susanne McDermott and Shannon Atkinson*
10:55 am – 11:15 am	Maturation of Walleye Pollock (*Theragra chalcogramma*) in the Eastern Bering Sea in Relation to Temporal and Spatial Factors - *Jennifer Stahl and Gordon Kruse*
11:15 am – 11:35 am	The Ecology of Age-1 Copper Rockfish (*Sebastes caurinus*) in Vegetated Habitats of Sitka Sound, Alaska - *Mike Byerly*
11:35 am – 11:55 am	Feeding Habits of Two Congener Rockfish Species, Dark Rockfish (*Sebastes ciliatus*) and Black Rockfish (*Sebastes melanops*) Caught in the Western Gulf of Alaska - *Liz Chilton*

11:55 am – 1:30 pm **LUNCH: On Your Own or Past Presidents Lunch – Rousseau Room**

Wednesday, November 17 (*Continued*)

Rousseau Room - Concurrent Session #2

8:00 am – 10:00 am **Session: Southeast Alaskan Freshwater Fish Ecology. Part 1 – *Kim Hastings, Chair***

8:00 am – 8:20 am	Patterns in Fish Distribution, Density, and Size along Longitudinal Gradients of Southeast Alaska Headwater Stream. - *Mark Stichert and Gordon Haas*
8:20 am – 8:40 am	Daily and Seasonal Movement of Dolly Varden and Cutthroat Trout in a High Gradient Stream - *Buck Bryant and Mark D. Lukey*
8:40 am – 9:00 am	The Use of Sonic Tags to Investigate the Movement and Depth of Cutthroat Trout in Turner Lake - *Roger Harding*
9:00 am – 9:20 am	Life History and Population Abundance Assessments of Steelhead in 12 Mile Creek and Beyond on Prince of Wales Island - *Sheila Jacobson and Valerie Blajeski* (presenter)
9:20 am – 9:40 am	How Wild Steelhead Win the Race **-** *Brenda Wright*
9:40 am – 10:00 am	In Search of Freshwater Lampreys - *Dan Cushing, Kim Hastings and Gordon Haas*

10:00 am – 10:15 am **BREAK**

10:15 am – 11:55 am **Session: Southeast Alaskan Freshwater Fish Ecology. Part 2** – ***Kim Hastings, Chair***

10:15 am – 10:35 am	Spawning Distribution and Habitat of Sockeye Salmon *(Oncorhynchus nerka)* in the Chilkat River Drainage - *Brian Elliott and Nicola Hillgruber*
10:35 am – 10:55 am	Inconsistencies Between Trophic Level Responses and Sockeye Escapement Estimates Led to a Change in the Research Direction at Hetta Lake **-** *Robert Bale and Meg Cartwright (presenter)*
10:55 am – 11:15 am	Prey and Nutrient Subsidies in Salmonid Food Webs: Implications for Fish and Forest Management in Alaska - *Mark Wipfli*
11:15 am – 11:35 am	An At-Risk Assessment of Dolly Varden through Comparison to Bull Trout - *Gordon Haas*
11:35 am – 11:55 am	

11:55 am – 1:30 pm **LUNCH: On Your Own or Past Presidents Lunch – Rousseau Room**

Wednesday, November 17 (*Continued*)

Auditorium – Concurrent Session #1 *(Continued)*

1:30 pm – 3:30 pm **Advances in Marine Biology. Part 2 – *Dan Urban, Chair***

1:30 pm – 1:50 pm	Coral and Sponge Habitat Mapping in the Central Aleutian Islands - *D. Woodby, R. Stone, J. Heifetz, J. Reynolds, E. Brown, D. Carlile, and G. Greene*
1:50 pm – 2:10 pm	Population Biology and Trophic Position of the Grass Shrimp (*Hippolyte clarki)* (Decapoda: Caridea) in Sitka Sound - *Aaron Baldwin*
2:10 pm – 2:30 pm	Spatial Distribution of Nearshore and Pelagic Fishes in Relation to Physical Oceanography in a Glacial Fjord - *Mayumi Arimitsu , John Piatt, Mike Litzow, Martin Robards, and Alisa Abookire*
2:30 pm – 2:50 pm	Sperm Whale and Longline Fisheries Interactions in the Eastern Gulf of Alaska: Cooperative Research between Scientists, Fishermen, and Government - *Jan Straley, Tory O'Connell, Linda Behnken, Jen Cedarleaf, Aaron Thode, and Sarah Mesnick*
2:50 pm – 3:10 pm	Advances in Spiny Dogfish Research in the Face of Commercial Fishing - *Cindy A Tribuzio and Gordon Kruse*
3:10 pm – 3:30 pm	A Green Sea Urchin Survey of the Pribilof Island of St. George - *Dan Urban*

3:30 pm – 3:45 pm **BREAK**

Rousseau Room

3:45 pm – 5:00 pm **Business Meeting – *Tim Joyce, President***

Auditorium

6:00 pm – 10:00 pm **Banquet**

6:00 pm – 8:00 pm	Social and Buffet (no host bar)
8:00 pm – 9:00 pm	Ray Troll Presentation
9:00 pm -	Social Continued - "Belly Meat" Acoustic & Blues Band

Wednesday, November 17 (*Continued*)

Rousseau Room - Concurrent Session #2 (*Continued)*

1:30 pm – 3:30 pm **Session: Contributed Papers. Part 3 – *Lisa Stuby*, *chair***

1:30 pm – 1:50 pm	Improving Fish Counts at Weirs Using Video Technology - *Jeffry L. Anderson (presenter), Nicholas J. Hetrick, and James P. Larson*
1:50 pm – 2:10 pm	Evaluating the Use of Ultrasound for Determining the Sex and Maturity Status of Cutthroat Trout - *Peter D. Bangs*
2:10 pm – 2:30 pm	Archival and Acoustic Tags Explore Steelhead Marine Migration, Ninilchik River, Alaska - *Philip J. Richards (presenter), Christian E Zimmerman, and Jennifer L. Nielsen*
2:30 pm – 2:50 pm	Relationships Among Biomass, Recruitment, Environmental Variation and Growth of Juvenile Yellowfin Sole and Northern Rock Sole in the Eastern Bering Sea - *Ben Williams, Terry Quinn, and Lew Haldorson*.
2:50 pm – 3:10 pm	Ecological Interactions between Hatchery and Wild Juvenile Chum Salmon (*Oncorhynchus keta*) in the Taku River Estuary - *Carl Reese (presenter), Nicola Hillgruber, and Bill Smoker*
3:10 pm – 3:30 pm	

3:30 pm – 3:45 pm **BREAK**

Rousseau Room

3:45 pm – 5:00 pm **Business Meeting – *Tim Joyce, President***

Auditorium

6:00 pm – 10:00 pm **Banquet**

6:00 pm – 8:00 pm	Social and Buffet (no host bar)
8:00 pm – 9:00 pm	Ray Troll Presentation
9:00 pm -	Social Continued - "Belly Meat" Acoustic & Blues Band

Thursday, November 18

Auditorium

8:35 am – 10:00 am **Session: A Neophyte's Guide to Answering Fishery Management Questions with Genetics Tools – *John Wenburg*, *Chair***

- 8:35 am – 8:40 am — Session Introduction - *John Wenburg*
- 8:40 am – 9:00 am — So You're Thinking of Building a Baseline? Issues to Consider When Developing a Genetic Application - *William D. Templin, Chris Habicht, Christian T. Smith, Lisa W. Seeb, and James E. Seeb*
- 9:00 am – 9:20 am — Genetic analysis for Determining the Origin of Harvested Yukon River Chum Salmon - *Blair G. Flannery, Eric Kretschmer, and John K. Wenburg*
- 9:20 am – 9:40 am — Assisting Management of Chinook Salmon in the Kuskokwim and Yukon Rivers: Genetic Analysis of Variations in Sex-ratios at Various Life History Stages - *Jeffrey B. Olsen, Steve J. Miller, Ken Harper, and John K. Wenburg*
- 9:40 am – 10:00 am — Applying Population Genomics to Fisheries Management - *David A. Tallmon*

10:00 am – 10:15 am **BREAK**

10:15 am – 11:55 am **Session: Char Life History, Diversity, Distribution and Management in Alaska. Part 1 – *Fred DeCicco*, *Chair***

- 10:15 am – 10:35 am — An Overview of Char Diversity in Alaska - *Fred DeCicco*
- 10:35 am – 10:55 am — Charting the Char in Togiak National Refuge, Alaska - *Mark Lisac*
- 10:55 am – 11:15 am — Genetics and Life History of Dolly Varden in Northwestern Alaska - *Penny Crane, Fred DeCicco, and John Wenburg*
- 11:15 am – 11:35 am — A Comparison of Aerial Counts and Mark-recapture Abundance Estimation of the Overwintering Population of Dolly Varden (*Salvelinus malma)* in the Ivishak River, Alaska 2001-2003 - *Tim Viavant*
- 11:35 am – 11:55 am — Use of a Per-recruit Model to Evaluate the Sustained Yield of Dolly Varden *(Salvelinus malma)* in Southeast Alaska - *Randy Ericksen*

11:55 am – 1:30 pm **LUNCH: On Your Own**

1:30 pm – 3:10 pm **Session: Char Life History, Diversity, Distribution and Management in Alaska. Part 2 – *Fred DeCicco*, *Chair***

- 1:30 pm – 1:50 pm — Composition and Yield of Lake Trout *(Salvelinus namaycush)* in Paxson Lake, Alaska - *Brendan Scanlon*
- 1:50 pm – 2:10 pm — Arctic char Spawning Life History in Cooper Lake, Kenai Peninsula, Alaska - *John Morsell, Paul McLarnon, and Wade Lawrence*
- 2:10 pm – 2:30 pm — Use of Radio Telemetry to Describe Life History Characteristics of Dolly Varden in the Kenai River - *Doug Palmer and Bruce King*
- 2:30 pm – 2:50 pm — Bull Trout Distribution and Biogeography - *Gordon Haas*
- 2:50 pm – 3:10 pm — Feeding Ecology and Energy Density of Juvenile Chum Salmon *(Oncorhynchus keta)* in Kuskokwim Bay - *Sean Burril (presenter), Nicola Hillgruber, and Christian E. Zimmerman*

3:10 pm – 3:30 pm **BREAK**

4:00 pm – 4:30 pm **Best Paper/Poster Awards**

4:30 pm **ADJOURN**

Plenary Session Speaker:

Robert Sam

Robert Sam has spent most of his adult life learning and sharing traditional Tlingit oral narratives. As a member of the Tlingit performing arts troupe, Naa Kahidi Theatre, he shared traditional stories with audiences around the United States and Europe. The local school district brings children to hear his stories at the end of each school year.

Sam is a regular traveler to Japan where he is host to those interested in learning about Tlingit culture. He is scheduled to share oral narratives this fall at conference that addresses children's mental health. In 1999, Mr. Sam was a keynote speaker at the National Conference of Oral History, organized by the University of Alaska.

Robert Sam was honored as a finalist for the 2002 Buffett Award for Indigenous Leadership for his work involving repatriation of human remains as well as his efforts in preserving traditional Tlingit culture. He is a member of the Sitka Tribe of Alaska and resides in Sitka.

Sam is currently assisting a Sitka clan in obtaining human remains presently held by the National Park Service. He also provides his time to national and international forums regarding sacred sites, traditional Tlingit culture and the respectful return of human remains.

Robert Sam worked for several years as the Sitka Tribe of Alaska's Native American Graves Protection and Repatriation Coordinator. During this time, he assisted tribal families and the State of Alaska Department of Transportation in repatriating the remains of 133 individuals who had passed away from tuberculosis at the Mt. Edgecumbe Indian Health Services hospital in Sitka during the 1940's and 1950's.

Sam has served on the Sitka Tribal Council and has been active in local conservation issues. He played an important community role during the investigation of the potential Superfund site of Silver Bay. Sam is also an original member of the Department of Defense Tribal Steering Committee and was instrumental in helping draft their policy on tribal relations, which is used as a model by other tribal governments and agencies.

Session: Contributed Papers
Part 1
Session Chair – *Lisa Stuby*

Linking western and traditional ways of knowing regarding humpback whitefish in interior Alaska

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Humpback whitefish are the main subsistence fish for the people of Northway Village who have depended on them for thousands of years and have a long -term understanding of the system. Local concerns over whitefish and a lack of knowledge in the scientific community about their basic ecology provided a basis for collaboration between fisheries biologists, social scientists, and Northway Village. During the spring and summer of 2001-02 159 radio transmitters were surgically implanted in humpback whitefish in three areas near Northway Village. Over the next three years, using both aerial and boat tracking, whitefish were tracked during specific life stages to determine patterns of habitat use. We also worked closely with the Northway Village Council to conduct interviews and spend time at fish camp with key fishing families in order to document their experiences and knowledge regarding whitefish ecology and cultural importance. This presentation will examine the creative ideas and methods being used in this particular study while also touching on some questions being raised about whitefish ecology such as daily movements, temperature limits, and seasonal locations. Case studies like this may have implications for how Human Dimensions research in fisheries can be done, what we might learn from these sorts of studies, and how they may impact management decisions.

Multi-agency research and management of transboundary river salmon stocks in southeast Alaska and northern British Columbia

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U.S. and Canadian First Nation, subsistence, recreational, and commercial fisheries harvest salmon from the transboundary Stikine, Taku, and Alsek Rivers. International harvest sharing and management agreements for these stocks are outlined in the Pacific Salmon Treaty. Cooperative research programs for inseason run strength assessment and postseason escapement evaluation on these rivers involve state, provincial, federal, and First Nations personnel. Researchers use biological data combined with coded wire tagging programs, weirs, aerial surveys, mark-recapture programs, radio telemetry, and test fisheries to estimate marine harvest and/or inriver run size or index escapements. Prior to each fishing season biologists from both nations meet to establish harvest guidelines, finalize plans for joint research programs, and establish fishery limitations for stocks of concern. During the fishing season researchers from each country exchange data and provide stock strength assessments to managers on a daily basis. The managers from both nations confer weekly about their planned fishery openings. Commercial fishery openings are set based on assessment of run strength for the various stocks and species. U.S. and Canadian biologists meet after the fishing season to finalize harvest and escapement estimates, reconstruct salmon runs to the three rivers, and prepare a report for the Pacific Salmon Commission. Salmon runs to these three rivers are generally healthy and several have experienced record high runs in recent years, however there are a couple stocks of concern that are closely monitored and frequently necessitate special restrictions in fisheries.

Marine fishery management in Alaska's Exclusive Economic Zone and the North Pacific Fishery Management Council - An introduction to the "council process"

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The North Pacific Fishery Management Council is one of eight regional councils established by Congress in the Magnuson-Stevens Fishery Conservation and Management Act of 1976. The Councils manage fisheries in the 200-mile Exclusive Economic Zone (EEZ) off the U.S. coast. The process of marine fishery management is accomplished as a partnership between the Councils and the National Marine Fisheries Service, with the Secretary of Commerce the ultimate regulatory authority. The North Pacific Council manages primarily the groundfish fisheries in the Gulf of Alaska and the Bering Sea and Aleutian Islands. These fisheries include Pacific cod, pollock, flatfish, Atka mackerel, sablefish, and rockfish species harvested by trawl, longline, jig, and pot gear. The North Pacific Council also makes allocation decisions for the halibut fishery off Alaska, while the International Pacific Halibut Commission conducts biological management. Managed in partnership with the State of Alaska are some of the salmon, crab, and herring fisheries that occur in Alaska's offshore waters. The "Council Process" is the annual marine fishery management and regulatory cycles the North Pacific Council oversees. This process is facilitated by input from the Council's Advisory Panel and Scientific and Statistical Committee, various other Council committees, Federal and State agencies, and the public. The process involves balancing fishery regulatory decisions with such considerations as target fish stock strength, ecosystem management, Essential Fish Habitat designations, marine mammal and seabird avoidance and protection measures, climate change, bycatch and waste reduction, and international relations, all accomplished in an environment heavily influenced by the National Environmental Policy Act and the Endangered Species Act. Much is at stake, as the Council's actions affect fisheries with a combined value after primary processing of approximately $1.5 billion. This paper presents an overview of marine fishery management in Alaska's EEZ.

Distribution of resident salmonids in the Ugashik Lakes in southwestern Alaska

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Few studies have investigated resident salmonids in southwestern Alaska. Basic biological information is needed to accurately document the current status of resident fish. The Ugashik Lakes are warm thereimictic, meaning that they typically lack thermal habitat structure. Normally, in deep lakes fish are distributed according to the temperature structure of the lake, but due to the lack of a thermocline, distributions should be influenced by other factors, such as depth, physical habitat features, or food availability. The object of our study was to determine if resident salmonids (Arctic char, lake trout, round whitefish, pygmy whitefish, Arctic grayling, Dolly Varden) were distributed according to depth, substrate particle size, or other physical habitat features. The lakes were divided into four areas or zones, each with three different depth strata. Random sample sites were chosen within each zone and depth strata, and a gill net was set at each site. Depth, water temperature at depth, substrate particle size, and other environmental factors were recorded. Dominant substrate particle size was recorded with the use of an underwater camera. Based on preliminary analysis, depth appears to be the principal determinant of distribution, but other factors such as substrate particle size and food availability may also play a major role.

(student)

Understanding the link between river features and habitat for spawning chum salmon

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This study was conducted from June 2002 to January 2004 on the Tuluksak River in southwestern Alaska. Chum salmon (*Oncorhynchus keta*) are reported to favor riverine spawning sites that have either an influx or outflow of hyporheic water. Landscape topography and channel morphology constitute "hydraulic controls" that create these preferred spawning conditions. Large-scale river features were mapped remotely by aerial surveys, satellite imagery (LANDSAT-7) and synthetic aperture radar (SAR) images. These large-scale features included sinuosity, permafrost distribution and continuity, ice-cover continuity in winter (as an indicator of upwelling), and abrupt changes in stream gradient or elevation of surface terrain. Small-scale river features that required on-site sampling were particle size of riverbed substrate, physico-chemical habitat, and redd location and distribution. In July 2003, 28 chum salmon spawning sites were identified by observation from a raft. One 16 km stretch of river encompassed 79% of the total number of spawning sites. Spawning sites were highly correlated with a discontinuous permafrost zone which is conducive to groundwater upwelling. These results represent progress toward developing habitat- based escapement goals for remote rivers in southwestern Alaska.

(student)

Session: Contributed Papers
Part 2
Session Chair – *Sara Gilk*

Diet of juvenile chum salmon from two Norton Sound watersheds

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Recent declines of chum salmon returns to Norton Sound, Alaska, have increased the interest in the early life history of chum in the region. The feeding, growth, and prey availability of juvenile chum while they reside in estuarine habitats, known to be important chum rearing grounds, has not been described for the region. We examined environmental variability, prey availability and the feeding habits of juvenile chum salmon collected in two Norton Sound watersheds. The Eldorado River estuary, Safety Sound, was studied in the summers of 2002 through 2004, and the lower Nome River was studied in 2004. Diet shifts were observed both among and within years, while prey availability remained relatively constant. Spatially, diets varied between sites within Safety Sound in 2003. Preliminary data from 2004 show slight dietary differences between chum from Safety Sound and the lower Nome River. Overall, the study provides the first detailed descriptions of feeding and food availability for juvenile chum in the Norton Sound region, while allowing assessments of variability temporally and spatially. The benefits to management include the establishment of baseline data and an improved understanding of the connections among juvenile chum run timing, habitat use, and feeding.

Fecundity of chum and coho salmon from two rivers in Norton Sound, northwestern Alaska

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Fish fecundity data can be used to model potential egg deposition and habitat seeding, juvenile survival, correlations between adult abundance and juvenile production, and to compare potential production from different escapements. Because fecundity is known to vary among populations and regions, models that use fecundity values from the literature instead of from local populations may include unknown levels of bias. To generate empirical estimates for the Norton Sound region of Alaska, we estimated salmon fecundity from two rivers in the region. Chum and coho salmon fecundity was estimated from the Unalakleet River in 2002 through 2004; chum salmon fecundity was also estimated from the Fish River in 2004. Total fecundity, relative fecundity (eggs per unit body length), and fecundity at a standard size were all reported to account for fish size and to allow comparisons to populations reported in the literature. Chum salmon fecundity was affected by body length; mean annual estimates (2002 and 2003 only) ranged from 2,809 to 2,843 eggs per fish. Coho salmon fecundity was affected by both age and body length; mean annual estimates (2002 and 2003 only) ranged from 5,335 to 5,938 eggs per fish. When compared to various populations reported in the literature (using total, relative, or standardized fecundity), Unalakleet River chum salmon fecundities were above average and Unalakleet River coho salmon fecundities were among the highest. From 2002 to 2003 in the Unalakleet River, fecundity increased by 8.2% in age 0.3 chum salmon and 8.5% in age 2.1 coho salmon. Overall, the results provide empirical data that can be used when modelling population dynamics of chum and coho salmon from Norton Sound. Variability among size classes, ages, and years should be considered when applying Norton Sound fecundity data.

Salmon life-history modeling approach for understanding ecology and management of fisheries

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We all know that production of salmon and fisheries are influenced by multiple factors, such as spawning density, marine survival, habitat condition, marine derived nutrients, etc. We also have been developing several hypotheses about effects of those factors on salmon and fisheries, some of which are conflicting with each other. However, we hardly integrate those factors and simultaneously evaluate relative effects of each factor on salmon and fisheries. Life-history modeling is one approach that integrates multiple factors and evaluates their effects. In this modeling, factors affecting production and survival of salmon are modeled and incorporated at each life-history stage from egg to spawning adults. In this presentation, I will demonstrate a chinook salmon life-history model and discuss its applications.

Contaminants in chinook salmon and chum salmon from the Kuskokwim and Yukon Rivers

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Fisheries and subsistence managers need to determine if contaminants are a threat to the health and viability of Alaska salmon populations, and many Alaskans are concerned about the quality of subsistence foods. To address these concerns for salmon fisheries, the U.S. Fish and Wildlife Service objectives for this study were to measure contaminants and investigate their effects in Chinook salmon (*Oncorhynchus tshawytscha*) and chum salmon (*O. keta*) from the Yukon and Kuskokwim rivers. We sampled male and female Chinook and chum salmon from The Rapids (upstream of Tanana) and Beaver on the Yukon River, and from Bethel on the Kuskokwim River. Yukon River sampling sites were located upstream of the Tanana River to reduce fish stock variation and capture the worst-case scenario for lipophilic contaminants because upriver spawners have more fat than downriver spawners. We sampled a variety of tissues for heavy metals and persistent organic pollutants (POPs) such as the pesticide DDT and polychlorinated biphenyls (PCBs). We also measured fish health indicators, including histology, reproductive hormones, enzyme levels, vitamins, sex chromosome abnormalities, and we conducted internal and external exams.

We found relatively low concentrations of both metal and organochlorine contaminants in Chinook and chum salmon from both rivers. In general, all contaminant concentrations were below those thought to affect fish health and reproduction, and other indicators of fish health were normal.

Pikmiktalik River Pacific salmon escapement enumeration

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Much of the Pacific salmon subsistence harvest of the communities of Stebbins and St. Michael occurs on Pikmiktalik River, which lies within the Yukon Delta National Wildlife Refuge. This fishery is one of the few managed under Federal subsistence authority within the Seward Peninsula Region, and prior to the start of this project daily and annual spawning escapement estimates were unavailable. In 2003, Kawerak, Inc., in cooperation with Stebbins and St Michael IRAs, began collecting information on salmon abundance and run-timing, as well as age, sex, and length, with funding from the Federal Office of Subsistence Management's Fisheries Resource Monitoring Program. Information is provided to Federal and State managers as well as the general public. A tower, partial diversion weir, and flash panel (placed on the river bottom to provide contrast) are used to count salmon. Counting is conducted 20 minutes each hour, and occurs 24 hours a day, 7 days per week. Counts are expanded to obtain total hourly, daily, and annual estimates. In 2003, total estimated escapements were 345 Chinook *Oncorhynchus tshawytscha*, 7,707 chum *O. keta*, 13,165 pink *O. gorbuscha*, and 87 coho *O. kisutch* salmon. In 2004 total estimated escapements were 225 Chinook, 8,051 chum, 50,621 pink and 11,799 coho salmon. Several hundred Dolly Varden *Salvelinus malma* and 915 whitefish *Coregonus sp.* also passed the site each year. To obtain biological information, salmon were captured with a beach seine. A stratified sampling design was used, and sample sizes was selected so that simultaneous 95% confidence interval estimates of age composition proportions would be no wider than 0.20. For chum salmon, 4 year olds dominated the 2003 sample (82.8%), while 4 (40%) and 5 (48%) years olds were about equally represented in the 2004 sample. In both years, chum salmon male to female ratio was about 50:50, and chum salmon average length was similar (576 mm, 2003; 572 mm, 2004). This project is developing the capacity of rural residents to assist in managing local fishery resources.

Session: Contributed Papers
Part 3
Session Chair – *Lisa Stuby*

Improving fish counts at weirs using video technology

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Fish weirs are a widely accepted tool for assessing Pacific salmon runs in Alaska. Although weirs can provide an accurate means of assessing annual spawning migrations, weirs can hinder fish movement, which may be biologically costly. Since 2000, the King Salmon Fish and Wildlife Field Office has made several modifications to the salmon counting weir on Big Creek, Becharof National Wildlife Refuge, to minimize impacts to migrating salmon. First, the weir was modified to a V-shaped floating design to guide fish directly to the passage area. To monitor fish passage, a counting chute and digital video equipment were added which allowed fish to pass freely through the weir. In 2004, a laser-based onscreen micrometer was added to facilitate measuring fish lengths without handling fish. In addition to improving fish passage through the weir, there are more benefits to these changes. Motion-detection hardware and software recorded images only when fish were passing through the weir, which required considerably less staff time to review than actual live counts. With the ability to replay, freeze-frame and zoom in during file review, the accuracy of our species identification and counts has improved. The use of video monitoring equipment has also resulted in a more comprehensive count of non-salmon species passing the weir than in previous years. A microwave link has been added to the system to feed a live video signal from the weir to the King Salmon Visitor Center, which provides a platform for outreach and education. This past year, we also used digital video equipment to successfully monitor fish passage at a weir in a tidally influenced, turbid water system near Cold Bay, Alaska.

Evaluating the use of ultrasound for determining the sex and maturity status of cutthroat trout

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The sport fishing regulations for cutthroat and rainbow trout (*Oncorhynchus clarki, O. mykiss*) in Southeast Alaska are comprised of minimum size limits and bag/possession limits. The minimum size limits are designed to protect the majority of trout until they have spawned at least once, thus sexual maturity rates relative to fish length are important for setting appropriate size limits. In previous maturity studies, we sacrificed fish in order to positively determine sex and maturity status; however this approach precluded sampling in populations that were small or had other management concerns, and biologists were concerned over potential public opposition to destructive sampling. In an effort to identify alternative, non-lethal techniques, we initiated a pilot study to evaluate the use of ultrasound machines for determining the sex and maturity status of cutthroat trout. In April 2004, we used ultrasonography on 63 cutthroat trout from Florence Lake on Admiralty Island. We found that ultrasonography was a reliable method for identifying mature females, but we were unable to distinguish the sex of immature fish due to the small size of the gonads. Testes in mature male cutthroat trout can also be relatively small (< 2 mm in diameter) and were not consistently identifiable. Although ultrasonography was only partially successful in sexing cutthroat trout, the technique would be useful for identifying mature females in maturity studies, thereby reducing the number of fish that need to be sacrificed.

Archival and acoustic tags explore steelhead marine migration, Ninilchik River, Alaska

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Little is known about the behavior of salmonids in the ocean or the role environmental variation has on the survival and distribution of salmonids within marine habitats. Understanding this relationship and how it varies with changes in environmental conditions requires a better understanding of movements and habitat utilization at all life history stages. Acoustic and archival tags provide opportunities to examine distribution and behavior of salmonids in marine habitats. We are conducting a pilot study aimed at testing archival and acoustic tag technologies as part of the Pacific Ocean Salmon Tracking project (POST). Acoustic tags were surgically implanted in steelhead kelts captured at the Ninilchik River weir from May through June 2002 and 2003. An array of acoustic receivers located in Cook Inlet were used to determine the timing of saltwater entry, duration of residence near the mouth of the river, and direction of travel as steelhead migrated from the Ninilchik River into Cook Inlet. Archival tags that collect pressure, temperature and/or ambient light data were also surgically implanted at the Ninilchik River weir in 2002 and 2003. The Ninilchik River weir was operated during the spring of 2004 with the intention of recapturing steelhead tagged with archival tags. We recovered three archival tags (9%) and 10% of the acoustic tags, all of which were from the 2002 release. Data were successfully downloaded from two recovered archival tags providing sixteen months of marine pressure (depth) and temperature data. The remaining archival tag was corrupted and no data were downloaded. Given the success of recovering fish tagged during the 2002 field season in 2004, we expect to recover additional archival tags containing pressure, temperature and light data in 2005.

Relationships among biomass, recruitment, environmental variation and growth of juvenile yellowfin sole and northern rock sole in the Eastern Bering Sea

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Recruitment of yellowfin sole and rock sole in the eastern Bering Sea declined in conjunction with biomass increases during the 1980s and 1990s, except for a few notable year-classes in the 1980s. These year-classes stand out as anomalies in what otherwise appears to be a density-dependent relationship. The causes of these anomalies were explored using correlation analysis and stepwise linear regression to evaluate relationships among growth, environmental variation, biomass, and recruitment variability. Spawner-recruit models were incorporated to describe recruitment of yellowfin sole and rock sole year-classes from 1974 – 1993. Results indicate that population abundances explain more variability in growth than environmental variables and that competition influences growth at the youngest ages; however, recruitment for both species was best explained with the inclusion of environmental factors. A generalized Ricker spawner-recruit model best describes recruitment of yellowfin sole incorporating yellowfin sole biomass, as well as indices of the Aleutian Low and bottom

Ecological interactions between hatchery and wild juvenile chum salmon (*Oncorhynchus keta*) in the Taku River Estuary

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The School of Fisheries and Ocean Sciences (UAF), in cooperation with ADF&G, Auke Bay Lab (NOAA), and DIPAC are investigating the potential interaction of wild and hatchery juvenile chum salmon (*Oncorhynchus keta*) in the Taku Inlet. For the duration of two years, 2004 and 2005, we will be collecting juvenile chum salmon throughout the outmigration period using beach seines and Kodiak trawls. Since all fish released from DIPAC are thermally marked, we will analyze otoliths to determine the fish's origin (hatchery or wild) and conduct diet and calorimetry analysis on a subsample of chum salmon juveniles. Overlap of range and diet with comparisons of caloric content will be used to evaluate the potential for intraspecific competition.

Preliminary data from the 2004 field season are currently being compiled and the analyses of otoliths, diet, and caloric content are in progress. Beach seine catches of chum salmon in the inner estuary began in late April, peaked around May 18th (mean 16.5 chum/set), and tapered off in late June. Catches in beach seines in the outer estuary jumped from < 6 chum/set to 562 chum/set following the release of 20.2 million hatchery chum salmon in the outer Taku area around May 9th. Outer estuary beach seine catches tapered off early June. Peak catches in the trawls in the outer estuary lasted for two weeks in middle/late May and averaged 141 and 142 chum per trawl, respectively. While the otolith analysis is still pending, it seems apparent that chum salmon abundance in the outer estuary was influenced by hatchery releases. Once the origin of the fish in our catches has been determined and diet and caloric content analyzed, we should be able to draw more concrete conclusions concerning the potential for competition between hatchery and wild juvenile chum salmon in the Taku Inlet.

Session: Salmon Enhancement: State, Federal, and Private Programs. Part 1
Session Chair – *Steve Reifenstuhl*

Southeast Alaska coastal monitoring: An overview of a long-term (1997-2004) research project studying the early marine ecology of juvenile salmon

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The primary goal of the Southeast Alaska Coastal Monitoring (SECM) research is to build and maintain a time series of biophysical oceanographic indices related to the seasonal growth, distribution, abundance, and habitat utilization of juvenile salmon stocks. Since 1997, the SECM project has obtained annual measurements of seasonal biophysical parameters in conjunction with marine sampling of juvenile salmon. This research occurs monthly from May to August along a seaward migration corridor in neritic waters (> 3 and < 65 km offshore) centered near Icy Strait in the northern region of southeastern Alaska. This presentation will be an overview of SECM research results on the early marine ecology of juvenile salmon. These results include: marine habitat utilization patterns, stock-specific migration, hatchery and wild interactions, neritic carrying capacity, predation, and the use of juvenile salmon abundance indices to forecast adult salmon returns.

An overview of the south central Alaska sport fish hatchery program

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ADF&G's Sport Fish hatchery program stocks approximately 4.5 million chinook and coho salmon, rainbow trout, Arctic grayling, and Arctic char in more than 250 locations. These stocked fish account for 80% of all rainbow trout harvested in Alaska, and 20% of all chinook salmon harvested in Southcentral Alaska. The smolt stocking program accounts for 166,000 days of angler effort, and a harvest of 75,000 adult salmon annually. Each release group of smolt is 100% otolith marked. Smolt released into systems with naturally producing populations are also 100% marked with an adipose fin clip and CWT. Approximately 2 million fry, fingerling and catchable sized fish are stocked annually into fresh water systems. Diploid rainbow trout, coho and chinook salmon, Arctic char and grayling are stocked into landlocked lakes. All-female triploid rainbow trout may be stocked in open or semi-open systems. Current research projects include developing methods to induce triploidy and sex reversal in all species of fish produced. Mixed sex triploid coho and chinook salmon, Arctic char, and grayling have been produced at the experimental level.

Effects of habitat and predator/prey interactions on stocked sockeye fry in Tatsamenie Lake

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Tatsamenie Lake has been stocked with otolith marked sockeye fry since 1991, as part of a program to increase annual returns of sockeye salmon (*Oncorhynchus nerka*) to the Taku River system by 100,000 fish annually. The average annual commercial catch of stocked Tatsamenie sockeye salmon between 1995 and 2002 has been about 3,000 fish. In order to determine whether stocked sockeye fry were suffering differential mortality from predation, in 2001 and 2002, we captured sockeye fry over the summer using beach seines in the littoral zone, and trawls in the limnetic zone. Samples of fry catches were collected, and preserved. We used gee traps, trap nets, fyke nets, floating and sinking gill nets, and angling to sample potential predatory fish. The stomach contents of these fish were collected by gastral lavage, and identifiable sockeye fry remains were retained and preserved. All retained fry samples were classified as wild or stocked, by examination of otoliths. In 2001 and 2002, the stocked fry did not appear to suffer differential mortality, as compared to wild fry. Based on the stomach samples, lake trout (*Salvelinus namaycush*) are probably the primary predator on Tatsamenie Lake sockeye fry, and are likely targeting the fry, as the fry migrate into the limnetic zone in late summer. Tatsamenie Lake sockeye fry have an unusually long residence time in the littoral zone, and based on previous dietary studies, feed heavily on aquatic insects. The food resources may be partitioned in space and time. Tatsamenie Lake sockeye fry likely feed primarily on aquatic insects during their littoral zone residence, and on zooplankton following migration into the limnetic zone in late summer. Thus, the aquatic insect populations in the littoral zone may be limiting sockeye salmon production in the lake.

Fifty years of habitat enhancement and restoration on the national forests in Alaska

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Habitat enhancement and restoration projects have been implemented on the National Forests in Alaska since statehood. This presentation summarizes 16 different types of enhancement and restoration activities across both the Chugach and Tongass National Forests. Temporal trends in implementation of projects types are displayed and the results of selected project monitoring results are summarized.

Calcium-sensing receptor (CaR) activation enhances parr-smolt transformation in chinook salmon.

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Na^+K^+ATPase activity and the onset of hypo-osmoregulation during parr-smolt transformation are regulated by calcium-sensing receptor proteins (CaRs) that function as salinity sensors. CaR's bind cations and L-amino acids in body fluids and integrate these signals to physiologically remodel salmon for ocean life. Juvenile chinook exposed to CaR reactive compounds in freshwater exhibit increased gill Na^+K^+ATPase activity and hypo-osmoregulatory ability compared to non-treated fish, comparable to seawater values. Such adaptation reduces osmotic mortality and enhances feeding upon seawater entry. Use of CaR reactive compounds to acclimate smolt to seawater before release can potentially increase the number and size of returning hatchery salmon compared to fish released without such treatment.

On-going studies of early marine life history of enhanced chum salmon fry in Gastineau Channel, Taku Inlet and adjacent waters

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Three independent but closely related research projects are being conducted by private and government agencies in Gastineau Channel, Taku Inlet and adjacent waters to study the early marine life history of hatchery-reared juvenile chum salmon (Oncorhynchus keta) and their potential interactions with wild chum fry. One project, conducted by Douglas Island Pink & Chum, Inc. (DIPAC), investigates the effect of two different rearing strategies on the spatial and temporal distribution, growth, and habitat utilization of newly released chum fry and the potential relationship of these factors with marine survival. Another study, conducted by ADF&G, looks at the incidence of piscine predation on juvenile chum salmon during their initial marine residency periods in nearshore and offshore habitats in order to document the relative degree of piscine predation on wild and hatchery-reared chum fry. A third study, conducted by the School of Fisheries and Ocean Sciences (UAF), investigates the potential interactions of wild and hatchery juvenile chum salmon in Taku Inlet (reported separately).Collectively, these studies use a combination of beach seines, Kodiak trawls, and variable mesh gillnets to collect samples of juvenile chum salmon and their predators in nearshore and offshore habitats. All hatchery fish are thermally marked, and otolith analysis is used to determine the origin (wild or hatchery) of the fry sampled. In addition to examining possible spatial and temporal overlap, the Taku Inlet study will also conduct diet and calorimetric analyses on chum salmon juveniles to evaluate the potential for intraspecific competition between wild and enhanced fry. This presentation will examine the progress made to date on these projects and review the initial results.

Session: Salmon Enhancement: State, Federal, and Private Programs. Part 2
Session Chair – *Steve Reifenstuhl*

The use of otolith marking to manage mixed hatchery/wild stock fisheries in Prince William Sound, Alaska and to advance research on the ecology of salmon

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Private, non-profit salmon hatcheries, in Alaska, share a responsibility for stewardship of the wild Alaskan salmon stocks they enhance. In the process of providing large quantities of enhanced salmon for commercial, subsistence and sport fishers it is vital that the wild stocks, returning in conjunction with enhanced fish, are not over harvested. Otolith marking of hatchery produced pink salmon fry in Prince William Sound provides a reliable, in-season identifier of returning adults that is used by the Alaska Department of Fish and Game to target fisheries toward hatchery stocks while assuring sustainable wild stock escapement goals. This is accomplished through pre-opener test fisheries, sampling of commercial fisheries, sampling of hatchery cost recovery sales and rapid processing of sampled otoliths. Otolith marked hatchery stocks have also become a valuable tool of State, Federal and International studies on salmon migration, feeding, and growth. Through otolith marking, private, non-profit hatcheries help assure the long-term survival of wild salmon stocks throughout Alaska while enhancing the economic future of the state's fishing industry.

Medvejie Hatchery ocean-type Chinook strategy

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Ocean-type or freshwater age zero Chinook salmon is a common life history among Chinook stocks along the British Columbia coast but rare in Alaska. Numerous Alaska enhancement programs have attempted to adapt the ocean-type Chinook strategy to a hatchery setting via incubation and rearing environment temperature manipulation. Marine survivals from these experiments have been poor, and therefore; the majority of enhanced Chinook production is stream-type or yearling smolt production, analagous to most wild Chinook in Alaska. The Situk River near Yakutat produces ~90% ocean-type smolt, a strategy that likely evolved due to rapid spring growth made possible by its shallow, warm, and productive estuarine waters. In 1999, NSRAA initiated an ocean-type Chinook program patterned after the life history of the Situk stock. Four gram Chinook fry (originally Andrews Creek stock 1982) were transported to a lacustrine environment where surface temperatures approach 12^0C in June; fry were fed and reared at low densities in net pens for thirty days. Unlike their raceway reared cohort, these fry grew at 4.72% body weight per day (BPD) or 2.52 times the rate of the hatchery reared fish. Smoltification of the fry began within three weeks of lacustrine entry. In early July the fry were transferred to saltwater; 99% of the fry acclimated to $30^0/_{00}$ seawater and continued growing at a rate of 4.0% BPD. By late July, at time of release the Chinook smolt were 22 grams. Brood year 1999 ocean-type Chinook survived from smolt release to adult at 2.55% with 3-ocean age being the dominant age class which is similar to Situk ocean-type. Survival of hatchery reared yearling Chinook in southeast Alaska average 2.7% or less. The implications of an ocean-type enhancement strategy are significant in terms of production costs (~65% less) and perhaps as important, for reduction of freshwater demand 11 months of the stream-type rearing cycle.

Fisheries research programs at the Little Port Walter research station

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Fisheries research at Little Port Walter began with herring research at local herring packing and reduction plants in the 1920's. Salmon research began with stream escapement enumeration in the 1930's and, after the construction of a permanent weir and research lab, in 1939 and 1940, field studies on the life history and freshwater ecology of pink salmon began. The research emphasis shifted from studies of pink salmon to studies of other salmon species in the 1960's and 1970's, and from freshwater ecology to enhancement research and development, in conjunction with the initiation of an active State of Alaska enhancement program (Fisheries Rehabilitation and Development Division) and the creation of the Private Non-Profit Hatchery Program. In the early 1980's research was expanded to accommodate a State of Alaska sponsored interest in salmon farming. This work was discontinued in the early 1990's when state legislation was passed which banned commercial fin-fish farming in Alaska. The late 1980's and 1990's were a period of substantial change in West Coast fisheries with the listing of several stocks of salmon in the lower '48 as threatened or endangered under the U.S. Endangered Species Act (ESA). The potential negative impacts of enhancement activities on listed stocks spurred the initiation of research at LPW in the late 1990's on the impacts of hatchery fish on wild fish, particularly chinook salmon. This work, along with ESA related research on steelhead are the primary focus of research currently.

The enhancement history and status of Virginia Lake sockeye salmon

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Virginia Lake is located on mainland southeast Alaska in close proximity to the island community of Wrangell. Modern Tlingit ancestors first settled the area and probably used the native sockeye salmon (*Oncorhynchus nerka*) inhabiting the system as a primary food source. Mill Creek drains the lake a short distance to saltwater and offers residents a convenient sockeye subsistence fishery at the estuary. Virginia Lake and its tributaries are organically stained and oligotrophic – a condition common to many systems of coastal Alaska and British Columbia. Attempts to stimulate lake-rearing salmon production in these areas have been practiced for more than 30 years. The Virginia Lake system has undergone substantial modification since the induction of a sockeye enhancement program in 1986. In addition to the construction of a fishpass structure in Mill Creek in 1988, Virginia Lake was stocked with over 7.6 million non-endemic sockeye fry from 1988-1995 and artificially enriched from 1991 to 2002. Despite a strong positive response by the phyto- and zooplankton communities to the nutrient enrichment, fry densities show a strong decline in recent years. In addition, recent escapement estimates suggest that less than 5000 adult fish are returning to the system – far less than the originally projected 20-60,000. Attempts to ascertain the cause for the low escapement remain largely unanswered due to incomplete datasets. Limited lake migration success, poor spawning success, and low fry to smolt recruitment are among the possible explanations for the diminished success of this enhancement project. At present, no further management modifications or monitoring efforts are planned for the system.

Session: Managing Alaska's Fisheries in the Face of Arctic and Sub arctic Climate Change

Session Chair – *Kate Wedemeyer*

Likely climate related oceanographic change in Alaska

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Global climate change has been measured as an average global change of 0.6^{o}C over the past several decades. Measures and predictions of future change indicate it is greatly magnified toward the polar regions. Indeed, Alaska has experienced a 2^{o}C change over the same period. The mean arctic annual surface temperature increase north of 60^{o} is projected to be 2-4 ^{o}C higher by mid century. Along with temperature changes, precipitation is predicted to increase 8%. Ninety percent of the increased temperatures is absorbed in the oceans.

Observed, hypothesized and predicted oceanographic changes include increasing average temperatures, especially in cold season; sea-level rise, sea freshening, increasing cloudyness; increasing precipitation in scattered regions; increasing variability; increasing storminess; increasing upwelling from deeper in the ocean; increased stratification in the upper ocean change in timing of spring bloom; switch from bottom-up control of forage fish populations to top-down; decrease in ice cover and depth; increasing sediment from melting permafrost; increasing river and coastal erosion

The purpose of this symposium is to first review examples of how that climate change is being reflected in Alaska's fisheries. More importantly, the final panel discussion will begin a discussion around the question, "How do we AFS members, as fisheries professionals, prepare and manage in the face of climate changes?"

Local Climate Changes Observed by Sitka Elders

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Mr. George Bennett, Sr., local Sitka Elder, is the presenter of this session. This session will focus on local climate change observations based on traditional ecological knowledge by Sitka Elders. This traditional ecological knowledge is based on local observations, oral history, culture and traditions. Topics include: observed changes to Sitka's herring *(Clupea pallasi)* spawn, decline in the quality of subsistence foods, observed changes to localized weather patterns, increase in ocean levels, increase of exotic species and the decline of indigenous species.

Implications of climate change on spawning timing and management of Pacific herring in Bristol Bay, Alaska

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Spawning timing and location of Pacific herring (*Clupea pallasi*) vary annually. Accurate predictions of spawning variability are important to the fishing industry and fishery managers, who strive to maximize product quality and prices. Roe quality peaks just prior to spawning and the largest, most valuable herring spawn first. Declining worldwide demand for roe and increasing fishing costs exacerbate the need for accurate timing of fishery openings. In cooperation with ADF&G, we studied the dynamics of pre-spawning school distributions and spawning and spawning location of herring in the Togiak Fishery Management District in northwestern Bristol Bay, Alaska. Historical data on herring observations and sea surface temperature (SST), surface air temperature (SAT), and sea ice concentration were analyzed within a geographic information system (GIS) at multiple spatial and temporal scales. A statistically significant ($P<0.001$, r^2=0.82) non-linear relationship exists between spawning timing and offshore (57.87 N, 171.03 W) ice concentration in April during 1977 to 1994, but less variability ($P<0.001$, r^2=0.65) in spawning timing is explained when more recent data are included. A weaker, but still significant (p=0.005, r_2=0.35), linear relationship exists between April SST and herring spawning timing. Along the northwestern coast of Bristol Bay, pre-spawning herring schools show a general inseason pattern of movement from east to west and spawning events are later in the west than in the east. This local movement corresponds to temperature gradients within the bay as revealed by AVHRR satellite imagery. Apparently, solar heating, melting of sea ice (cold pool formation), and mixing of warmer waters from the south combine to influence the physiology of maturing herring in offshore waters during winter, rates of shoreward migration in late winter/early spring, as well as school behavior in inshore waters just prior to spawning in spring. These oceanographic processes are driven by climate changes in the northern hemisphere.

Ecological changes in Kachemak Bay, Alaska

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Alaska Dept of Fish & Game trawl surveys conducted over a 29-year period in Cook Inlet's Kachemak Bay have documented, via shifts in species composition, changes widely recognized to have occurred in the northern Gulf of Alaska marine ecosystem. ADFG conducted small-mesh trawl surveys between 1976 and 2004. This gear was chosen based on its high selectivity for relatively small species. Although the surveys were originally designed to assess shrimp populations, the data collected have also proven useful as a multi-species ecosystem-monitoring tool. A review of the species composition data indicates that larger predatory fishes appear to have benefited from ecosystem changes during the survey time series, whereas shellfish and smaller forage fish species appear to have been adversely affected. Declines in shellfish populations in the 1980's corresponded with dramatic increases in survey fish catches from less than 20% of the total survey biomass in the 1970's to more than 80% in recent years. Commercial landings data from the 1970's to present also indicate a shift in abundance from shellfish species to finfish species. Although overfishing was likely a factor in initial shellfish declines, it is now recognized that a regime shift within the northern Gulf of Alaska ecosystem, driven by the Pacific Decadal Oscillation, continued to suppress crustacean population levels.

Time series analysis of Pacific cod recruitment and ocean temperatures in Canada and Alaska

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Ocean temperatures are highly influenced by climatic variability and are predicted to rise as a result of global climate change. Temperature has also been demonstrated to influence the abundance and distribution of marine fish stocks. As part of our research into the effect of climate in general and temperature in particular on Pacific cod (*Gadus macrocephalus*) stocks in Alaska, we have studied time series of cod recruitment from Alaskan and Canadian waters. We used these data to explore three questions: 1) How are individual cod stocks affected by local changes in ocean temperature? 2) How does recruitment variability compare among stocks, and is that variability related to large-scale climate indices? 3) Is the effect of temperature pronounced during particular cod life stages or seasons of the year? Here, we present the results of our analyses and discuss the implications of climate change for Pacific cod.

(Student)

Session: Coregonid Life History Research: Methods and Application

Session Chairs – *Randy J. Brown & Ken Harper*

Colville River Arctic cisco population trends

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Arctic cisco catch rates from commercial and village fisheries in the Colville Delta show substantial fluctuation between 1967 and present. Catch rates for both village and commercial fisheries have fluctuated in a similar manner, indicating that catch rates are reflecting changes in regional abundance of Arctic cisco. Regional abundance of Arctic cisco in the Alaskan Beaufort Sea is a function of sporadic large recruitments that originate in the Mackenzie River. When winds are favorable, young Arctic cisco are transported into the Alaskan Beaufort Sea, where they establish in the Colville River and remain until they reach maturity. When they reach harvestable size, typically at 5 to 7 years, they support targeted fisheries until they mature and leave the region. The cyclic nature of the recruitment process allows some prediction of the harvest rates in the village and commercial fisheries that target Arctic cisco. High recruitments result in high fishery catch rates after a 5 to 6 year lag, while low recruitments result in low catch rates. Abundance indices developed from catches of juvenile Arctic cisco by fyke nets in Prudhoe Bay allow pre-season predictions of catch rates so that residents will have some idea of what to expect from the upcoming season. Harvest predictions based on fyke net indices of summer abundance are subject to error because changes in brackish water in the delta during the fishing season will change distribution of Arctic cisco in relation to main fishing areas. Arctic cisco orient to salinities between 15 to 25 parts per thousand, which are commonly found in the lower portion of the delta during the fishery, from mid-October to late November. Highest catch rates have been recorded when high abundance coincides with a favorable salinity distribution during the fishing season.

Seasonal habitat use and movement patterns of broad whitefish (*Coregonus nasus*) in freshwater systems of the central and western Beaufort Sea

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Broad whitefish (*Coregonus nasus*) are a preferred subsistence fish species by Inupiat Eskimos living along the Beaufort Sea Coast. They are harvested in the Colville River, Fish Creek drainages, and most heavily from camps set along drainages between Barrow and Teshekpuk Lake. Broad whitefish occur in highest numbers in drainages along the Beaufort Sea Coast from Prudhoe Bay to Barrow. The species occurs, at least seasonally, in most coastal drainages within the North Slope oilfields, however numbers increase to the west with highest densities in the Ikpikpuk/Chipp River/Teshekpuk Lake region. To date only a handful of directed research efforts have investigated the life history characteristics or habitat use patterns of the species along the Beaufort Coast. Between 1997 and 2004, we radio-tagged and tracked over 120 adult broad whitefish in fresh water systems along the central and western Beaufort coast including: the Putuligayuk/Sagavanirktok rivers, East Creek, Fish and Judy creeks, and Mayoriak River/Teshekpuk Lake tributaries. Our main objectives were identifying important habitats for migration, feeding, wintering and spawning. Broad whitefish in the study area have shown significant movements between and within coastal drainages, in some cases moving over 100 km along the coast to distant systems. Broad whitefish have shown strong fidelity in the Colville and Prudhoe Bay regions to wintering and spawning areas with respect to both location and timing of arrival. Strong fidelity to freshwater feeding areas and specific systems was observed for fish from all study areas. Our data indicate relative use of small drainages with connected lakes is high, as opposed to major river systems, for feeding during the open-water season; a consistent pattern across the study area.

CPUE data lead to new discoveries in whitefish migration and life history strategies from the Middle Yukon River

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In recent years, returning salmon runs have been monitored using daily fishwheel catch rates in the mainstem Yukon River, above the Tanana River confluence. The addition of video technology has allowed the collection of catch data for other fish species, including whitefish. From this new information, it has become apparent that there are substantial upriver movements of inconnu, humpback and broad whitefish, and Bering cisco in the middle Yukon River during the summer months. These runs of whitefish are made up of mature spawning fish, determined by gonad examination and age. Gonadosomatic indices increased in all species as the season progressed. Anadromy was detected in all four species using otolith microchemistry analysis. All of the whitefish examined had empty stomachs, suggesting none were feeding during migration. A wide range of age classes were represented in the migrating inconnu, humpback, and broad whitefish, indicating both first-time and repeat spawners were present. In contrast, the Bering cisco run consisted of a narrow range of age classes dominated by young fish, suggesting that most were first-time spawners. Telemetry studies documented spawning areas for the migrating inconnu and broad whitefish in the middle Yukon River. These new discoveries have greatly expanded our knowledge of Yukon River whitefish populations and will help direct future research needs.

Life history and spawning movements of broad whitefish (*Coregonus nasus*) in the middle Yukon River

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Whitefish of all types have long been an important subsistence food source for the people of the Yukon River drainage and their dogs. The broad whitefish is the second largest of six species of the subfamily Coregoninae that were found in fishwheel catches during a mark/recapture project for fall chum salmon (*Onchorynchus keta*) run by the U.S. Fish and Wildlife Service at the Rampart Rapids between Tanana and Rampart, Alaska. The objectives of this study were to determine run timing, age distribution of the spawning population, spawning location, and if the population used marine influenced water as part of their habitat. In this effort a wide spectrum of techniques were used including radio telemetry and both the ageing and microchemical analysis of thin-sectioned otoliths. Like other coregonids of similar size these are long-lived fish that regularly live into their teens. The microchemical data suggest that some of these fish make long migrations and use marine influenced waters during part of their life history. The information gleaned from this study will contribute to a better understanding of the complex life history of this important resource.

Spawning Periodicity of Humpback Whitefish *Coregonus pidschian* in the Upper Tanana River

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Humpback whitefish are known to be long-lived and iteroparous. Scientists who have studied the energetic cost of reproduction for this species suggest that individuals cannot spawn two years in a row, and have proposed instead that they spawn once every two or three years, a strategy referred to as "skip spawning". Even though the skip spawning theory has never been directly tested with humpback whitefish, it is generally accepted as true. Radio telemetry was used to determine if mature humpback whitefish in the upper Tanana River drainage spawned two years in a row based on their presence in two known spawning areas during the fall spawning season. Radio tags were implanted in 32 fish in May 2002, and located three times each year for two full years: during late May in feeding habitats; during late September during spawning time; and during late January in overwintering habitats. Survival was determined based on fish movements between habitats. To justify the assumption that fish presence on the spawning area implied spawning intention, sampling was conducted on the spawning areas during two spawning seasons. Over 400 humpback whitefish were examined and only reproductive fish were found. Twenty-six radio-tagged fish were known to be alive during the first spawning season and 24 were located in spawning areas. Twenty of the fish that spawned during the first season were known to be alive during the second season. Fifteen of these fish were located in spawning areas and five remained in feeding habitats. These data contradict previous assumptions regarding spawning periodicity for humpback whitefish and reveal that most mature humpback whitefish spawn every year in the upper Tanana River drainage.

Kuskokwim River coregonids and their use of whitefish lake

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Humpback whitefish Corigonus pidschian, broad whitefish C. nasus, and least cisco C. sardinella constitute an important subsistence resource in the Kuskokwim River drainage. Concerns about declines in whitefish size and abundance led to the adoption of subsistence harvest regulations for Whitefish Lake in 1992. To gather life history and population information on whitefish using Whitefish Lake we operated a weir at the lake outlet during September and October 2001, June through September 2002, and May to October 2003, and May to June 2004. Weir passage out of the lake totaled 27,882 humpback whitefish and 15,134 least cisco in 2003 and 31,858 humpback whitefish and 26,043 least cisco in 2002. Broad whitefish passage was approximately 450 for all years. Scales, otoliths, and lengths were collected from a sub sample of whitefish passing the weir and from subsistence catches. A sub sample of humpback whitefish, least cisco and broad whitefish were also marked with external floy ® tags to obtain movement and harvest information. Tag returns suggest fidelity to the lake as a feeding area and similar seasonal movements between years. Whitefish using the lake appear to be mature or maturing based upon a Gonad-somatic index and strontium concentrations in otoliths indicate an early life history spent in brackish waters of the lower Kuskokwim. Harvest of Whitefish Lake fish is occurring both within the lake and in the Kuskokwim River as the fish migrate to possible spawning and over-wintering areas. Broad whitefish may have been over harvested in the past and population numbers have not rebounded.

Session: Advances in Marine Biology. Part 1
Session Chair – *Mike Byerly*

Reproductive biology, spawning season, and growth of female rex sole (*Glyptocephalus zachirus*) in the Gulf of Alaska

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Rex sole (*Glyptocephalus zachirus*) have a wide distribution throughout the North Pacific, ranging from central Baja California to the western Bering Sea. Although rex sole are an important species in the commercial trawl fisheries off the U.S. west coast, knowledge of their reproductive biology is limited to one study off the Oregon coast that analyzed ovaries with gross anatomical methods. This study was initiated to determine reproductive and growth parameters specific to rex sole in the Gulf of Alaska (GOA) stock. Female rex sole (n = 594) ranging in length from 166 - 552 mm were collected opportunistically around Kodiak Island, Alaska, from February 2000 to October 2001. All ovaries were analyzed to determine the maturity stage using standard histological criteria. Year-round sampling of rex sole ovaries confirmed that rex sole are batch spawners with a protracted spawning season in the GOA. The spawning season for rex sole spanned at least 8 months, from October to May, which is a longer duration and in different months than previously estimated.

Female rex sole in the GOA had an estimated length at 50 % maturity (ML_{50}) of 352 mm, which is 46 % greater than the estimated ML_{50} for the stock off the Oregon coast. At the same length that 100 % of rex sole from Oregon waters were mature, only 15.8 % of rex sole in the GOA are mature. The maximum age of collected female rex sole was 29 years. The estimated age at 50 % maturity (MA_{50}) for female rex sole in the GOA was 5.1 years and was similar to the MA_{50} for rex sole off the Oregon coast. The von Bertalanffy growth model in the GOA was significantly different than the model from the Oregon coast. Higher growth rates in the GOA correspond with differences in length at maturity and similarity in age at maturity between the two regions.

Reproductive ecology of Atka mackerel: Embryonic developmental series

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Atka mackerel (*Pleurogrammus monopterygius*) range from Asia to North America in the southern Bering Sea and northern Pacific Ocean. In Alaska, a better ecological understanding of this integral species that supports a multimillion dollar commercial trawl fishery is critical for reliable management programs. We aim to determine the embryonic developmental series for Atka mackerel, as one component of a comprehensive multi-objective study to elucidate the reproductive ecology of this species. Currently available data on the embryonic developmental series of Atka mackerel are not suitable for accurate age determination of eggs due to lack of information, detail, and standardized methods. Our primary objective of this component is to generate a complete embryonic developmental series for Atka mackerel at 4, 7, and 10°C. Fertilized eggs collected from captive Atka mackerel were transferred into closed-system incubation tanks, sampled at regular intervals and preserved in Stockard's solution. Spawning events were video recorded to determine time zero. Subsequent data analysis and descriptions will be performed according to recent embryonic developmental research conducted on other species. To date, incubation and sampling has been completed at 10°C with eggs hatching at 40-45 days after fertilization, while a preliminary trial at 7°C had a hatch time of 75-80 days. Hatch time results at 4°C are pending. Data from a complete embryonic developmental series will allow the assessment of age of eggs found *in situ* when the prevailing water temperature is known. As a consequence it will be possible to estimate spawning and hatching dates, thus providing critical information for better stock assessment and management of Atka mackerel in Alaskan waters.

Maturation of walleye pollock, *Theragra chalcogramma*, in the eastern Bering Sea in relation to temporal and spatial factors

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Walleye pollock, *Theragra chalcogramma*, are both ecologically and commercially important in the eastern Bering Sea (EBS). Maturity is a critical parameter in the stock assessment to set annual total allowable catch. Pollock maturity has not been examined in the EBS since 1976, and possible interannual and geographic variation has not been studied to date. Our goal is to estimate correct maturity schedules for EBS pollock. Maturity data, fish lengths and macroscopic maturity stages were collected aboard pollock trawlers during winter 2002 and 2003 across the EBS from 10,197 pollock. Similar data were collected by NMFS scientists during hydroacoustic surveys from 1989 – 2002. Histological analysis of ovary tissue collected in 2003 confirmed the appropriateness of macroscopic staging. However, some pollock classified macroscopically as "developing" may mature either in the current or following spawning seasons. Therefore, our analysis was performed with two alternative assumptions: fish classified as "developing" were either considered immature or mature. Maturity rates were estimated by logistic regression using maximum likelihood methods. Geographic variability exists; fish mature at the smallest lengths north of the Pribilof Islands. Size at maturity varies interannually, as well. Temporal and spatial variation in maturity may be due to biological or environmental factors, such as pollock density, water temperature, or prey availability.

(Student)

The ecology of age-1 copper rockfish (*Sebastes caurinus*) in vegetated habitats of Sitka Sound, Alaska

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Variables that may indicate habitat quality were measured to assess the relative value of three different shallow subtidal vegetated habitats to age-1 copper rockfish (*Sebastes caurinus*). All habitats studied appeared beneficial to fish with respect to the particular variable measured. Relative growth rate was significantly higher in understory kelps than in the other habitats while energy content was highest in eelgrass. Though fish in eelgrass had lower growth rates, they were the largest in length, and had highest densities. Mixed kelp and eelgrass habitat was suboptimal with respect of growth and energy content but also had high densities. Fish in the mixed habitat moved the least both within their habitat and to other habitats while the opposite occurred for fish in eelgrass. Diets were similar for fish in kelp and eelgrass habitats and daily ration did not differ significantly between habitats. Thus, the observed differences in the variables measured were not related to food but may instead be dependant on non-exploitative interactions.

Feeding habits of two congener rockfish species, dark rockfish (*Sebastes ciliatus*) and black rockfish (*Sebastes melanops*) caught in the western Gulf of Alaska

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Dark rockfish (*Sebastes ciliatus*) are often caught by commercial jig operations targeting black rockfish (*Sebastes melanops*) in the Gulf of Alaska. Previous feeding ecology studies of rockfish caught in southeast Alaska found differences in the diet of these two species with black rockfish as piscivorous predators while zooplankton invertebrates were the primary prey of dark rockfish. In July of 2001, 434 dark rockfish were caught as bycatch on an ADF&G black rockfish survey conducted around Sanak Island and the Sandman reef area of the western Gulf of Alaska. Each individual fish was weighed, sexed, measured and the otoliths were removed to examine natural mortality of dark rockfish. Stomach samples were also collected from both dark and black rockfish when the two species were caught at the same stations for the purposes of investigating niche overlap and potential differences in diet. Both rockfish species had an abundance of Pacific sand lance (*Ammodytes hexapterus*) and Pacific sandfish (*Trichodon, trichodon*) in their stomachs although the frequency of occurrence of Pacific sand lance and Pacific sandfish was greater in the black rockfish diet. Juvenile walleye pollock (*Theragra chalcogramma*) and Pacific cod (*Gadus macrocephalus*) occurred more frequently in the diet of dark rockfish than black rockfish illustrating the variety of forage fish prey in the dark rockfish diet. Polychaete worms were the most frequently observed invertebrate in the diet of black rockfish with cnidarians and euphasiids as the most frequent invertebrate prey for dark rockfish. Crab larvae were also present in the stomachs of both predators although this prey was not a major contributor to either predator's diet. Black rockfish feeding exclusively on forage fish (66%) was higher than dark rockfish feeding solely on forage fish (35%) while dark rockfish feeding exclusively on invertebrates (41%) was higher then the 4% of black rockfish samples containing only invertebrate prey. Dark rockfish also had a higher number of samples with combined forage fish and invertebrate prey items than the black rockfish, supporting the hypothesis of black rockfish as a piscivorous predator.

Session: Advances in Marine Biology. Part 2
Session Chair – *Dan Urban*

Coral and Sponge Habitat Mapping in the Central Aleutian Islands.

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A joint project between the National Marine Fisheries Service, the Alaska Department of Fish and Game, and the University of Alaska began in 2003 to provide the first detailed mapping of coral and sponge habitats for the Aleutian Islands. Coral gardens were first discovered in the central Aleutian Islands in 2002, and the conservation of coral and sponge habitats in this area has become a key issue for federal and state fisheries managers due to incidental mortality in fisheries using bottom contact gear. Bottom substrates were mapped using multibeam sonar bathymetry and backscatter data in a systematic sample of 17 sites between 50m and 3000m depth in swaths averaging about 5 km wide. A series of transects were sampled at most of these sites using the Delta submersible and the Jason II, a remotely operated vehicle, to estimate densities and distribution of coral, sponges, various other invertebrates, and fish. This presentation will provide highlights of some of the observations and a status report of work in progress. Final results, expected in 2006, are to include a predictive model of coral and sponge distribution as a function of measurable environmental characteristics, estimates of the relative abundance of corals and sponges, their importance to commercially valuable fish and invertebrates, and the degree to which these living substrates have been disturbed, including disturbance by fishing gear. Funding for this research is provided by the North Pacific Research Board, NOAA's Undersea Research Program, and the National Marine Fisheries Service.

Population biology and trophic position of the grass shrimp *Hippolyte clarki* (Decapoda: Caridea) in Sitka Sound

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The caridean shrimp *Hippolyte clarki* Chace, 1951 is one of the most abundant shallow-water shrimps in southeastern Alaska. These shrimps aggregate in dense numbers in *Zostera* eelgrass beds and *Macrocystis* kelp canopies. Prior diet studies on juvenile rockfishes in Sitka Sound indicate that *H. clarki* forms an essential component of their diet in eelgrass habitats. Ecologically similar shrimp in other areas have been shown to be a critical link between primary production in the eelgrass beds and higher trophic levels. No information on the population or sexual biology of *H. clarki* exists. Samples have been collected biweekly since July, 2004 from eelgrass habitats within the Sitka National Historic Park and eelgrass and kelp habitats on Middle Island in Sitka Sound. The samples show a bimodal distribution with males below 3.0 mm carapace length (CL) and females above 3.0 CL, which suggests protandric hermaphroditism. The shrimp were present in the *Macrocystis* habitat throughout the study but present in the eelgrass only after late August. Further diet analysis and stable isotope studies will be used to determine trophic position of this shrimp.

(Student)

Spatial distribution of nearshore and pelagic fishes in relation to physical oceanography in a glacial fjord

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Glacier Bay National Park is marked by complex oceanographic processes that influence the distribution and abundance of nearshore and pelagic fishes. We sampled marine waters in the park between 1999 and 2004 in order to characterize marine predator and forage fish resources. At least 45 species of nearshore fishes were collected with 289 beach seine sets at 66 sites. We also sampled a minimum of 51 pelagic fish species with 225 modified herring trawl sets. Nearshore and pelagic habitats are analyzed using AVHRR satellite imagery and existing USGS data that detail oceanographic regimes within the park. The distribution and abundance of select nearshore and pelagic fish species relative to marine habitat parameters such as bathymetry, salinity, temperature and turbidity are examined.

Sperm whale and longline fisheries interactions in the eastern gulf of Alaska: Cooperative research between scientists, fishermen, and government

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Sperm whales have learned to take sablefish, a natural prey, off longline gear in the Gulf of Alaska. Reports of depredation were first noted in 1978 and have steadily increased in frequency and severity, with a notable increase since the late 1990s likely due to the lengthening of the fishing season. In Alaska, injury to whales has not yet occurred, however, mortalities and serious injury of sperm whales have occurred in other areas of the world due to similar fisheries interactions. Fishermen have felt economic impacts due to reduced catch. Through cooperative research with fishermen, government and scientists, our ultimate goal is to provide recommendations for strategies to reduce or eliminate depredation on longline gear by sperm whales. As a first step, we are collecting information, with collaboration from the southeastern Alaskan fishing fleet, on the timing of interactions seasonally and diurnally. This research will: define the scope of the problem; help identify stock structure and the ecology of this endangered species; provide baseline information needed for studying depredation mechanisms and cues; and finally, assist in the development of non-lethal deterrence to sperm whale depredation. The core team of 10 fishing boats for the Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) participated during the 2003 and 2004

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fishery. Each SEASWAP member was issued a logbook and digital camera to capture photographs of whales near their vessels. In 2003 56 percent of the SEWSWAP longline sets had whales present, 64 percent of the sets with whales present had depredation. Seventeen individual whales were identified in 2003, 14 in 2004 with one whale re-sighted between years. A population estimate of sperm whales for the study area yielded 134 (53, 269 95%CI). A crossbow and dart were used to take skin and blubber plugs for genetic sampling. Ten genetic samples were taken from 6 whales in 2003; all of these whales were male. Six samples were taken in 2004 and have yet to be processed. Additionally in 2004 we added an acoustic component to the study. Sperm whales are very vocal and we have determined acoustically that whales feeding in the absence of longline gear work at around 250 m, while whales feeding around longline gear are working at 50 m. The 2004 data is being analyzed and we hope to continue in the future with more emphasis on deterrents.

This project is funded through North Pacific Research Board.

Advances in Spiny Dogfish Research in the Face of Commercial Fishing

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In the Northeast Pacific Ocean, spiny dogfish *(Squalus acanthias)* have supported commercial fisheries for over 100 years, despite sparse biological knowledge about the species. Tagging studies suggest diverse stock structure, including migratory offshore stocks and distinct non-migratory inshore stocks that require region-specific management and research. Biological differences exist between these groups of dogfish, a related study by the author found differences in timing of parturition among dogfish in British Columbia (BC, Canada) inshore waters and those residing in neighboring Puget Sound, Washington (WA). Management strategies were developed by the WDFW for WA and DFO for BC for their respective fisheries. Currently, a management plan is lacking for spiny dogfish in Alaska. With increasing public interest to develop a commercial fishery in Alaska, it is crucial to advance our region-specific knowledge of this species, so that management strategies can be adapted from past lessons learned in other jurisdictions with biological parameters appropriate for Alaska. Biological understanding of dogfish advanced with the completion of a study in WA, including new methods for monitoring reproductive health of a population. New Alaskan research projects include assessment of stock status, population demography (e.g. age and size composition, maturity, mortality), life history, ecology, and fisheries bycatch. Biological samples are being collected throughout the Gulf of Alaska to document spatial and temporal variability in biology and ecology to assist in the development of appropriate management units. Ecological impacts of this species are also being investigated by examining predator/prey interactions, consumption, abundance, and seasonal and interannual shifts in geographic distributions. This research is intended to assist ADF&G and Alaska Board of Fisheries to assess the merits of proposed new directed commercial fisheries, as well as to support NMFS and the North Pacific Fishery Management Council to manage federal fisheries in which spiny dogfish bycatch occurs.

(Student)

A green sea urchin survey of the Pribilof Island of St. George

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A systematic dive survey for the green sea urchin *Strongylocentrotus droebachiensi* was conducted around the Pribilof Island of St. George. The local Community Development Association wished to conduct a fishery and the survey was needed to set an acceptable harvest guideline. In addition, this survey provided an opportunity to gather baseline information on a virgin population at the edge of the species range.

Results of a previous reconnaissance conducted by the industry were used as a starting point for the survey design. The island divided into three areas and 40 dive transects were divided between the areas with spacing dependent upon the density of urchins noted in the reconnaissance. Counts of urchins greater than 50 mm test diameter were made and all urchins within a 1-meter^2 quadrat were collected for aging and roe analysis. A small sample of urchins was collected from within the breakwater on the south side of the island because local residents indicated these were the largest urchins to be found anywhere on the island. Population estimates were made by converting transect counts to urchins per meter of coastline and expanding for the amount of coastline. As a precautionary measure, the population estimate is taken as the lower bound of the one-sided 90% confidence interval in each area.

High densities of urchins were found in nearly all transects with a harvestable population of urchins estimated at 185,000 pounds. Urchins from open waters around the island were found to have similar growth at age, but the urchins from within the breakwater were found to be faster growing and were some of the largest green urchins found in the state. Roe quality from this August survey was variable. A small fishery was conducted in September 2002 but the harvest was hampered by poor weather and by the failure to attract more divers to the fishery. St. George remains a remote and harsh environment, but this survey demonstrated that developing a fishery for urchins on the island will not be limited by the resource.

Session: Southeast Alaskan Freshwater Fish Ecology. Part 1

Session Chair – *Kim Hastings*

Patterns in fish distribution, density, and size along longitudinal gradients of southeast Alaska headwater streams.

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In southeast Alaska small headwater streams are nearly ubiquitous and are often directly adjacent to land use activities that alter the landscape. Currently, little is known about the spatial and temporal dynamics of stream fish residing in these areas. The goal of this study is to examine seasonal patterns in fish assemblage structure along longitudinal gradients of headwater streams and examine features that potentially influence these patterns. We are comparing species composition, biomass, density, and size variation at 33 sample sites on 14 streams in two physiographically similar watersheds in central southeast Alaska. Sample sites are located upstream from marked changes channel slope and are of three general types, low-slope (mean channel slope 1.4%), medium-slope (mean channel slope 5.5%), or high-slope (mean channel slope 9.4%) sites. We are also assessing the structure of the associated habitat within each of the three site types to determine if features such as channel slope, stream size, cover, habitat heterogeneity, and substrate composition correspond to observed changes in fish distributions. Preliminary data suggests fish distributions in small headwater streams are not static and may vary across multiple scales. Results from our initial field season (summer and fall 2004) will be presented and discussed within the context of our project goals and objectives.

(Student)

Movement of Dolly Varden and cutthroat trout in a high gradient stream of southeast Alaska

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The movement of resident Dolly Varden and cutthroat trout in small high gradient (>5 %) is an important consideration in the design and replacement of of culverts on forest roads throughout southeast Alaska. Many have been identified as barriers to fish passage during high flows. We use passive integrated transponder (PIT) tags inserted into salmonids > 60 mm fork length and stationary antennas and transceivers to determine time and date of movement. Identification of individual fish allows us to identify the size of the fish, direction of movement and the distance moved. Concurrent measurement of stream stage is matched with time each fish was detected at a weir. Both cutthroat trout and Dolly Varden moved throughout the 1200 m length of the stream. Most fish movemed less than 200 m; however, some fish moved the entire length of the stream. Distance moved did not appear to be related to the size of the fish. Generally more fish moved during the fall and few fish moved during the winter. Preliminary results suggest that movement decreases at high stream stages. Cutthroat trout and Dolly Varden move throughout high gradient streams and at a wide range of flows. Movement in small streams appears to be influenced by season, but extensive movement by some fish occurs during the spring and summer. Movement within streams is common and fish may use several small habitat patches distributed throughout the stream.

The use of sonic tags to investigate the movement and depth of cutthroat trout in Turner Lake

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The ability of the Alaska Department of Fish and Game to estimate cutthroat trout (*Oncorhynchus clarki)* abundance in Southeast Alaska lakes has played an important role in its stock assessment and management programs. One of the key assumptions made for our abundance models is that cutthroat trout are "available" to our capture gear (i.e., every fish has an equal probability of being marked and recaptured). However, our capture gear is typically deployed along the lake bottom and the shoreline, thus any fish in the pelagic zone may not have the same probability of capture. In 1998 a pilot project was conducted at Turner Lake to evaluate this assumption through a sonic tracking study. This study also served as a feasibility study for future sonic tagging experiments and was designed to evaluate tagging methods and assess tracking equipment and techniques.

Six cutthroat trout were successfully implanted with sonic tags and subsequently tracked between 2 and 10 days after tagging. Movement of cutthroat trout varied from little movement at all (site specific fidelity where they stayed within the same 50 m of shoreline) to quick changes in location (i.e., approximately 2 km in 1 hour) to periods of pelagic forays. While the number of fish tracked during this study is too small to draw conclusions, the observed behavior suggest that cutthroat trout in Turner Lake remain or come into contact with the shoreline on a regular basis and are thus available to our capture gear. Results from this project suggest that sonic tagging of cutthroat is possible and the location and depth of fish can be accurately determined. Future sonic experiments should consider external attachment of tags, increased sample size, and tags with longer duration >15 days.

Life history and population abundance assessments of steelhead in 12 Mile Creek and beyond on Prince of Wales Island

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Presently there is a lack of current and sufficient steelhead population and life history data available for tracking trends in steelhead populations on Prince of Wales Island in Southeast Alaska. With the advent of federal subsistence proposals for expanded Tongass National Forest wide steelhead harvest opportunities it is crucial to acquire accurate stock assessments and life history patterns for both current and future management decisions. During the spring of 2004, the USDA Forest Service Craig Ranger District and the Alaska Department of Fish and Game implemented a pilot Steelhead study in 12 Mile Creek, a system that is typical of many small to moderate-sized streams on Prince of Wales Island, Southeast Alaska. This pilot study served as a guide for determining the most cost effective and precise methodologies for estimating population abundance to be used for a Prince of Wales Island large-scale steelhead population assessment and life history study beginning in 2005. The secondary objective of the 2004 pilot study was to collect current quantitative steelhead population and life history data with low variances and high precision.

Three methods were used for the capture of steelhead -, a fenced weir with upstream and downstream adult migrant traps, and hook-and-line angling and beach seining downstream of the fenced weir. The weir was used to count all migrating steelhead and to validate the mark-recapture estimates. Collected fish were measured, identified to gender, floy tagged and adipose fin-clipped prior to release. "Re-captures" were based on underwater visual sightings of marked fish, from snorkel surveys conducted by dive teams. Ratios of marked to unmarked fish observed in the snorkel surveys were then used to derive total abundance estimates of returning steelhead.

How wild steelhead win the race

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We compare steelhead trout and coho salmon young-of-the-year (YOY) growth in two watersheds in southeast Alaska. Coho salmon YOY emerge from the gravel in mid-April to late May with an average fork length of 38mm. Steelhead trout emerge from the gravel in mid-July with an average fork length of 29mm. Steelhead grew 2 to 4 times faster than coho salmon from July through September. Steelhead grew an average of 36mm in 62 days and coho salmon grew an average of 17mm in 123 days in Staney Creek in southern southeast Alaska. In the Kadashan River (250 miles north) steelhead grew 15mm and coho salmon 20mm for a similar time period. Water temperature and food supply may account for the differences in growth between the two species. Steelhead YOY emerge when water temperatures are near the summer peak and food supply may be more abundant and better quality. For example, steelhead YOY emerge when adult pink salmon are spawning which may provide both free floating salmon eggs and increased drift invertebrates from redd construction. Temperatures during July and August usually each the summer maximum (8-12^{o}C) and adult pink salmon adults are reaching maximum numbers in freshwater by late August. In the northern watershed, water temperature did not go above 4 ^{o}C until late June. Steelhead win the growth race by emergence timing with warmer water and increased high quality food supply (salmon eggs).

In search of Freshwater Lampreys

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Not much is known about lamprey populations in Southeast Alaska. Three species of lamprey are documented in the region, each with four to seven records. Western Brook Lamprey (*Lampetra richardsoni*) is a freshwater lamprey, typically 100-150 mm in length, previously reported from only three locations in Alaska. It is nonparasitic, living most of its life as a filter feeding ammocoete buried in silt. In the spring, nonfeeding adults migrate short distances to spawn in gravel. We have identified *L. richardsoni* in a stream on the mainland of Southeast Alaska, several kilometers above a large waterfall that presents a complete barrier to upstream migration. While natural landlocked populations of salmonids are common in Southeast Alaska, this is the first known instance of an isolated freshwater lamprey population in the state.

We are curious whether landlocked lamprey populations in this region are truly rare or have simply missed detection. Extensive minnow trapping in the reach where the lamprey specimens were collected has never resulted in a lamprey capture. Thousands of stream surveys have been conducted in southeast, but these typically use methods that are appropriate for salmonids and unlikely to detect lamprey. In 2004 we surveyed six probable lamprey spawning sites but found no evidence of lamprey at any of them. Adult *L. richardsoni* in Southeast Alaska are most likely to be visually observed from April to July, spawning above riffles in gravel streambed a short distance above silty habitat such as beaver-influenced channel. Redds are circular and roughly 15-25 cm wide and 5-10 cm deep. They superficially resemble hoofprints, but can be distinguished by structure such as the distribution of fine particles around the lip of the redd. We request that anyone who has sighted freshwater lampreys in Southeast Alaska, especially above upstream migration barriers, contact us to discuss the details of their observations.

Session: Southeast Alaskan Freshwater Fish Ecology. Part 2

Session Chair – *Kim Hastings*

Spawning distribution and habitat of sockeye salmon (*Oncorhynchus nerka*) in the Chilkat River drainage

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Sockeye salmon *Oncorhynchus nerka* in the Chilkat River drainage use varied spawning and rearing areas. Spawning distribution has previously been estimated based on scale pattern analysis, which provides reliable albeit limited information. To date the full extent of sockeye salmon spawning habitat in the Chilkat River is not identified. In 2003 and 2004, we used radio telemetry to determine distribution and identify spawning habitats of sockeye salmon in the Chilkat River drainage. During year one, 111 sockeye salmon were implanted with radio transmitters as they entered the lower river; 109 (98%) of these resumed their migration to spawning areas. Of these successfully tagged fish, 90 (81%) were followed to the spawning areas, 13 (12%) were intercepted by the sport and subsistence fishery, and 6 (5%) transmitters were found in the drainage, separated from the fish due to unknown causes.

One objective of our study is to document the distribution of sockeye salmon outside of Chilkat Lake, the principal sockeye salmon spawning area. Altogether 37 (33%) tagged fish were tracked to the main stem Chilkat River. Within the riverine habitat, fish used off-channel areas with upwelling water (54%), main channel areas with riffle habitat (22%), and tributaries (24%). Main channel spawning sockeye salmon were originally tracked to pool and side-channel habitats before moving out into the main channel to spawn. Results for 2003 showed that a significant proportion of sockeye salmon utilize riverine areas rather than depending on lake habitat for spawning.

During the 2004 field season, 213 sockeye salmon received transmitters as they entered the lower Chilkat River; 100% of these fish resumed their upriver migration. Several spawning areas not previously catalogued by the Alaska Department of Fish and Game were identified, while other riverine-spawning fish were tracked to locations found in 2003.

Inconsistencies between trophic level responses and adult sockeye estimates led to a change in the study design at Hetta Lake

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Residents of Hydaburg identified sockeye salmon returning to Hetta Lake as one of the most important subsistence resources and expressed concern about the apparent decline in sockeye catches in the subsistence fishery. We used mark-recapture methods in the area of highest concentration of spawners, the inlet stream, to get an index of escapement in Hetta Lake. We estimated the total escapement by expanding this index to the whole lake based on the proportion of spawners counted inside and outside the study area. In 2001, 2002, 2003, we estimated the sockeye spawning population to be 6,000, about 400, and 1,300 sockeye salmon, respectively. The Hetta Lake escapement ranked below average compared to other lakes. However, the hydroacoustic estimate of sockeye fry densities in Hetta Lake were one of the highest in the region. Using the 2001 adult and 2002 fry estimates, the number of fry produced by each spawner in other Southeast lakes (n=8), showed a range of 3 to 73 fry/spawner compared to 171 fry/spawner in Hetta Lake. The 2002 adult and 2003 fry estimates showed a similar disproportionate number of fry per spawner in Hetta Lake compared to other lakes. Furthermore, lower zooplankton biomass estimates in Hetta Lake in contrast with other lakes in 2002 and 2003 provided supporting evidence that sockeye fry densities were high in Hetta Lake. We explored the possibility that, by indexing the adult sockeye escapement only in the stream area, we were underestimating the spawning population. Extending our beach surveys to the end of October in 2003 revealed that the proportion of beach spawners increased from 2% in September to 85% by the end of October. We concluded that a weir on the outlet stream would provide a more accurate measure of the sockeye escapement into Hetta Lake. Measuring trophic level responses to estimates of adult sockeye salmon provided insight into the bias of our research methods, prompting us to change our study design.

Prey and nutrient subsidies in salmonid food webs: Implications for fish and forest management in Alaska

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Food and nutrient availability can have dramatic effects on food webs, influencing community structure, population dynamics, and productivity. Here I summarize data from invertebrate trap catches, and fatty acid, stable isotope, and diet analyses to assess inputs and effects of food (e.g., invertebrates, detritus) and nutrient subsidies from marine, terrestrial, and headwater sources on salmonid-bearing food webs in southeastern and southcentral Alaska. Quantity and nutritional quality of subsidies varied widely depending on source and season. Aquatic habitats lower in watersheds received more marine subsidies and less headwater subsidies than those farther upstream, and vice versa. Terrestrial prey from adjacent riparian habitats were the most abundant and consistently available subsidies in streams (spring through fall), and riparian forest type greatly influenced food abundance. Biota in habitats receiving marine inputs from returning salmon contained strong marine isotope and marine fatty acid signals, and contained more energy reserves (lipids). Salmonid diet analyses showed that fish consumed about equal amounts of freshwater and terrestrially-derived prey during most of the growing season, but ingested substantial amounts of marine resources (i.e., salmon eggs and decomposing salmon tissue) when these subsidies were present. Food, as well as habitat, appears to be an important driving force in fish-bearing food webs in coastal Alaska, and resource management dramatically influences these trophic processes, and ultimately, freshwater productivity.

An at-risk assessment of Dolly Varden through comparison to bull trout

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Background: Bull trout (*Salvelinus confluentus*) have only recently been recognized as a species distinct from Dolly Varden (*S. malma*), yet bull trout have become a high profile endangered species. Conversely, Dolly Varden receive little attention. The long-standing confusion over these two species is due to their overall similarity which then suggests that Dolly Varden warrant analogous consideration.

Purpose: Similar awareness and protection of Dolly Varden would provide for pro-active, and likely more successful, management. Comparable effective protection for both species should also help accommodate problems inherent in their difficult identification.

Methods: Fish and seventeen habitat variables were sampled in eighteen proximal stream sites in northwestern BC (adjacent to southeast Alaska). A data and literature review supplemented this field study.

Results: Dolly Varden and bull trout have similar preferences, but Dolly Varden may in fact be at additional risk due to important subtle differences. Dolly Varden have lower water temperature preferences, which is significant since the cold water requirements of bull trout have already been deemed of critical importance. Additionally, Dolly Varden are often found in smaller, isolated, and distinct populations, and in smallest faster streams. Their genetic data shows stronger population structure with higher between-population, and lower within-population, variability than that lauded for bull trout. Dolly Varden have a more, and increasingly, restricted distribution, with many populations in decline with this largely associated with human density and impacts.

Conclusions: Dolly Varden warrant similar strong conservation, management, and protection to bull trout. This is admittedly the particular case in the conterminous US and in southern BC, but the fairly clear lessons about the poor status of these two char species there should not be ignored here in more northerly regions. Since this area is the core of the Dolly Varden's healthy range, we have a larger responsibility for its maintenance.

Session: A Neophyte's Guide to Answering Fishery Management Questions with Genetics Tools

Session Chair – *John Wenburg*

So you're thinking of building a baseline? Issues to consider when developing a genetic application

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Genetics applications are becoming increasingly important as tools for answering management questions, but their usefulness is dependent on the quality of background data. The following issues need to be addressed when developing a baseline for genetic applications: 1) geographic coverage of the populations included, 2) biological basis for genetic structure, 3) sample sizes for population representation, and 4) choice of genetic marker. Each of these main issues is accompanied by attendant questions for which answers will depend on the intended application, associated costs, and required levels of accuracy and precision. We discuss these issues and present examples of our experience with building baselines for genetic applications.

Genetic analysis for determining the origin of harvested Yukon River chum salmon

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Management of Pacific salmon fisheries presumes that the appropriate harvest rate of each population is a function of their sizes and reproductive capacities. Consequently, appropriate management requires knowledge of the species' population structure and the ability to control the harvest of individual populations. Genetic analysis of a species can provide information about population structure. Using this information as a baseline, the composition of stock mixtures in harvests can be estimated using a process called mixed-stock analysis (MSA). Chum salmon (*O. keta*) of the Yukon River are of particular interest and concern to both the United States and Canada. Identification of the relative proportion of the chum salmon resource for these countries would simplify allocation and management as dictated by the Yukon River Salmon Agreement. Consequently, in 2004, the US Fish and Wildlife Conservation Genetics Laboratory in Anchorage initiated a pilot study of in-season MSA for Yukon River fall chum salmon. Here we discuss the evolution of this project to use genetics as a tool to help solve a complex international management issue.

Assisting management of chinook salmon in the Kuskokwim and Yukon Rivers: Genetic analysis of variations in sex-ratios at various life history stages

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Pacific salmon (*Oncorhynchus* spp.) are semelparous and generally exhibit balanced sex ratios. Some populations, however, display persist and often extreme sex ratio bias. Distorted sex ratios have been reported in populations of adult coho salmon, adult chinook salmon and juvenile sockeye salmon. Extreme and persistent sex ratio bias may adversely impact the genetic health of a population if the overall abundance is small and rapidly declining. Such a scenario may exist in some chinook salmon populations on the Yukon and Kuskokwim Rivers in western Alaska. The develop an effective conservation and management plan for these populations requires knowledge of when (at what life stage) the sex ratio becomes unbalanced and the likely factor(s) influencing gender abundance. Sex ratio distortion is known to occur during early juvenile development and in adults during ocean migration. Sex-determining genetic markers can be used to distinguish between these two possibilities and help focus conservation efforts on the life-stage specific factors that influence sex ratio. In this study a genetic marker specific for the Y chromosome in chinook salmon was used to estimate the genotypic sex ratio in juveniles and adults from three western Alaska populations. These populations have exhibited declining abundance during the period 1990-2003 and extreme male-biased sex ratios (70 – 78% phenotypic male). The study results indicate that juvenile sex ratios do not differ significantly from unity whereas adult sex ratios (based on phenotypic and genotypic sex) heavily favor males. These results suggest that the factors influencing sex ratio in these populations may involve gender-based differences in life history strategies such as age at return and marine foraging behavior.

Applying population genomics to fisheries management

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Population genomics is an emerging field that has the potential to greatly increase the accuracy and precision of some types of information used in fisheries management. This field has arisen out of the marriage of large numbers of highly polymorphic genetic markers and increasing computational speed to analyze genetic marker data. I outline the population genomics approach to studying wild populations, provide examples of how population genomics can be used to infer relationships among populations, and why this matters for fisheries management. I also discuss briefly the use of Approximate Bayesian Computation as a computationally efficient means to use population genomics data for managing wild populations.

Session: Char Life History, Diversity, Distribution and Management in Alaska. Part 1

Session Chair – *Fred DeCicco*

An overview of char diversity in Alaska

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Fish in the Arctic char complex are circumpolarly distributed throughout the Arctic region of the world and occur farther north than any other freshwater species. Arctic char *S. alpinus* occur in lake resident, stream resident and diadromous populations in Asia, Europe and North America. Although the farthest north populations are lake resident, anadromous populations usually dominate at higher latitudes. Dolly Varden *S. malma* are distributed throughout the Pacific Basin and in Arctic drainages from the Mackenzie River in the east to the Kolyma River in the west with isolated populations of occurring farther to the east in Canada. There are five species of char in Alaska, lake trout, Arctic char, Dolly Varden, brook trout and bull trout. Of these, Dolly Varden are most common and are present as both resident (stream and lake) and diadromous populations. Dolly Varden occur in two recognized taxonomic forms in Alaska. The southern form ranges from Southeast Alaska across the Gulf of Alaska to the south side of the Alaska Peninsula. Southern Dolly Varden spawn in streams but generally overwinter in lakes. The northern form ranges from the Alaska Peninsula northward through the Bering Strait and across the North Slope to the Mackenzie River in Canada. Northern Dolly Varden generally spawn and overwinter in streams. Arctic char in Alaska are known only as lake residents, however, anadromous Arctic char may occur in some areas of Bristol Bay. The Arctic char of northern Alaska is similar to the taranetz char of the Russian Far East.

Charting the char in Togiak National Wildlife Refuge, Alaska

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Three species of char *Salvelinus* occur in southwest Alaska. Arctic char *S. alpinus*, Dolly Varden *S. malma* and lake trout *S. namaycush* have quite different life histories strategies adapted to utilize differing habitats and food resources. Local nomenclature and conventional harvest survey techniques have contributed to the confusion of these species distribution, habitat preferences, and harvest intensity.

Over 90% of subsistence households surveyed in Togiak utilize char in their diet. In 1995 approximately 11,000 char were harvested in the subsistence fishery in the village and most years the number of char far exceeds the number of salmon in the subsistence harvest. Recent studies have determined that Dolly Varden predominate in this harvest. Concerns about declining char stocks and potential for overexploitation prompted investigation of Dolly Varden populations in Togiak Refuge to gather baseline information necessary to develop a long term monitoring plan.

A variety of methods have been employed since 1997 to determine species distribution, life history characteristics, and to identify important spawning and overwintering habitat for Dolly Varden in three major drainages within Togiak Refuge. Techniques have involved standard ASL sampling, marking, radio telemetry, otolith microchemistry, genetic stock identification, mark-recapture and weir abundance estimates, traditional local knowledge interviews, maturity and photographic indexing, and public outreach. Over 13,000 Dolly Varden have been sampled between 1997 and 2004. A summary of the results from this seven years of investigation to resolve the "manager's nightmare" will be presented.

Genetics and life history of Dolly Varden in northwest Alaska

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Dolly Varden are ubiquitous in northwest Alaska, supporting both sport-and subsistence fisheries. There are currently two recognized forms (northern and southern) of Dolly Varden in Alaska. However, variation in phenotypic and life history traits in northern form Dolly Varden above and below the Bering Strait suggest that more forms may be present. Here we analyze the genetic stock structure of 16 Dolly Varden collections from northwest Alaska at seven microsatellite loci and three mitochondrial DNA segments. Our goals were 1) to test the hypothesis that the northern form of Dolly Varden consists of two forms arising from independent lineages historically separated by the Bering Land Bridge and 2) to develop a method to quantify contributions of Dolly Varden stocks harvested in subsistence fisheries in northwest Alaska. Significant differences in allele frequencies were detected among all pairwise combinations of populations but evidence for a genetic break corresponding to life history variation was weak with genetic relationships among populations following geographic proximity. Genetic data can be applied for analysis of stock composition. Mean contribution estimates from analysis of simulated mixtures from individual tributaries ranged from 82% to 98%, suggesting that robust stock composition estimates for regional groups, and in some cases, individual tributaries can be obtained. Dolly Varden were sampled from the Wulik River subsistence fishery in October 2001. Bayesian Markov chain Monte Carlo estimates of regional stock proportions showed that approximately 28% of the Dolly Varden from the mixture sample originated from Norton Sound and 67% from Kotzebue Sound.

A comparison of aerial counts and mark-recapture abundance estimation of the overwintering population of Dolly Varden *Salvelinus malma* in the Ivishak River, Alaska, 2001-2003

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Replicate aerial surveys were conducted concurrently with mark-recapture abundance estimates of the overwintering aggregation of Dolly Varden char *Salvelinus malma* in a 28-km index section of the Ivishak River. Five replicate helicopter surveys by two observers and a mark-recapture abundance experiment were conducted during September of three consecutive years. Aerial surveys were internally precise, with standard errors for each year ranging from 2.8% to 6.7% of the mean summed count. Mean summed aerial survey counts represented between 22% and 25% of abundance as estimated by mark-recapture methods. Estimated abundance decreased during the three years of the study, with both aerial counts and mark-recapture estimates falling by nearly half each year. These results indicate that aerial counts could serve as a cost-effective indicator of abundance for overwintering aggregations of Dolly Varden in this and other similar systems.

Use of a per recruit model to evaluate sustained yield of Dolly Varden, *Salvelinus malma,* in southeast Alaska

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Dolly Varden are the most common species of char in Southeast Alaska and contribute the highest sport harvests of any trout/char in the region. Despite their importance to regional sport fisheries, limited stock specific information exists. Fishery managers need appropriate methods to evaluate whether Dolly Varden harvests are sustainable as mandated in the Alaska Constitution. This presentation describes a per recruit model developed to analyze sustained yield of a Dolly Varden population in Chilkoot Lake, and its potential application to other Dolly Varden fisheries.

Chilkoot River and Lake support one of the largest freshwater sport fisheries in Southeast Alaska. The harvest in this fishery peaked at over 14,000 Dolly Varden in 1985 and then steadily dropped to approximately 7,000 fish in the early 1990s. This decline in harvest raised concerns about the sustainability of the fishery. Subsequently, the Alaska Board of Fisheries reduced the Dolly Varden bag and possession limit in Chilkoot Lake and River from ten to two in 1994. Since that time, the harvest has stabilized at less than 2,000 fish per year. ADF&G estimated the number of Dolly Varden 220 mm or greater in length residing in Chilkoot Lake during the winter of 1997-1998 at 109,152 (SE =21,065). The sport fishery exploitation of Dolly Varden the following year was estimated at less than 1%. A per recruit model was developed utilizing information from this study to evaluate sustainable fishery exploitation rates for this stock. Results of this analysis suggest that an exploitation rate of 7% is sustainable. At population levels observed in 1997-1998, the analysis indicates that the current harvest is sustainable and could be increased, while harvests observed in the mid 1980s were likely not sustainable. This analysis provides a benchmark to measure future harvests in the lack of better stock specific information.

Session: Char Life History, Diversity, Distribution and Management in Alaska. Part 2

Session Chair – *Fred DeCicco*

Composition and yield potential of lake trout *Salvelinus namaycush* in Paxson Lake, Alaska

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Lake trout *Salvelinus namaycush* support important recreational fisheries in Alaska roadside and remote lake systems. The life history of lake trout allows this species to be easily over-exploited when not managed properly. Because lake trout inhabit deep water and typically occur in low densities, stock assessment research is difficult, costly, and may result in biased estimates, particularly in large or remote lakes. In lieu of stock assessments, researchers and managers are increasingly using models to estimate yield potential (YP) of lake trout based upon environmental variables such as lake surface area, thermal habitat volume, and concentration of total dissolved solids. In 2002, length and weight information was collected from spawning lake trout *Salvelinus namaycush* in Paxson Lake in order to evaluate yield potential, estimated using a model based on lake surface area. Based on the average weight of 63 fish sampled on the spawning grounds, the model predicted a harvest of 294 lake trout ≥ 600 mm TL/yr (SE = 49) can be sustained. The estimated YP of 294 lake trout/year was nearly identical to the estimated harvest of lake trout from Paxson Lake in 2001 (302 fish), and higher than the average of annual harvest from 1999 to 2001 (258 fish). The proportion of lake trout sampled on the spawning grounds that were ≥ 600 mm TL was 0.09 (SE = 0.01), compared to 0.06 (SE = 0.02) for lake trout sampled on the spawning grounds in Paxson Lake during 1987-1995. Based upon the estimated YP, lake trout in Paxson Lake are not being over-harvested, and therefore a change in the regulation to further reduce harvests is not warranted at this time.

Arctic char spawning life history in Cooper Lake, Kenai Peninsula, Alaska

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Studies of native Arctic char in Cooper Lake on the Kenai Peninsula were initiated in 2002 as part of a large environmental study program required for relicensing of the Cooper Lake Hydroelectric Project. Mark and recapture studies indicated a large population (more than 100,000 fish) of mostly small (dwarf?) Arctic char. One issue that was raised during the public involvement process was the potential for fluctuating water level in the Cooper Lake reservoir to adversely affect Arctic char spawning or incubation success. Consequently, one aspect of char life history that was emphasized during the study program was identification of the location, depth, and timing of spawning. Location and timing of spawning were investigated using a combination of radio-tagging and underwater videography. Radio tags were surgically implanted into 20 mature char in early October 2003 and the fish were tracked through early December. Additionally, underwater visual surveys of selected lake areas were conducted during the same time period using a small remotely operated vehicle (ROV) with a color video camera. Use of these two methods, either separately or in combination, resulted in the location of 11 confirmed spawning areas at depths ranging from 12 to 54 ft. Spawning behavior and spawning habitat characteristics were documented on video tape. Spawning sites fell into several categories based on the origin of the substrate material: (1) avalanche or slide debris sites; (2) eroding moraine bluff sites; or (3) low-water beach sites. Avalanche debris sites tended to be deeper than the other sites, with spawning usually occurring in the run-out zone of a colluvial delta at depths greater than 40 feet. At the two eroding bluff sites, spawning mostly occurred at depths 16–20 feet. Low-water beach sites were on wave-washed gravel from beaches that had been exposed to wave action at a time when the reservoir level was low. Spawning depth at these sites ranged from 14 to 17 feet. Substrate at spawning sites was variable, ranging from coarse avalanche debris with little visible gravel to fine beach gravel. A feature common to all the spawning areas was the absence of the thick silt layer that characterizes the remainder of the lake bottom combined with the presence of some coarse substrate. Results of the radio tracking suggested that most fish moved to spawning areas during the last week of October and remained until mid-November. Visual observations noted the presence of pre-spawning behavior as early as October 22 with the peak likely occurring from October 25 to November 18.

Use of radio telemetry to describe life history characteristics of Dolly Varden in the Kenai River

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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 399 Dolly Varden over a 4-year period. 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.

Bull Trout distribution and biogeography

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(abstract vaporized in cyber-space;
apologies from the program chair)

Feeding ecology and energy density of juvenile chum salmon (*Oncorhynchus keta*) in Kuskokwim Bay

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In Western Alaska, poor returns of chum salmon (*Oncorhynchus keta*) since 1998 have raised much concern, particularly among people of the Arctic-Yukon-Kuskokwim region, who rely heavily on these fish for subsistence and commercial fishing. The causes for these declines are still unidentified. Since so little is known about the early marine residence of juvenile chum salmon, it is difficult to analyze the possible factors responsible for population variation during this critical stage. This study examines the early marine ecology of chum salmon in Kuskokwim Bay, Alaska. In particular, we are examining prey density and composition, feeding rates and selectivity, energy density, and the timing of off-shore migration of juvenile chum salmon. Juvenile chum salmon were sampled with a modified Kvichak trawl, from June through August in 2003, and from May through June in 2004. In addition, the sampling protocol included a CTD and Secchi disk cast and a Tucker trawl (2003) or ring net (2004) cast to collect zooplankton and larval fish. In both years, rainbow smelt (*Osmerus mordax*) and pond smelt (*Hypomesus olidus*) were the most abundant fish species sampled. In 2003, chum salmon catches composed 7.7% and 0.1% of total catch during cruise 1 (June) and cruise 2 (July). Mean fork length (FL) of juvenile chum salmon increased from 49.2 mm (n=56, SD=3.895) to 55.8 mm (n=3, SD=6.028). Mean energy density of juvenile chum salmon was 4751.494 cal/g (n=56, SD=115.375) and 4709.446 cal/g (n=3, SD=30.088) for cruises 1 and 2, respectively. In 2004, proportional abundance of juvenile chum salmon gradually increased from 0.34% during cruise 1 (May) to 47.8% during cruise 7 (June). Peak outmigration appeared to occur during cruise 7 (11 June). In 2004, mean FL of chum salmon increased from 38.3 mm (n=11, SD=2.490) during cruise 1 to 51.3 mm (n=808, SD=4.516) during cruise 7. Diets of juvenile chum salmon frequently included adult dipterans indicating that chum salmon were feeding at the water surface.

(student)

Poster Session
Session Chair – *Corrine Ferguson*

Radio tracking Whitefish Lake Coregonids

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The lower Kuskokwim River flows through the Kuskokwim Delta surrounded by lowlands riddled with freshwater lakes. Some Kuskokwim River Coregonids enter Whitefish Lake just before ice out to feed. Lengths of stay vary before the fish move back to the river. We operated a weir at the lake outlet during 2001 -2003 and the spring of 2004 to monitor movements into and out of the lake, and gather information on the relative size of the populations utilizing the lake. A sub-sample of the fish captured at the weir were tagged with Floy® t-bar tags. Fidelity of an important feeding area was determined by recaptures of tagged whitefish. Recaptures of tagged whitefish by subsistence fisherman throughout the Kuskokwim Drainage have indicated extensive migrations. To better understand movements of Whitefish Lake fish and locate possible spawning concentrations for future populations monitoring, we surgically implanted radio transmitters in 17 broad whitefish *Coregonus nasus,* 30 humpback whitefish *C. pidschian*, and 30 least cisco *C. sardinella* in May of 2004. Seventy five percent of broad and humpback whitefish were previously tagged in 2002-03. Movements were monitored by boat and aerial surveys and by fixed receiver stations. Fish leaving the lake in the early to mid-summer were found to congregate in possible spawning areas of tributary streams with fish that left in the summer and throughout the fall. Radio tagged fish moved both up and down the river near villages and traditional subsistence fishing sites indicating population harvest outside the lake subsistence fishery.

Population structure of Alaska Pacific ocean perch (*Sebastes alutus*)

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The population structure of a species underlies the basis of its production and provides crucial information for its effective management and conservation. The objective of this project is to characterize the population genetic structure of Pacific ocean perch (POP) in Alaskan waters, and to evaluate this structure in the context of geographic and oceanographic features and POP life history. In this study, we examined 12 collections from 10 geographic areas. Genetic variation will be measured among and between collections using mitochondrial and microsatellite technology. At this time, 9 microsatellite loci have been examined from a total of 12 loci that will be used. Genetic variation observed between the collections indicates sub-population structure of Alaskan POP. This preliminary analysis shows that Alaskan POP has both geographic structure and follows a pattern of isolation by distance. Comparison of geographic structure to current management areas will provide insight as to the effectiveness of these divisions.

Fall chum salmon abundance estimation on the Tanana and Kantishna Rivers using mark recapture techniques

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Fall chum salmon, *Oncorhynchus keta*, mark-recapture studies were conducted for the ninth consecutive year on the Tanana River and for the fifth year on the Kantishna River in 2004. In the Tanana River, chum salmon were captured and tagged using a fish wheel located on the right bank of the river, approximately 5-km upstream of the Kantishna River mouth, and tagged and untagged fish were counted using digital video in a fish wheel located approximately 76 km upriver. In the Kantishna River, chum salmon were captured in a fish wheel on the left bank of the river, approximately 9-km upstream of its confluence with the Tanana River, and recaptured in four fish wheels. Two fish wheels were located approximately 113 km upstream in the Toklat River, and two fish wheels 139 km upstream on the Kantishna River. These studies were conducted during August and September in 1995-2004.

Mark recapture has proven to be an effective means of providing abundance estimates for managing subsistence and commercial fisheries within the Tanana River drainage.

Seasonal changes in the diet of walleye pollock, *Theragra chalcogramma*, around the Chiswell Islands, Gulf of Alaska, 2003

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In contrast with the Bering Sea and western Gulf of Alaska, relatively little information is available on the diet of walleye pollock, *Theragra chalcogramma*, in the northern Gulf of Alaska. The objective of this study was to analyze stomach contents of walleye pollock within a 10 nm radius of the Chiswell Islands (59º 36 N, 149º 34 W). Echo integration-midwater trawl surveys were done at night in April, August and November 2003. Trawl depth ranged between 18 – 125 m during April and August. Fish targets occupied deeper habitat during November, so trawls were done between 100 – 236 m. April and August pollock ranged in fork length from 7 – 61 cm, with 89% of sampled stomachs coming from individuals between 25 – 61 cm. The euphausiids *Thysanoessa spinifera* and *T. inermis* were the dominant prey items in April, comprising 41% by number and 26% by wet weight of stomach contents (N = 43). Copepods, primarily *Neocalanus plumchrus/flemingeri*, accounted for 35% by number. In August there was an increase in euphausiids to 72% by number and 46% by wet weight of stomach contents (N = 57). Although *Euphausia pacifica* appeared in the diet at this time, *T. spinifera* was the major euphausiid prey species. The number of copepod prey decreased to 17% by number, most of which consisted of *Calanus marshallae*. November stomachs are currently being analyzed. Those that have been examined (N = 21) came from fish between 37 – 61 cm. Decapods made up 83% by number and 72% by wet weight of these stomachs, with *Pandalus borealis* being the dominant prey item. These results show the importance of euphausiid and decapod prey in the diet of walleye pollock in the northern Gulf of Alaska.

Prey availability near two Steller sea lion haulouts in Alaska

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To better understand the declining abundance of Steller sea lions (SSLs) in western Alaska, we examined the seasonal availability of prey in southeastern Alaska, where SSL abundance is increasing. From 2001 to 2004, we identified prey in nearshore waters <100 m deep near two SSL haulouts, Benjamin Island and The Brothers Islands, in summer and winter.

Catch and number of prey species available to SSLs were greater in summer than in winter at both haulouts, and greater at The Brothers Islands than at Benjamin Island. Total catch by seining and jigging at both haulouts and for all sampling periods was 201,331 fish and 559 fish; 58 species were identified in summer and 44 species in winter. Seine catches for both locations were dominated by young-of-the-year walleye pollock, Pacific herring, and Pacific sand lance in summer and salmon fry, armorhead sculpin, and rock sole in winter. Jig catches were dominated by armorhead sculpin, Pacific cod, and rockfish in summer and winter.

Most fish captured by seining were juveniles (median FL $\leq$ 80 mm) and likely too small to be targeted by SSLs, whereas most fish captured by jigging (median FL $\geq$ 249 mm) were large enough to be consumed by SSLs. Thirty-four species that we captured have been identified in SSL scat collected at either haulout. Availability of prey close to SSL haulouts could contribute to overall diet diversity and provide a source of food that may reduce foraging effort in summer. Less available prey in winter, however, may force SSLs to travel farther from haulouts to forage.

Barrier bypasses - increasing available habitat in the Kodiak Island archipelago

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Enhancement and rehabilitation of salmon stocks has been ongoing in the Kodiak Island archipelago since the early 1900s, when sockeye salmon Oncorhynchus nerka hatcheries were operated at Karluk Lagoon and Afognak Lake. These early programs were not particularly successful. After statehood, the Alaska Department of Fisheries began new programs to rebuild sockeye salmon stocks.

In the 1980s, the Alaska Department of Fish and Game (ADF&G) along with the newly formed Kodiak Regional Aquaculture Association investigated and implemented various salmon rehabilitation, enhancement, and research programs in the Kodiak Management Area (KMA). In the 1990s, efforts focused on increasing lake and stream habitat, and natural stock rebuilding. The projects of the 1990s were carried over into the next decade to provide and maintain supplemental production for the various user groups in the KMA.

One method used to increase salmon production in the KMA has been the installation and operation of barrier bypasses (i.e., fishways, steeppasses, fish passes, fish ladders) to allow adult salmon utilization of previously unavailable spawning and rearing habitat. Currently, there are nine operational bypasses in the KMA: Frazer Lake fish pass located on Kodiak Island; and Little Kitoi Lake, Portage Creek, Laura Creek, Gretchen Creek, Little Waterfall Creek, and Seal Bay Creek fish passes, located on Afognak Island.

In addition to adult bypass systems, a smolt bypass system was installed in 1992 at Telrod Creek, located on the west side of Kodiak Island, to move sockeye salmon smolt downstream around injurious barrier falls. Stocked fry utilize the nursery habitat in Spiridon Lake and migrate out as smolt via a pipeline around the falls to the marine environment.

Supplementing KMA salmon production is an ongoing long-term project. By providing access to previously unavailable spawning and rearing habitat over the past 10 years, these projects have resulted in sockeye salmon harvests ranging from about 405,000 fish in 1997 to about 956,000 fish in 1996. On average this equates to about 20% of the total KMA sockeye salmon harvest.

Timing and origin of Chinook salmon stocks in the Copper River and adjacent ocean fisheries using DNA markers

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The Copper River drainage supports stocks of Chinook salmon that are harvested by a commercial fishery in the Copper River Delta and by subsistence, personal use, and sport fisheries within the river. Recent management plans adopted by the Board of Fisheries require 1) estimates of harvest from all fisheries and 2) estimates of the abundance of returning stocks. Genetic information has proven to be valuable for describing genetic diversity and stock structure within large systems. The information can then be used to estimate the contribution of individual stocks to fishery harvests. We are developing a genetic baseline of DNA markers for Chinook salmon from the major rivers and tributaries of the Copper River drainage. The baseline will be used to characterize the stock structure of Chinook salmon within the system and to estimate the timing and relative abundance of individual stocks in the Baird Canyon fish wheel and ocean fisheries.

Otolith Diagnostics Reveal Older Age Profile of Walleye Pollock

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Surface characters were observed in otoliths from walleye pollock *(Theragra chalcogramma)*, tested for repeatability, and compared toages derived using unconventional growth pattern interpretation criteria for the species. Characters of "luster" (flat, semi gloss, gloss), "texture" (smooth: general, contour-wavey; not-smooth: bumpy, wrinkly, poolish), "opalescence" (absent, lightly present, strongly present), and "original > crenulation" (present, absent) at their most detailed level had 49.5%, 28.3%, 33.3%, and 66.2% agreement (respectively) among four observers of varying experience. Decreased character detail (flat versus "any gloss", smooth versus not smooth, and absent versus "any present") increased agreement to 86.2%, 71.2%, and 50.4%. Within-observer agreement for two observers averaged 82.7%, 74.4%, 70.2%, and 87.5% agreement for luster, texture, opalescence, and crenulation at their greatest detail. Age-length data were compared to each character, with an added character, "foliation", observed at the time of age determination. Good recognition of these characters support their integrity, though possibly affected by observer ability. These characters suggest complexity in otolith accretion, suggested to be induced through animal growth variation and time, and support this unconventional pattern interpretation for walleye pollock that results in a more complex and older age composition for the species.

Engineering for biologists: developing new methods for collecting data

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Collecting data electronically can improve data quality, decrease data entry time, speed data collection, reduce errors, and make training easier. With all of these potential advantages, why is electronic data collection rare in Alaska fishery sciences? There are 2 potential reasons for the lack of wide acceptance of electronic data collection. First, there are few software programs that are useful for the data we routinely collect and the conditions under which they are collected. We have developed a touchscreen based program designed specifically for collecting crab data in Alaska. This application does not require the use of a pen or stylus, reducing the number of items that need to be handled, and a gloved hand can operate all buttons making data entry easier and more reliable. The program can use GPS units to record position and electronic calipers feed data directly to the computer. The program has several features to reduce data entry errors and make data collection simple and consistent. Second, electronic units that can withstand the rigors of field use in Alaska have been limited. Due to cost concerns the current system was developed and tested with a non-rugged computer with simple water-proofing measures. Water resistant calipers were used and tested under various realistic situations. We have generated a list of existing rugged computing devices and their advantages and disadvantages are discussed. We believe we have developed a human friendly system that can collect data efficiently and reliably, especially compared to written methods.

Modeling disease prevalence in Prince William Sound Pacific herring

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Since 1999, the Pacific herring (*Clupea pallasi*) fisheries in Prince William Sound (PWS) have been closed because of low population biomass linked to disease outbreaks. From disease studies conducted in PWS from 1994 to 2002, two major diseases were uncovered, viral hemorrhagic septicemia (VHSV) along with severe ulcers, and *Ichthyophonus hoferi.* VHSV and ulcers played a more significant role before 2001, while *I. hoferi* prevalence began affecting population numbers more significantly in 2001. An age-structured population model was created that integrated disease information from 1993 onward and fishery and population information from 1980 onward. This model first used data through 1998, then was updated to include data through 2000, and currently has been updated to include data through 2004. With the new data, fifteen models of various combinations of natural mortality, disease indices, and age stratifications were compared. The most parsimonious and biologically sound model had a background mortality of 0.25 for all ages, used VHSV to estimate disease mortality for younger ages (ages 3-4), and used *I. hoferi* incidence for older ages (5+). This model is currently being used to obtain parameter estimates of recruitment, abundance, and biomass for the PWS Pacific herring fishery as an aid in management decisions.

Distribution, diet, and energy density of age-0 walleye pollock, *Theragra chalcogramma*, in the Bering and Chukchi Seas, Alaska

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A considerable amount of research has been conducted on juvenile walleye pollock, *Theragra chalcogramma*, in the Bering Sea and Gulf of Alaska. Much of the research in the Bering Sea has focused near the Pribilof Islands, an area known for high abundance of age-0 pollock. Because pollock are important both commercially and ecologically, a better understanding of the effects of physical and biological processes on early marine survival of pollock throughout the species' range is essential. This study examines large-scale distribution, energy density and diet of age-0 pollock in the Bering and Chukchi Seas.

Age-0 pollock were collected during the Bering-Aleutian Salmon International Survey, August-October, 2003. Data were divided into three geographic regions: Bristol Bay, Bering Sea shelf, and Chukchi Sea. Age-0 pollock were distributed throughout all geographic areas, with the highest abundance in Bristol Bay. Pollock from the Chukchi Sea and Bristol Bay had significantly greater energy densities than pollock from the Bering Sea shelf (4226 J/g, 3985 J/g, and 3340 J/g, respectively), while there was no difference in energy density between the Chukchi Sea and Bristol Bay. Stomach content analysis indicated that pollock from Bristol Bay had a more varied diet dominated by calanoid copepods (49%) and euphausids (23%), whereas pollock from the Bering Sea had a diet dominated by calanoid copepods (65%). No diet data were available for the Chukchi Sea.

The lower energy density of fish from the Bering Sea could be due to the presence of a coccolithophore bloom in that region during the summer of 2003, which might have reduced the fish's reactive distance, resulting in diminished ingestion rates. Future analysis of zooplankton biomass and oceanographic data from this cruise will provide a better understanding of the factors driving the observed differences in juvenile pollock energy density and their effects on early marine survival.

Educational outreach through the collection of biological data

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Community participation is minimal for collecting biological data from subsistence fisheries harvests. The objectives of this project were to hire three people per community from each of 10 communities along the Yukon and Koyukuk Rivers. Local people were hired to collect biological data from subsistence caught Chinook and summer chum salmon. Information collected from subsistence harvests were provided to state and federal agencies. By providing information to state and federal agencies, a new niche for data collection was opened; furthermore, interagency collaboration allows agencies, non-profit organizations, and local communities to create partnerships. Biological data collected consisted of age/sex/length through the collection of scales, fin clips for genetic stock identification, and heart tissue for *Ichthyophonus* presence or absence. Contracts were entered into with each tribal council. Each tribal council hired three people which consisted of a supervisor and two technicians. Field crews collected data from fish camps or from various locations close to the community. Scales were collected from Chinook (N= 200) and summer chum (N= 200) salmon. Fin tissues were collected from Chinook (N= 200) salmon at specific spawning tributaries. Heart tissues were collected from Chinook (N= 30) salmon early in the spawning run and Chinook salmon (N= 30) late in the spawning run.

Eight of the 10 communities collected biological data from subsistence salmon harvests. A total of 24 people were hired in the following communities: Holy Cross, Grayling, Koyukuk, Huslia, Galena, Nulato, Ruby, and Minto. This was the second year for the project and many of the same people were hired from the previous year to collect biological data. Information gathered from this project could be used in conjunction with other salmon harvest data collected to aid in making future fisheries management decisions on Chinook and summer chum salmon harvests in the Yukon and Koyukuk Rivers. This project can be used as a model to build educational capacity and expertise in fisheries biology in remote communities.

From derby to customized fishery – Factors influencing changes in the Dutch Harbor herring fishery

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The Aleutian Islands area Dutch Harbor commercial herring food and bait fishery has been subject to dramatic changes in harvest rates, market value, fishery techniques, regulations and management. From 1981 to 2000 this fishery was primarily a purse seine fishery; in 2001 a gillnet fishery was established. In 2004 the Alaska Board of Fisheries (BOF) raised the gillnet allocation from 7 to 14 % of the Dutch Harbor food and bait herring allocation. Concurrently a 100 ton allocation was reserved for an experimental pound fishery designed to produce a high quality food product. During 1990 – 2002 exvessel prices and fishery participation were high and fishing periods were generally few and short. This derby-style fishery often exceeded the harvest allocation mandated by the BOF. In 2003 ADF&G management strategy mandated that the amount of fishing effort be reduced to a level that allowed an orderly fishery. Because of changes in the bait market, processors were interested in less than the allowable harvest for the fishery. Fishermen agreed to form a cooperative to limit the daily harvest and reduced the number of seine vessels used. In 2004, two processors of seine caught herring formed a processing agreement and 16 fishermen agreed to a cooperative with only one vessel fishing. This situation slowed the pace of the fishery, allowing for longer fishing periods and a higher degree of flexibility in the management. The remaining harvest allocation provided opportunity for small operations to harvest and process herring and the ADF&G established fishing periods upon individual request in August.

Energy density predicts fish abundance and variability in abundance

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We tested the hypothesis that energy density (kJ g^{-1}) is positively correlated with abundance and spatial-temporal variability in abundance in nearshore marine fishes. We measured fish abundance with beach seines set every two weeks at 11 sites in Kachemak Bay during summer 1996-1999 (n = 231 sets), and we estimated energy density from the literature. Pearson correlation showed that fishes with higher energy density were more variable on seasonal (r = 0.71) and annual (r = 0.66) time scales. Higher energy density fishes were also more abundant overall (r = 0.85) and more patchy at a scale of 10s of km (r = 0.77). Bottom-up and top-down trophic interactions are known to produce variability in resource abundance, and we propose that fish quality (energy density) may be correlated with the strength of trophic interactions, and therefore the degree of variability in abundance. Energy density, abundance and spatial-temporal variability are all critical aspects of trophic ecology.

We propose that intercorrelation between these characteristics may provide a useful conceptual framework for understanding trophic interactions in fish communities.

A straying assessment of an introduced sockeye salmon stock on Northern Afognak Island as determined by two methods of stock identification

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Sockeye salmon *Oncorhynchus nerka* runs returning to Foul Bay and Waterfall Bay (WB), as a result of annual releases of juveniles into Hidden Lake (Foul Bay) and Little Waterfall Lake, (Waterfall Bay) are harvested in Terminal Harvest Areas (THA) within the Kodiak Commercial Fisheries Management Area, located in the western Gulf of Alaska. Artificial barriers are installed prior to fish returning to prevent adult sockeye salmon from migrating up-stream into freshwater. Waterfalls at each system block upstream migration and prevent development of self-sustaining anadromous salmon runs; however, without the artificial barriers, portions of the salmon runs remain in freshwater and are unavailable to THA fisheries. In 1998 and 1999, sockeye salmon escapements from Thorsheim Creek (near Foul Bay THA) and Portage Creek (near WBTHA) were sampled and analyzed to determine if any of the introduced sockeye salmon were straying into nearby sockeye salmon streams due to the artificial barriers. The study indicated that an insignificant number of sockeye salmon strayed into Thorsheim and Portage Creeks. There was, however, one segment of the Portage Creek escapement data that indicated a possible bimodal distribution and raised questions about the results. Thus, a more detailed study was conducted to determine if Little Waterfall Creek sockeye salmon were straying to Portage Creek.

The scale characteristics of Portage Lake and Little Waterfall Lake outmigrating age 1. sockeye salmon smolt from 1998 were used as standards or "knowns" for identifying the stock composition of the Portage Lake adult escapement in 2001. These scales exhibited visually discernable differences. For example Portage Lake smolt scales were small (focus to first annulus), and had a small number of circuli, that were tightly spaced. Conversely, Little Waterfall Lake smolt scales were large, and had a large number of circuli within the first year of growth that were widely spaced. The latter scales also displayed a consistent "stress check" or "false" annulus, which was commonly found four

(continued on next page)

to five circuli from the focus. Digital measurement and marking of the smolt scales substantiated these visual differences. The known scales were compared to scales collected in 2001 from adult sockeye salmon at WBTHA and Portage Creek. The scales were visually examined to identify scale patterns within the first year of freshwater growth indicative of each stock. The scales were also examined under a compound microscope and several measurements were taken to describe the first freshwater year. The differences in these scale measurements were statistically quantified utilizing discriminant analysis.

A total of five of the 822 available Portage Creek scales or 0.61% displayed the same visual characteristics as the Little Waterfall Lake samples. Therefore, approximately 19 of the 3,147 adults in Portage Creek in 2001 were identified as Little Waterfall fish that strayed from the WBTHA. Dividing the number of strays by the sockeye harvest from the THA (16,023) results straying rate of 0.1186%. Applying this straying rate to previous years WBTHA harvests results in a low of 10 strays (0.08%) estimated in 2000 to a high of 44 strays (0.26%) in 1996. The average number of strays from 1995-2000 was 21 or 0.26% of the total Portage Creek escapement.

The results of this study suggest that sockeye salmon are not prone to straying when prevented from entering freshwater streams by artificial barriers. This may be due to the efficiency of the WBTHA fishery which harvests the majority of the salmon before they encounter the barrier net (Wadle and Honnold 2000). We recommend continued use of the barrier net during the WBTHA sockeye salmon fishery and that the fishery continue to be executed as in past years to allow for maximum harvest of the introduced runs. If a fishery does not occur in the WBTHA, the barrier net should be removed to allow returning sockeye salmon to escape into Little Waterfall Creek which would further reduce the incidence of straying.

Keeping Alaskans involved in clean water protection

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Alaska's water resources are public resources owned collectively by all Alaskans. Educating people about their natural resources, explaining the impacts we have on water quality, and expanding the number of people watching out for watershed and estuarine health are reason enough to engage volunteers in monitoring their streams and bays. However, with dwindling resources for water quality monitoring at both state and federal levels, the need for volunteer-collected data is increasing in Alaska, especially when the monitoring program is well designed and institutes quality assurance/quality control measures. Cook Inlet Keeper fosters responsible stewardship in Cook Inlet residents, and empowers citizens with the scientific tools needed to protect watershed health. Equally important, Keeper and its volunteers regularly collect quantifiable data which is essential to intelligent policy and permitting decisions. Cook Inlet Keeper encourages citizens to take a hands-on role in collecting and disseminating reliable water quality data through its monitoring programs, which include: 1) Citizen's Environmental Monitoring Program, 2) Lower Kenai Peninsula Watershed Health Program, 3) Cook Inlet Community-Based Water Quality Laboratory, and 4) East End Road Construction Monitoring Project. These programs have exposed more than 250 citizens to chemical and biological monitoring of streams, wetlands and estuaries. Cook Inlet Keeper's monitoring programs rely on strong partnerships with local governments, state agencies, universities, non-profit organizations, Native villages, and the citizens of Alaska. Fisheries scientists and managers are encouraged to develop these type of partnerships to create comprehensive and ongoing inventories of water quality in order to track changes and understand impacts to stream and watershed health.

Fish surveys of Upper Chester Creek Watershed, Fort Richardson, Alaska, 2003-2004

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Urbanization of Anchorage Alaska has negatively impacted Chester Creek and contributed to a decline in local fish populations. Recent efforts to restore anadromous coho salmon (*Oncorhynchus kisutch*) to the stream focused attention on fish populations that may have found refuge in the relatively pristine upper watershed located on Fort Richardson, a military reserve. Aquatic habitat characteristics and the presence of four fish species were documented in 2003, while in 2004 a systematic electrofishing survey was made with a total of 646 fish captured, measured and released. Of this total 55% were Dolly Varden (*Salvelinus malma*), 36% were slimy sculpin (*Cottus cognatus*), 6% were rearing coho salmon (*Oncorhynchus kisutch*) and 3% were rainbow trout (*Oncorhynchus mykiss*). Coho salmon fry were observed in 2 of the 3 study sites both years and spawning coho salmon (n= 80) were observed during foot surveys in 2004. Upper Chester Creek watershed currently supports small populations of rearing and spawning adult coho salmon whose distribution may expand as stream health is restored.

Lacustrine growth of juvenile pink salmon, *Oncorhynchus gorbuscha*, and a comparison with sympatric sockeye salmon, *O. nerka*

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Juvenile pink salmon, *Oncorhynchus gorbuscha* (Walbaum), typically migrate to sea directly after emergence, exhibiting little feeding and growth in freshwater, although they feed actively and grow rapidly at sea. In contrast, sockeye salmon, *O. nerka* (Walbaum), typically feed in lakes for 1 or 2 years, and grow slowly at sea. The naturally sympatric populations in Lake Aleknagik, Alaska offered an opportunity to compare their growth in the common lacustrine environment. Length frequency distributions of juvenile pink salmon caught in the lake during the summer in 1991 and 1999-2003 indicated a growth rate of 0.54 mm d-1, 54% greater than the estimated growth rate of juvenile sockeye salmon sampled from 1958-2003 (0.35 mm d-1). Examination of daily growth rings on otoliths indicated that pink salmon in Lake Aleknagik grew an average of 1.34 mm d-1 in 2003 but sockeye salmon grew only 0.63 mm d-1 (average specific growth rates were 3.0 and 1.8, respectively). Pink salmon increased from approximately 32 mm and 0.2 g at emergence to 78 mm and 3.0 g within 3-4 weeks. After experiencing these rapid growth rates, the pink salmon seem to leave the lake by late July in most years. The diets of pink and sockeye salmon in the littoral zone of the lake were very similar; > 80% of the stomach contents consisted of adult and pupal insects and the remainder were zooplankton. This high degree of diet overlap suggests that the observed differences in growth rate are not attributable to variation in prey composition. These observations and studies of pink salmon elsewhere suggest that they may grow more rapidly than sockeye through a combination of less risk-averse behavior (feeding near the surface in the day rather than vertically migrating), feeding more often, and perhaps also having a different metabolic rate.

2003 Award Recipients

Wally Noerenberg Award for Fisheries Excellence
Alex Wertheimer

Cultural Diversity Travel Award
Courtenay Peirce

Best Paper
Alfred L. DeCicco, ADF&G
Direct validation of otolith ages in Arctic grayling

Best Poster Award
Jeffrey P. Barnhart, ADF&G
Warm water checks in weathervane scallops Patinopecten caurinus
Coauthor: Scott Carpenter

Best Student Paper
Suzann G. Speckman, University of Washington
Bottom-upforcing across trophic levels in a subarctic estuary
Coauthor: Carolina Minte-Vera, Julia K. Parrish, and John F. Piatt

Best Student Poster Award
Anthony Eskelin, University of Alaska-Fairbanks
Relative precision of trap efficiency experiments to estimate coho salmon smolt abundance in small streams
Coauthors: F. Joseph Margraf and James Hasbrouck

Business Meeting Agenda

November 17, 2004

1. Call to Order

2. Establishment of Quorum

3. Approval of the Agenda

4. Approval of Minutes from November 5, 2003 (Fairbanks) Business Meeting

5. Reports:
    a. Treasurer
    b. Committee Reports
        i. Aquatic Education
        ii. Awards
        iii. Chapter Historian
        iv. Continuing Education
        v. Cultural Diversity
        vi. Electronic Communications
        vii. International Relations
        viii. Membership
        ix. Past Presidents/Finance
        x. Student Sub-units
        xi. Wally Noerenberg Award
        xii. Environmental Concerns
        xiii. Newsletter
        xiv. Resolutions and By-laws

6. Outgoing President's Address

7. Installation of Officers

8. Unfinished Business:
    a. Approve the Financial Plan concept submitted by the Past Presidents
    b. Increase the Cultural Diversity Award Endowment to $15,000.
    c. Increase the Wally Noerenberg Award Endowment to $15,000.

9. New Business

10. Next meeting – September 11 – 15, 2005 in Anchorage

11. Adjourn

On-site Handouts: Approved ExCom Minutes; Financial Plan from the Past Presidents Committee

Alaska Chapter, American Fisheries Society
Annual Business Meeting, Fairbanks, Alaska

November 5, 2003

Quorum was determined by head count; 54 Alaska Chapter members were present. Carol Kerkvliet called meeting to order at 3:30 PM.

Carol Kerkvliet, president, introduced officers. Alaska Chapter Executive Committee (ExCom) members present were: President-elect Tim Joyce, Vice-president Molly Ahlgren, Past President David Wiswar, Treasurer Ray Hander, and Secretary Alisa Abookire.

Motion: Bill Smoker moved to approve Minutes from Alaska Chapter Business Meeting in Girdwood, Alaska, on October 23, 2002. This motion was seconded by Bill Bechtol and approved unanimously.

Treasurer's Report

Ray Hander reported there were approximately 284 people at the meeting: 35 students, 8 1-day members, 8 1-day nonmembers, 4 2-day members, 7 2-day nonmembers, 153 3-day members, 43 3-day nonmembers, 13 Society of American Foresters, 3 continuing education only, and 7 others. Approximately 145 persons purchased banquet tickets.

The current total assets are approximately $109,000, not including meeting expenses. To date we have grossed $51,000 in registration, continuing education, and banquet proceeds. Account balances are as follows:

Cultural Diversity Award Fund	$12,384
Main Checking	$78,411
Market Rate Savings (CD)	$11,812
Student Travel Fund	$2,987
Wally Noerenberg Award Fund	$4,694

Ray noted that we are getting very poor returns on current Chapter accounts, and we need to explore other investment options for those accounts. Ray spoke with Carol Ann Woody, previous chair of the Financial Committee, and Bob Ourso, the previous treasurer, regarding this issue in order to begin earnest discussion and subsequent action toward more assertive investments.

Ray informed the Chapter that we hired bookkeeper Shaneh Ward, at Advanced Financial Services in North Pole, Alaska, and accountant Elaine Williamson, at Kohler, Schmitt & Hutchison. They have both helped organize the books and have filed taxes for 1999, 2000, and 2001.

Bill Wilson asked to clarify the balance of the Wally Noerenberg Fund, since the amount is much less than last year's balance of $12,000. Ray said it may have been an error on his end in switching the account names; no money was taken out of that account this year besides the award amount of $500 for last year's recipient.

Carol noted that Ray has made a lot of headway this year with our books and his work was applauded.

New Committee Reports

Mike Wiedmer provided background on the newly initiated 'Status of Western Native Fishes Project' by the Western Division (WD) to assess the status of freshwater, non-anadromous fishes of western North America. Mike Wiedmer, Rodger Harding, Fred DeCicco, Gordon Haas, and Mark Lisac have been attending monthly teleconferences on behalf of the Alaska Chapter, and they have formed a list of species they want to inventory. Mike noted that in February 2005 at the conference in Utah there will be a session about native fishes, and he encouraged people to submit abstracts. Allen Bingham asked about status of this new committee. Carol said the committee has not been formally created at the Chapter level, but does exist at the WD level and includes those members from the Alaska Chapter that are participating in the monthly teleconferences.

Committee Reports

Aquatic Education - Carol read the short report that Laurel Devaney provided via email. The Education Committee has been inactive this year. Laurel would like to solicit interested candidates to join the committee. The position of Co-chair, previously held by Andrea Medeiros, needs to be filled.

Awards - Andy Gryska reported that the awards committee has worked on award criteria this year to make it easier to assign award recipients. Andy recognized the award winners for best paper and the best student paper from the 2003 meeting. Additionally, in 2003, the committee awarded a meritorious service award, and it was the first time the award was given since 1997. Andy said they are always looking for people to give the award to, and solicited nominations for next year. Lee Ann Gardner suggested that in next year's program we list the award winners from the previous year, and her suggestion was met with support from other Chapter members present.

Chapter Historian - Randy Brown has begun to organize the business meeting minutes that he received from Jim Reynolds. His ultimate goal is to digitalized the minutes and post them on our Chapter website. Randy said there's no consistent format throughout the years and it is a challenge to isolate the paperwork that applies to the business meeting. When the Chapter started, all notes were handwritten. It is a time intensive job and at present there are 5 large boxes of paperwork that he's getting familiar with. Meanwhile, if anyone has requests for specific information, he will sort through and send copies out.

Brenda Wright asked if he was also going to digitalize the old programs along with the business meeting minutes. Randy said that that would be a lot of information and they were not currently planning to do it, and he personally cannot take on that task If Chapter members were in favor of doing that, they can consider contracting a printing company to do that task and using money from the chapter budget. At this point, Randy is still sorting paperwork and will make decisions about what to include (such as letters to U.S. Presidents and Alaska State Governors) at a later time, as Randy doesn't think we want to digitalize all 5 boxes. Carol asked Brenda if there was a value in scanning all the programs, Brenda said that correspondence and business meeting minutes are priority.

Continuing Education - Debbie Burwen was not present. Carol reported that Debbie does not want to Chair this committee any longer, but will remain active as co-chair. Carol read Debbie's report and restated that we need a chair for this committee.

Cultural Diversity - Jerry Berg reported that the Cultural Diversity Award was created about 8 years ago to encourage and involve minorities in AFS. This past year Gretchen Bishop stepped down as co-chair but Lisa Stuby stepped up. Although the application went out late this year, there were 2 excellent applicants. Fortunately, ExCom agreed to sponsor one of the 2 applicants, Zac Penny, the president of the newly formed campus unit at Sheldon Jackson College. Courtenay Peirce was the recipient of the award this year. Jerry said he was glad he didn't have to make a choice between the 2 applicants because they were both very strong candidates.

Jerry reminded members that last year there were 2 awards given for 7 applicants, and there is a reoccurring dilemma of choosing award recipients. Jerry asked for input regarding how to better give awards and suggested that the committee may require more flexibility to allocate a set amount of award money among several applicants. Alex Wertheimer asked for specifics about how the awards are given, and questioned if partially funding students would achieve the objective of bringing more students to the meeting. Jerry said he thought it would allow the committee flexibility and might provide travel money for up to 3 students. Carol recalled that at the Sitka meeting the award was set up to have 2 awards for 1 year and then the process would be reevaluated after that. Alex said he would make a motion.

Point of Order: Allen Bingham said that this discussion and subsequent motions should occur later as new business.

Bill Smoker asked if the Chapter has the budget to continue to finance the second award. Initially there were raffles and fundraisers to fund student travel. The second award was created in Sitka to specifically fund Native Alaskan student travel, and originally the interest on a CD paid for an award. Last year we started the discussion about how to continue to fund the award. Bill Bechtol said he always thought that if the interest did not support the award, the committee had the flexibility to do what they needed to do. Bill thought the committee could work it out with ExCom and didn't need a new motion. Allen Bingham reminded the Chapter that the fund cannot be touched, and so the excess amount to reimburse principle comes out of the general fund. Alex Wertheimer said that ExCom will have to designate a specific amount to the awards committee each year and he clarified that Jerry is asking if he has the flexibility to decide if he should give only 1 award or several partial awards. David Wiswar suggested we wait on further discussion until after the finance committee report.

Electronic Communications - Allen Bingham reported the highpoints of the year. There is a chapter email list on a Parent Society server and it works very smoothly without crashing. However, the maintenance of the list is a problem because the membership database program is an RBase program and does not merge with the parent society list; therefore, Allen has to enter the email addresses by hand. Allen asked that if anyone present has not received one of these emails in the last year then let Allen know and he'll update your email on the distribution list.

Elections for Chapter officers are currently being held in both paper ballots and e-ballots. The e-ballot server is currently down, but it should be fixed soon. After the meeting, folks can expect a ballot in their email inbox, and there have already been 20 votes cast via email.

Allen stated that our Chapter maintains the student chapter websites, mostly related to changes in the officers and memberships. Allen informed the Sitka students (since they are new) to send him things they want posted on the website.

International Relations - Fred DeCicco was not present. He provided his report via email, but it was not read.

Membership - Molly Ahlgren reported that the Alaska Chapter has a total membership of 414, which is an increase of 41 people (11%) since last year. Of the 414 current members, 286 are active members, 32 are life members, 8 are retired members, 61 are student members, and 27 are young professionals. Membership in the 'young professional' category has increased 145% and student membership has also increased. The increase in student membership is due to the newly created Campus Student Subunit at Sheldon Jackson College, which has a lot of support from faculty and currently consists of 12 members. Molly thanked Allen Bingham for tracking all the membership information.

Past Presidents / Finance Committee - David Wiswar asked all the Past Presidents to stand up for recognition, and provided some background for how and when this committee was formed. The Finance Committee has made recommendations for ways to invest and allocate our Chapter funds, and they are ready to give those recommendations to ExCom. David said that there should be a plan of actions for new investments in the near future.

David introduced the officer candidates: Hal Geiger for Vice President, Steve Zemke for secretary and Bob Piorkowski (not present) for secretary.

Student Subunits -Carol asked for a report from each Campus in the Student Subunit. Mark Stichert (Fairbanks Campus, the voting student member on ExCom) reported there are about 25 active student members in Fairbanks. There were 20 annual meeting attendees and 5 presenters. They helped organize student volunteers for the meeting. Mark recognized the session chairs and ExCom for providing both reduced and free registration for students and assisting with student travel costs.

Jennifer Stahl (Juneau Campus) reported there are about 20 active members in Juneau, and 8 of those students were at the meeting. They all had complete airfare expenses paid for and a lot of hotel costs paid for by the Student Travel Fund. Jenny introduced the other officers. The main event for their campus unit is a student symposium in the spring, where students present their work to fellow students and faculty. Additionally, they try to do public service each year and they have fundraiser ideas for the future.

Zach Penny (Sheldon Jackson College Campus) reported that this year they were established as a new campus in the Student Subunit. They adopted the bylaws and formed their Campus unit in spring of 2003 with 23 students; they currently have 12 students due to graduation. Zac read the officer names for this year. Dave Turcott is their advisor. They have meetings twice a month, and are planning to order sweatshirts for all their members. So far they have had barbeques and fishing trips and are planning to tour a local hatchery. They plan to have short seminars in winter on fish topics provided by professors at SJC. Zach thanked everyone for the travel money to allowed him and Kyle Deerkop to be at the meeting.

Allen Bingham pointed out that the Alaska Student Subunit is one group and the individual groups are called 'campus groups'. There are 3 Campus groups and only 1 Student Subunit.

Wally Noerenberg Award - Doug Palmer noted that this award for fishery excellence is the highest award in the Chapter and it recognizes a lifelong of achievement in fisheries. There have been only 10 recipients since the award was created. The committee has a rigid structure: it is comprised of 3 Chapter past presidents and a chair, who cannot be a past president. This year the committee was comprised of past presidents Carol Ann Woody, Bill Bechtol, and Cindy Hartmann. The deadline for nominations is typically July 31 and there was one nomination this year. The recipient will be announced tonight at the banquet. David Wiswar will replace Cindy on the committee.

Other Business

Hutton Program - Louis Carufel passed out pamphlets about the Hutton Program, which was established about 2 years ago in honor of Bob Hutton. It is a program to expose high school students to fishery science. Students that have finished their sophomore year can apply and there is usually an 8-week assignment in June that they complete. The scholarship award is $3,000, and Louis read details of the program. Carol mentioned that ADF&G in Anchorage has used this program successfully.

Committee Reports (Continued)

Environmental Concerns - Cecil Rich has been serving on this committee since last year. Cecil reported that the committee utilizes the experience and knowledge in the Chapter to address issues of environmental concern. The previous year, the committee was not very active. This year the main project was a letter of concern to Governor Murkowski in regards to the transfer of the habitat division from ADF&G to DNR. Cecil thanked Bill Hauser for helping him and drafting the initial letter. Cecil recruited several people to review the letter and Cecil thanked those folks, especially Jim Reynolds. The letter was approved by ExCom and sent to the Governor and other environmental groups. The WD wrote a separate letter, drafted by Eric Knudson, and sent it to the Governor. Cecil thanked Allen Bingham for his support with email and website in regards to circulating the letter.

Cecil said he would help with future issues that the membership is concerned about. One thing that came to mind was impact on riparian zones, as none of DNR's responsibilities include development in riparian zones. Cecil is open to ideas of how to raise the level of awareness on that issue thru education. If there's interest in that issue or any other issue, Cecil welcomed input and comments.

Hal Geiger asked if we got a reply from the Governor; Cecil said we did not.

Oncorhynchus Newsletter - No report was presented; John Thedinga was absent.

Resolutions and By-laws - No report was presented; Dennis Tol was absent.

Other Business (Continued)

Outgoing President's Address - Carol Kerkvliet thanked everyone for the coaching and mentoring during the last 3 years. Carol said she's been a facilitator but acknowledged the committees that have really done the work. Highlights of her term include the creation of the Sheldon Jackson College Campus Student Subunit, initiating the scanning of business meeting minutes for eventual posting on the web, and environmental concerns letters. Carol also mentioned that authorship guidelines from the Parent Society

will be posted on our Chapter website soon. Carol said that it's been a great experience for her and "thank you, thank you, thank you". Carol then passed the gavel to Tim Joyce.

Installation of New Officers - Tim Joyce thanked Carol for being such a great leader and said he was glad she would stick around as Past President. He thanked David for being such a great past president.

New Business

Comments on 2003 Chapter Conference - Tim Joyce thanked the Forest Service for allowing him to put the conference together, and the Fairbanks Visitor Bureau for help with arrangements. Tim thanked the students for all their assistance and for attending the business meeting. He recognized Mary Whalen for help putting the program together. Tim stressed that revenue from the raffle supports student travel and encouraged folks to buy more tickets.

Tim liked the idea of including a special page in the program to recognize award recipients from the previous year. Tim solicited comments. Bill Bechtol observed that the registration this year was exceptionally smooth. And the registration numbers were high and there was a terrific structure to allow other groups like the Forest Service to attend. Tim thanked Ray Hander for all his time and help with the meeting. Ray said a lot of the thanks should go to Bob Ourso, as he had a lot of the ideas already implemented and Ray just carried the torch for Bob after his unfortunate accident. Carol mentioned that there is a program for Bob that folks may sign at the end of the business meeting; she will send it to him to keep him in the loop.

Comments on the 2004 Chapter Conference - Molly Ahlgren will organize next year's annual meeting. Molly said she is thinking about having it in Sitka and has talked to 10 people thus far about being session chairs. Allen Bingham stated how much it helped keep people together to provide lunches at the meeting. Lee Ann Gardner asked if any specific dates were bracketed yet, and Molly said not at this time.

2005 Parent Society Meeting in Anchorage - Bill Wilson is the general chair for this meeting, and it will be held from 11-16 September 2005. Bill is looking for lots of help and people from outside Anchorage can also help with the meeting. Bill thought they would need 40-45 total volunteers. The next organizational meeting is the Monday before thanksgiving at Anchorage ADF&G.

Bill also reported on the sales of The Key to Fishes of Alaska. As of September, 821 copies were sold. Originally 3000 copies were printed, and 500 or those were complimentary copies. Bill said ExCom can expect some revenue to arrive this year.

Whitefish / Coregonid Research - Richard Cannon thanked Tim and Carol for the opportunity to talk. He and others are looking for a more coordinated research group to deal with some of the Whitefish subsistence issues. He said an informal meeting would follow the business meeting to discuss the options of forming a formal Chapter committee within AFS and having a session at the annual meeting next year.

Membership - Allen Bingham brought up the issue of possibly changing our bylaws regarding the issue of membership categories. For example, changing the 'other' category to young professional category. Allen suggested that the chapter revise the bylaws to say something like 'if the parent society creates new membership categories then our state Chapter will mimic those new categories'. This change in the

bylaws would include the retired category and the young professional categories, and would allow the young professionals a discounted membership rate that they currently get from the Parent Society.

Tim asked Allen to submit proposed language to ExCom, and ExCom will then proceed. Bill Hauser reminded Tim that there's a committee that deals with Chapter bylaws and they should deal with the protocol. Currently Dennis Tol is not active in his role of bylaws committee chair, and that if he is not interested then Allen Bingham suggested Joe Margraf might help with this issue.

Cultural Diversity Committee - Tim Joyce resumed discussion from the cultural diversity committee reports. Tim said we are currently faced with how to proceed; either grant 1 award each year or give a set dollar amount that can be partially distributed among several applicants.
Motion: Alex Wertheimer moved to grant the cultural diversity committee the flexibility to award the scholarship to one or multiple applicants, based on proceeds from the endowment. Bill Bechtol seconded the motion.

Discussion: Bill Smoker noted that the earnings of the endowment might not be a set amount each year. Alex said the proceeds from the endowment would be the minimum amount of the award and ExCom will have to decide on an annual basis if they want to use general funds to increase the award amount. Allen Bingham clarified that the award amount would fluctuate based on ExCom. Alex said yes, it would be a different amount annually. Lisa Stuby asked if the endowment came from donations and asked whether the amount could be increased. Allen said that at one time the raffle was designated to fund the cultural diversity award amount. The long-term solution will have to be determined by the finance committee and perhaps for now ExCom should just work with the cultural diversity committee on an annual basis to determine the award amount. Allen said the number of applicants may fluctuate and the amount needed each year will also fluctuate based on the venue of the annual meeting.

Tim noted that this year both applicants were able to attend the meeting because the award funded one and ExCom picked up the cost of bringing the second applicant. Kate Wedemeyer said the original history of the award was not limited to student travel but also included young professionals. Kate suggested that ExCom reallocate funds to increase the endowments. Hal Geiger said that perhaps the motion was not needed. Bill Smoker said that it's a waste of our Chapter resources to build up endowments.

Tim asked if there were any more questions regarding the motion. With none, Alisa Abookire made a few clarifications to the original motion and read it aloud as follows:
Motion: Alex Wertheimer moved to grant the cultural diversity committee the flexibility to award a scholarship to one or multiple applicants, based on an annually determined amount that is at least equal to proceeds on the endowment and as much as a monetary amount determined annually by ExCom from the general fund. The motion passed unanimously.

Mentorship Program - Molly Ahlgren described the mentorship program. This year AFS members have sponsored all the student members in the SJC campus of the Student Subunit. Molly encouraged this program, especially for undergraduate students that do not have exposure to graduate students. Molly asked folks to consider sponsoring a student, and if interested to let her know. Molly thanked all the mentors, especially Bill Bechtol for his many years of mentorship with SJC students.

Molly asked if the Chapter would cover the cost of membership for 10 individuals, either undergraduates or technicians, involved in the mentorship program. Tim Joyce asked how the individuals would be solicited. Allen Bingham said that he would need the idea to be fleshed out more before a motion can be made. For example, will there be a committee to determine which 10 individuals get their membership costs paid? And if a committee is formed the mentors need to be identified first. Tim asked Molly if she would postpone the issue and bring it up to ExCom to pursue and develop further. Bill Bechtol agreed that this is a great idea but should be addressed at a later time outside the business meeting. Molly found that satisfactory and said she will bring it up to ExCom.

Finance Committee - Bill Bechtol introduced plans to set up the CD's using the following priorities:

Create Student Scholarship Fund - Lee Ann Gardner volunteered to create a student scholarship fund for the Chapter. Her plan is to create a scholarship program that will be facilitated by the financial aid programs at a university. Lee Ann suggested a specific committee be formed to solicit applications and make a selection based on criteria. Lee Ann also suggested that proceeds from continuing education or The Key to the Fishes of Alaska might be used to support this scholarship fund.

Tim agreed that Ex Com could establish a committee. **Motion**: Lee Ann Gardner moved to create a student scholarship committee to manage awarding of a student scholarship fund. Bill Hauser seconded the motion.

Discussion: Bill Smoker was concerned because there was no designated level of student. Lee Ann said it would be open to both undergraduates and graduate students and would involve a field of study in specific areas that would be determined by the committee. Bill Smoker asked Lee Ann to clarify how the university would facilitate awarding the scholarship. Lee Ann said it would take time to get it set up but there's no minimum monetary amount required by the university, and the university does not charge any amount for managing the fund. Alex Wertheimer was concerned because the idea has not been fleshed out yet and it seems early to be making a motion on this scholarship fund.

Tim stated that in about a month the finance committee will give their financial plan to ExCom; this motion should be tabled until that time to allow us to prioritize how we want to use our money. The motion was tabled until ExCom gets a financial plan and decides how to proceed with a scholarship fund. Lee Ann agreed it was OK to table discussion. Bill Wilson suggested we remove the motion so the committee can proceed prior to the next business meeting. Lee Ann withdrew the motion. Bill agreed. It was decided that in the meantime, an ad-hoc committee will be formed and Lee Ann Gardner will chair the committee.

A Second Cultural Diversity Award or Increase the CD amount - Tim said the Chapter needs to decide if we want to create an additional cultural diversity award or increase the CD amount. Right now we are supplementing the cultural diversity award with our general fund. Tim asked for input. Larry Peltz said he wanted the Chapter to first have a financial plan before we make these decisions.

Increase the balance of the Wally Noerenberg Account - Likewise, in regards to the issue of increasing the CD for the Wally Noerenberg account to $10,000, the topic will be tabled until the financial plan is presented.

Tim asked for more new business. With no new business, Tim asked for a motion to adjourn. A motion from the floor was made. This motion was seconded and unanimously approved.

Meeting adjourned at 5:40 P.M.

Special Thanks
to all those who made this meeting possible:

Session Chairs
Lisa Stuby
Sara Gilk
Steve Reifenstuhl
Kate Wedemeyer
Corrine Ferguson
Randy Brown
Ken Harper
Mike Byerly
Dan Urban
Kim Hastings
John Wenburg
Fred DeCicco

Local Arrangements
Molly Ahlgren
Sheldon Jackson College – AFS students

Registration
Ray Hander

Communications
Allen Bingham

Audio/Visual
Chrissy Apodada
Cleo Brylinski
Student AFS Sub-Units (UAF, UAJ, UAA, SJC)

Continuing Education
Toshihide "Hamachan" Hamazaki

Program
Allen Bingham,
Francis Cannizzaro
Elaine Strelow

Notes

Notes