From the Mountains to the Sea: Linked Ecosystems

American Fisheries Society
Alaska Chapter

24th Annual Meeting
November 18-20, 1997
Centennial Hall
Juneau, Alaska

1997 Alaska Chapter AFS Annual Meeting

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From the Mountains to the Sea: Linked Ecosystems
1997 Alaska Chapter AFS
Annual Meeting Overview

Monday, November 17

3:00 - 5:00 pm	**Registration**	
6:00 pm	**DIPAC Reception**	*DIPAC Fish Hatchery (Transportation provided from Baranof and Centennial Hall)*

Tuesday, November 18

8:00 am - 4:30 pm	**Registration**	
8:30 am	**Opening**	*Peggy Merritt, President Alaska Chapter AFS*
9:00 - 9:30 am	**ADF&G**	*Frank Rue, Commissioner, Alaska Dpartment of Fish and Game*
9:30 - 10:00 am	**Aquatic Habitat Management on the Tongass National Forest**	*Phil Janik, Regional Forester, U.S.D.A. Forest Service, Alaska*
10:00 - 10:20 am	**Break**	
10:20 - 11:00 am	**Large Wood form Forest to the Sea**	*Jim Sedell*
11:00 - 11:50 am	**Thermal Limits and Ocean Migrations of Pacific Salmon: Long-Term Consequences of Global Warming**	*D.W. Welch, Y. Ishida and K. Nagasawa*
11:50 am - 1:00 pm	**Lunch/Past President's Lunch**	
1:00 - 3:00 pm	**Development of the Alaska Anadromous Fish Habitat Assessment (AFHA) and its Use in Revision of the Tongass Land Management Plan**	*Fred Everest*
3:00 - 3:20 pm	**Break**	
3:20 - 5:00 pm	**Contributed Papers (salmon, steelhead trout)**	*Judith Gordon*
5:30 - 7:00 pm	**Alaskan Brewery tour and social**	*Transportation provided from Centennial Hall*
7:00 - 9:00 pm	**Aquatic Education Workshop**	*Egan Room*

Wednesday, November 19

8:00 - 10:00 am	**Linkages in Marine Ecosystems**	*Gordon Kruse*
8:20 - 11:20 am	**Function and Management of Forested Headwater Streams in the Pacific Northwest**	*Mark Wifpli*
10:00 - 10:20 am	**Break**	
10:20 am - 12:00 pm	**Population assessments**	*Brian Frenette*
12:00 pm	**Lunch/Joint Western/AK/NIPC Arrangements Meeting**	
1:00 - 3:30 pm	**Poster Sessions**	*Egan Room*
1:00 - 3:00 pm	**Introduction to the Public Trust Doctrine**	*Christopher Estes*
1:00 - 3:30 pm	**Salmon Management**	*Ben VanAlen*
3:40 - 5:00 pm	**Business Meeting**	
6:30 pm	**Social Hour/Banquet**	*At The Hangar, Guest Speaker: Lt Governor Fran Ulmer*

Thursday, November 20

8:00 - 10:00 am	**Contributed Papers (stream habitat)**	*K Koski*
9:00 - 11:00 am	**Shellfish Research and Management**	*Ray RaLonde*
10:00 - 10:20 am	**Break**	
10:20 am - 12:00 pm	**Habitat Surveys**	*Bill Lorenz*
12:00 - 1:00 pm	**Lunch** **"Stocks at Risk Committee" Meeting**	*Alex Werthiemer*
1:00 - 3:00 pm	**How Many Fish Are There? Problems Estimating the Abundance of Fish populations**	*Doug Jones*
3:00 - 3:30 pm	**Break**	
3:30 pm	**Summary/Awards**	

Session Agenda

TUESDAY, NOVEMBER 18

Plenary Session
Chair: M.D. Bryant
Ballroom 1

8:30 am	**Opening**	*Peggy Merritt, President Alaska Chapter AFS*
9:00 - 9:30 am	**ADF&G**	*Frank Rue, Commissioner Alaska Department of Fish and Game*
9:30 - 10:00 am	**Aquatic Habitat Management on the Tongass National Forest**	*Phil Janik, Regional Forester, U.S.D.A. Forest Service, Alaska*
10:00 - 10:20 am	**Break**	
11:00 - 11:50 am	**Large Wood from Forest to the Sea**	*Jim Sedell*

Session 2: Development of the Alaska Anadromous Fish Habitat Assessment (AFHA) and its Use in Revision of the Tongasss Land Management Plan(TLMP)
Chair: Fred Everest
Ballroom 1

1:00 - 1:20 pm	**Development of AFHA. Relationship to PACFISH; Congressional directives, R-10/PNW response, timeframes, products**	*Jack Capp*
1:20 - 1:40 pm	**The role of the Fish Habitat Assessment Team (FHAT) in AFHA. Structure, process, findings, recommendations**	*Jeff Kershner*
1:40 - 2:00 pm	**The revised 1997 TLMP strategy for protection and restoration of riparian and fish habitats. Brief history of timber management and disturbance; forestwide old-growth retention strategy; riparian and fish habitat standards and guidelines**	*Ron Dunlap*

2:00 - 2:20 pm	**Consistency in use of aquatic science information and recommendations of AFHA in TLMP. Did TLMP make appropriate use of scientific information on aquatic resources? Were the recommendations on AFHA included in TLMP?**	*Fred Everest*
2:20 - 2:40 pm	**Risk to fishery resources of the Tongass National Forest associated with implementation on the revised TLMP. The risk asessment process; risk levels in the TLMP revision.**	**Gordon Reeves**
2:40 - 3:00 pm	**Verifying risk assessments developed through expert opinion. Implement the plan, monitor, amend the plan as needed to adapt to monitoring results.**	**Fred Everest**

Session 3: Pacific Herring Management and Research
Chair: Fritz Funk
Ballroom 2

1:00 - 1:20 pm	**A New Paradigm for Marine Fisheries Management: The Use of In-season Acoustic Biomass Estimates to Protect Spawning Stocks**	*Gary Thomas*
1:20 - 1:40 pm	**Viral Hemorrhagic Septicema Virus in Wild Pacific Herring**	*Richard Kocan, P. Hershberger and J. Winton*
1:40 - 2:00 pm	**Shifts in PWS Juvenile Herring Carbon Source Determined with 13C/12C: Evidence for Changes in Oceanographic Forcing During 1994-5**	*Thomas C. Kline*
2:00 - 2:20 pm	**Extrinsic Ascendancy of Pacific Herring Populations**	*Erik H. William*
2:20 - 2:40 pm	**Ichtyophornus Infections in Wild and Lab-reared Pacific Herring**	*Richard Kocan, P. Hershberger, T. Mehl, M. Bradley and N. Elder*
2:40 - 3:00 pm	**Imaging Spectometer Detects and Measures the Surface Area of Pacific Herring Schools in the Bering Sea**	*Fritz Funk*

Session 4: Contributed Papers (salmon, steelhead and trout)
Chair: Judith Gordon
Ballroom 1

3:20 - 3:40 pm	**Ecological Differences Between Sockeye Salmon Populations Originating from Proximate Streams within the Tustumena Lake Watershed**	*Carol Ann Woody*
3:40 - 4:00 pm	**Assessing Rainbow Trout Movements On the Algagnak River, Southwest Alaska**	*R.B. Benter and E. Eric Knudsen*
4:00 - 4:20 pm	**Life Histories and Migrations of Copper River Delta Cutthroat Trout** *Oncrhynchus clarki,* **Inferred from Radio Telemetry**	*David A. Saiget, J. Ken Hodges, Merlyn D. Schelske and Dave E. Schmid*
4:20 - 4:40 pm	**Variability of Family Size and Marine Survival in Pink Salmon has Implications for Conservation Biology and Human Use**	*Harold J. Geiger, William W. Smoker, Lev A. Zhivotsky and A.J. Garret*
4:40 - 5:00 pm	**Changes Associated with the 1989-90 Ocean Climate Shift, and Effects on British Columbia Steelhead and Coho Salmon Populations**	*D.W. Welch, B.R. Ward, B.D. Smith and F. Whitney*

WEDNESDAY, NOVEMBER 19

Session 5: Linkages in Marine Ecosystems
Chair: Gordon Kruse
Ballroom 2

8:00 - 8:20 am	**The Gulf of Alaska and the Bering Sea: The Physical Basis for Marine Productivity**	*Thomas J. Weingartner*
8:20 - 8:40 am	**Relationship between Winds, Sea Surface Temperature and Year-Class Strength of Tanner Crabs in the Southeastern Bering Sea**	*Gregg Rosenkrantz*
8:40 - 9:00 am	**Recuitment Patterns of Alaskan Crabs and Relationships to Decadal Shifts in Climate and Physical Oceanography**	*Jie Zheng and Gordon H. Kruse*
9:00 - 9:20 am	**Hindcasting Primary Productivity in the Bering Sea: A 47 Year Record from Carbon Isotope Ratios in Whale Baleen**	*Dr. Don Schell*

9:20 - 9:40 am	**Forage Fish Availability to Seabirds in Prince William Sound**	*Jennifer Boldt, Lewis Haldorson and Kenneth Coyle*
9:40 - 10:00 am	**Linkages in Marine Ecosystems: Dungeness Crabs and Sea Clams**	*Dr. Tom Shirley, Dr. Brendan Kelly, James Taggart and Dr. Jim Bodkin*

Session 6: Function and Management of Headwater Streams in the Pacific Northwest
Chair: Mark Wilpfli
Ballroom 1

8:10 - 8:20 am	**Introduction**	*Lee Benda/Mark Wifpli*
8:20 - 8:40 am	**Changes in Subsurface Flow and Piezometric Response to High Intensity Rainfall in Headwater Streams in Southeast Alaska**	*Douglas N. Swanston and Robert Erdhardt*
8:40 - 9:00 am	**The Influence of Clearcutting and Natural Forest Death on Sediment and Woody Debris Generation in Headwater Catchments of Southeast Alaska**	*Adelaide Johnson*
9:00 - 9:20 am	**Physical Process in Headwater Channels**	*Richard D. Woodsmith*
9:20 - 9:40 am	**The Stohastic Behavior of Steep, Low-order Channels and its Consequences to the Dynamic Morphology of Aquatic Habitats**	*Lee E. Benda*
9:40 - 10:00 am	**Headwater Streams Relevant to Fish Production in Oregon**	*Gordon Reeves*
10:00 - 10:20 am	**Break**	
10:20 - 10:40 am	**Physical Characterization of Stream and Riparian Functions for Use in Designing Forest Management Strategies**	*Kate Sullivan*
10:40 - 11:00 am	**Trophic Links Between Headwater and Fish-bearing Streams: Are Headwater Streams Important Sources of Energy for Anadromous Salmonid Streams in Southeast Alaska?**	*Mark S. Wifpli and Dave Gregovich*
11:00 - 11:20 am	**Aquatic Vertebrates in Western Washington Headwaters with Different Natural Disturbance Regimes: Recovery Patterns and Potential Sensitivity to Human Disturbance**	*Peter A. Bisson, Lawrence C. Jones, Martin G. Raphael, Charles M. Christafulli and Charles P. Hawkins*

11:20 - 11:40 am	**Headwater Streams in Northwestern Oregon: Channel Characterizations and Vertebrate Assemblages in Young Forests**	*Deanna H. Olson, Bruce Hansen and Loretta L. Ellenburg*

Session 7: Contributed Papers (population assessments)
Chair: Brian Frenette
Ballroom 2

10:20 - 10:40 am	**Riverine Fisheries Acoustics in Alaska, Where We've Been, Where We Are and Where We Are Headed**	*Deborah A. Hart*
10:40 - 11:00 am	**Using Sonar to Index the Abundance of Chinook Salmon in the Kenai River, Alaska**	*Debby Burwen and Daniel Bosch*
11:00 - 11:20 am	**The Status of Alaska Salmon Populations Geographic Information System (SASPop GIS)**	*Timothy J. Haverland, Larry Talley, Alex C. Werthheimer and Harold Geiger*
11:20 - 11:40 am	**A Continuous Fox-Form of the Surplus Production Observation-Error Estimator**	*Zhenming Su*
11:40 am - 12:00 pm	**Population Assessments of Arctic Grayling and Dolly Varden in Featherly Creek, 1994-96**	**F. Jefffrey Adams**

Session 8: Introduction to the Public Trust Doctrine: A Panel Discussion
Chair: Christopher Estes
Ballroom 2

1:00 - 3:00 pm	**An Introduction to the Public Trust Doctrine and its Relationship to the Alaska Statehood Act, Alaska National Interest Lands Conservaiton Act (ANILCA) and Alaska Native Claims Setlement Act (ANCSA)**	*Richard Roos-Collins (Moderator), Gregory Cook and Jude Pate*

Session 9: Salmon Management
Chair: Ben VanAlen
Ballroom 1

1:00 - 1:20 pm	**Management and Assessment of Transboundary Taku and Stikine River Sockeye Salmon Stocks**	*Andy McGregor*
1:20 - 1:40 pm	**Historical Abundance and Management of Coho Salmon in Southeast Alaska**	*Leon D. Shaul*
1:40 - 2:00 pm	**Management of the Commercial Troll Fishery in Southeast Alaska**	*Mark Stopha*
2:00 - 2:20 pm	**Purse Seine Fishery Management in Southeast Alaska**	*Phil Doherty*
2:20 - 2:40 pm	**Projrcted and Actual Alaska Pacific Salmon Catch Statistics from 1970 to 1997, with a Focus on the 1997 season**	*David A. Petree, Harold J. Geiger and Timothy Haverland*
2:40 - 3:00 pm	**Appropriate Scale of Salmon Management Units for Maintaining Sustainable Abundance and Biodiversity**	*E.E. Knudsen, G.K. Sage and K.S. Scribner*
3:00 - 3:20 pm	**The Pacific Salmon Treaty and Coast Wide Management of Chinook Salmon**	*Jeff Koeings*

THURSDAY, NOVEMBER 20

Session 9: Contributed Papers: Stream Habitat
Chair: K Koski
Ballroom 1

8:00 - 8:20 am	**Invertebrates Colonizing Anadromous Salmonid Carcasses in Southeastern Alaskan Freshwater Systems**	*D.T. Chaloner, M.S. Wifpli and J.P. Hudson*
8:20 - 9:00 am	**Salmon Carcassess Increase Stream Macroinvertebrate Abundance in Alaska**	*John Hudson, Mark S. Wifpli and John Caouette*
9:00 - 9:20 am	**The Effects of Urbanization on Salmonid Abundance and Life History Strategy in Duck Creek, a Small Coastal Stream**	*J. Mitchell Lorenz and K V. Koski*
9:20 - 9:40 am	**Restoration of Water Quality and Anadromous Fish Habitat in Duck Creek, an Impaired Urban Stream in Juneau, Alaska**	*K V. Koski and J. Mitchell Lorenz*

9:40 - 10:00 am	**Seasonal Movements and Distribution of Juvenile Steelhead and Coho Salmon in Southeastern Alaska Drainage Basin**	*Robert Bramblett, Brenda E. Wright, M.D. Bryant and R. White*

Session 10: Shellfish Research Management
Chair: R. RaLonde
Ballroom 2

9:00 - 9:20 am	**Difficulties in Determining Sustained Yields for Developing Red Sea Urchin Fishery in Southeastern Alaska**	*Doug Woodby*
9:20 - 9:40 am	**Hatchery Production of Littleneck Clams and Purple Hinge Rock Scallops in Alaska**	*Jon Agosti*
9:40 - 10:00 am	**Littleneck Clam Hatchery Seed Culture and Growout Studies in Southcentral Alaska**	*Jeff Hetrick*
10:00 - 10:20 am	**Break**	
10:20 - 10:40 am	**Larva Sampling and Setting Studies for the Pink and Spiny Scallop in Sitka Sound, Alaska**	*Raymond RaLonde*
10:40 - 11:00 am	**The Geoduck Fishery, Enhancement and Aquaculture Efforts in Puget Sound, Washington**	*Hal Beattie*

Session 11: Stream Habitat Surveys
Chair: Bill Lorenz
Ballroom 1

10:20 - 10:40 am	**Development of a Set of Core Attributes for Stream Fish Habitat Inventories on National Forest Lands**	*Glen Chen, Jeff L. Kershner, Kerry Overton, John Potyondy, Jerry Boberg, Larry Schmidt, Ken Roby, Mason Bryant and Deborah Konoff*
10:40 - 11:00 am	**TBA**	
11:00 - 11:20 am	**Stream Protocols for Habitat Surveys in the Tongass National Forest**	*Bill Lorenz*
11:20 - 11:40 am	**An Evaluation of the Statistical Power of Existing Stream Survey Data on the Tongass National Forest**	*John Caouette and Katherine E. Coghill*
11:40 am - 12:00 pm	**The Effectiveness of Riparian Buffer Zones to Protect Salmonid Habitat in Alaska Coastal Streams**	*Douglas J. Martin and Morgan E. Robinson*

Abstracts

Poster Session

Wednesday, November 19

1:00 - 3:00 pm

Egan Room

How Many Fish Are There? Problems Estimating the Abundance of Fish Populations
Chair: Doug Jones
Ballroom 1

1:00 -1:20 pm	**Observer Bias in Escapement Estimation**	*Ed Jones*
1:20 - 1:40 pm	**The Trouble with Tagging**	*Dana Schmidt, Pat Shields, Gary Kyle and Stan Carlson*
1:40 - 2:00 pm	**Estimating Fish Populations in Streams: Removal Methods Using Minnow Traps**	*M.D. Bryant*
2:00 - 2:20 pm	**Discrepancies Between In-season and Multiple-year Abundance Estimates of Resident Cutthroat Trout Populations in Several Southeast Alaska Lakes**	*Roger Harding and Robert Marshall*
2:20 - 2:40 pm	**Problems Associated with Jolly-Seber Estimates of Out- Migrating Chinook Salmon in the Chena River**	*T.M. Lambert and J.B. Reynolds*
2:40 - 3:00 pm	**The Lack of Randomness in Mark-Recapture Experiments**	*Dave Bernard*

A Simple Stratified Design for Mark-Recapture: Estimation of Salmon Smolt Runs

Stan R. Carlson, Lewis G. Coggins, and Charles O. Swanton

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We describe a mark-recapture technique in which a stratified design and sampling at one or two stream locations are used to estimate the abundance of a migrating salmon smolt population. The method consists of counting smolt captured at a designated site of which a sample is marked and released back into the population. Marked smolt recovered downstream from the release site are counted to estimate capture probability (trap efficiency) which is used to estimate smolt abundance for a segment of the population. This procedure is temporally stratified such that each mark-release event is discreetly paired with one recovery period; this can typically be accomplished by releasing marked smolt in relatively short intervals (a few days) with little chance of recaptured fish occurring in later strata. This approach accounts for potential temporal changes in capture probability with the fairly modest assumption of stratum consistency. The method is a simplification of the generalized two-sample stratified design with some important advantages: (1) since marking occurs at discreet intervals, personnel costs are substantially reduced; (2) because release events and recovery strata are paired, only one type of mark is needed which simplifies mark and recapture tallying; and (3) when only one capture site is used, material costs are reduced by about half. Approximately unbiased abundance and variance estimators of the total smolt population are presented as well as a simple method of determining the number of smolt to mark. We develop bootstrap techniques for quantifying precision and estimating confidence intervals. Additional stratification based on grouping smolt by size is also discussed. An example, using sockeye salmon *Oncorhynchus nerka* **smolt migrating from Akalura Lake, Kodiak Island, Alaska, is given to illustrate the technique. We also discuss errors in a previous report by Rawson (1984; Alaska Department of Fish and Game, FRED Division report number 28) which originally motivated this investigation.**

Growth Patterns of Juvenile Sockeye Salmon Under Different Thermal Environments in Alaskan Lakes

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The in-lake rearing conditions imposed on juvenile salmonids are important determinants of freshwater growth patterns. Within sockeye producing lakes, growth of juvenile sockeye salmon (*Oncorhynchus nerka*) may be directly related to food resources and temperature or inversely related to fish density. Alaskan sockeye nursery lakes include a variety of clear water, organically stained, and glacially turbid lakes exhibiting a wide range in thermal characteristics. Stained lakes have warmer surface temperatures and longer growing seasons compared to clear lakes, whereas glacial lakes are colder and have shorter growing seasons. Clear lakes that develop thermal stratification in summer tend to have a relatively deep mixing depth. In stained lakes, a shallow summer thermocline restricts most of the heat to the near surface layers causing hypolimnetic temperatures to remain at approximately 4-5° C. Cold meltwater intrusion counteracts deep mixing and heat transport to the lower layers in glacial lakes. Thus, the summer heat budget, defined as accumulated calories between spring (4° C) isothermy and time of maximum heat content, was poorly correlated with morphometric variables. However, in deep lakes a cold isolated hypolimnia or cold water entering the basin at depth reduces the volume-weighted temperature. As such, mean depth accounted for 77% of the variation in seasonal mean water column temperature (*TS*). Taken together, the factors *TS*, zooplankton biomass, and fry density accounted for 70% of the variation in mean age-1 smolt length and weight. Because smolt-to-adult survival of Pacific salmon is related to smolt size, the dependence of smolt size on temperature and density-dependent factors argues for including limnological data to develop or refine escapement goals and to evaluate traditional stock-recruitment models.

Effects of Climate Change on Fishes in Alaskan Stream and Rivers

J. Reynolds, M. Oswood, S. Andersen, P. Cleary, M. Hjorth, B. McIntosh, H. Nute, B. Scanlon, T. Tydingco, and B. Whit

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and Department of Biology and Wildlife
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The concept of ecological "filters" to explain freshwater fish diversity (Tonn 1990, Trans. Am. Fish. Soc. 119:337-352) is useful as a qualitative framework for understanding the present-day distribution of fish fauna in Alaskan running waters and the likely effects of climate warming on this distribution and its diversity. This fish fauna is largely derived from a Pleistocene refugium, supplemented through migrations of marine-origin fishes from the North Pacific Ocean. Species richness has remained low primarily due to temperature-related phenomena. Juvenile fishes are probably the life stage most vulnerable to cold-temperature filters, the weak link in completion of life cycles. Failures of temperate species to survive when stocked in northern Canada and Alaska attest to the effectiveness of these ecological filters. However, it is likely that average air temperatures in northern Alaska are only slightly colder than the lower limits for some temperate coolwater species such as rainbow trout and smallmouth bass. Projections of climate warming for interior Alaska indicate that these lower limits will be reached within 100 years or less. Then, Alaska will be less of a refuge for its specialized fish fauna if new species are successful in increasing their northern range, either by long-distance migrations from marine sources or through introductions from temperate regions of North America.

Exploration of Stream Survey Data on the Hoonah Ranger District, 1992-1997

Chris Riley

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Hoonah, Alaska

Stream surveys conducted on the Hoonah Ranger District from 1992 to 1997 were organized hierarchically by channel type to describe number and length of segments surveyed. Data were explored to describe frequency of pools, mean residual pool depth, and large wood debris frequency for each segment, and distribution of each by channel type. Patterns in distribution were explored comparing segments in managed and unmanaged watersheds. Results indicate that these data items are useful in describing current and desired condition of stream habitat.

A New Arctic Char, Salvelinus alpinus sp., from Western Alaska

J. F. Webb

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R. B. Phillips, E. H. Leder, and K. M. Westrich

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A previously unknown char, *Salvelinus alpinus sp.*, was discovered in certain lakes in the Kigluaik Mountains on the Seward Peninsula of western Alaska during routine inventories of fish and their habitats during summer, 1987. The fish from two of these lakes were judged to belong to the Arctic char complex, *S. alpinus*, based on morphometric and meristic features attributed to this group. Until the discovery of these populations only Dolly Varden, *S. malma,* were known from this area of western Alaska. Additional examination of physical features have revealed some apparently unique characteristics compared to other populations of the *alpinus* group in Alaska and perhaps elsewhere. Also, the populations from the two lakes are different from each other in that the sexually mature individuals from one lake have neotenic features (i.e., parr marks) and the sexually mature adults in the other lake do not exhibit neoteny. Subsequent examination of these fish in which the sequence of the ribosomal DNA first internal spacer region (rDNA ITS1) was determined, indicated that these fish were different from other Arctic char that were available for comparison which included *S. alpinus sp.* from the Kenai Peninsula in southcentral Alaska and *S. alpinus erythrinus* from Nayuk Lake in the Northwest Territories, Canada. Further genetic analysis using mitochondrial DNA restriction site fragment length polymorphisms (RFLPs) indicates that the populations from the two lakes are also different from each other. This study provides further insight into the ongoing effort by char specialists to explain the postglacial dispersal and distribution of the Arctic char complex in North America and Asia.

Genetic Differention of Sockeye Salmon Subpopulations from Tustumena Lake, Alaska

Kevin Sage

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Adult sockeye salmon (*Oncorhynchus nerka*) samples were collected from eight spawning populations within Tustumena Lake and from the lake outlet spawning population (N=469). Individuals were surveyed for genetic variation at seven variable microsatellite loci cloned from sockeye salmon. Significant differences in allele frequencies were observed in all seven of the loci examined. Population differences in allele frequencies within each of the seven loci ranged from 16.7% to 36.3%. The most notable differences observed were between the lake outlet spawning population and the tributary and shoreline spawning populations, and between Clear Creek and the other tributary and shoreline spawning populations. The outlet and Clear Creek populations also represent two of the smallest spawning populations surveyed and demonstrate the importance of managing for all the populations within the system if the maximum amount of genetic diversity is to be maintained. Within the watershed, genetic similarity and geographic proximity also appear to be correlated. In general, spawning populations on opposite sides of the lake and geographically more distant, are more different from one another than are those in close geographic proximity. These results indicate that genetic difference do exist among the populations despite recent (within 2,000 years) colonization following deglaciation.

Lowell Wakefield Fisheries Symposia: Information Exchanges for Alaskan Resource Scientists and Managers

Brenda Baxter

The poster will describe the history of Alaska Sea Grant's multi-agency educational series, list the various topics addressed, and present the call for papers for the 1998 symposium. For the first time, a Wakefield symposium will join the Alaska Chapter of AFS and two other AFS organizations to sponsor an International Symposium on Ecosystem Considerations in Fisheries Management. The Wakefield Symposium, the AFS Alaska Chapter annual meeting and 25th anniversary celebration, the AFS North Pacific International Chapter annual meeting, and the AFS Western Division annual meeting will all be held in Anchorage September 29 -October 3, 1998.

Genetic Relationships Among Chinook Salmon (Oncorhynchus tshawytscha) Populations in Alaska Based on Variation at Multiple Allozyme and Microsatellite Loci

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Chinook salmon (*Oncorhynchus tshawytsch*) populations are distributed throughout Alaska from Southeast Alaska to the northern Bering Sea Coast and inhabit widely ranging habitats with varying geological age and history. We used eight microsatellite loci and to assay genetic variation from eleven populations originating from the Yukon River to southern Southeast Alaska. The microsatellites were derived from chinook salmon, sockeye salmon (genus *Oncorhynchus*) as well as brown trout (genus *Salmo*). The data reveal high levels of population differentiation both within major regions of Alaska and among regions and indicate the existence of several lineages of chinook salmon within Alaska. In addition, some island populations were found to be particularly divergent from other geographically adjacent populations. We compare these data to a comprehensive allozyme data set of 25 polymorphic loci gathered from the same individuals. The data sets are currently being used to address the conservation concerns of chinook salmon including the origins of populations harvested in mixed-stock fisheries, the interaction of hatchery and wild populations, and the definition of appropriate management units.

Factors Affecting Habitat Utilization by Juvenile Salmonids in Ophir and East Ophir Creeks, Yakutat, Alaska

Kellie Whitton[1]

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Ophir Creek, a small (6.85 km) stream near Yakutat, Alaska, has been historically important to the sport, commercial and subsistence fisheries of the local community. Several land-use practices (logging, drainage ditches and urbanization) and two natural processes (isostatic rebound and tectonic uplift) may have contributed to habitat degradation and dewatering of the stream. Currently, adult coho, *Oncorhynchus kisutch* **and sockeye,** *O. nerka*, **salmon spawning habitat utilization is being monitored, but little is known about juvenile salmonid habitat quality and utilization. Outmigration studies done in 1995 suggested that winter rearing densities in East Ophir Creek - a tributary of Ophir Creek - were as twice as high as in the mainstem (43.8 fish/100m^2 vs. 19.1 fish/100m^2). These differences could not be explained with available information. During the summers of 1996 and 1997 baseline information on juvenile salmonid habitat availability, utilization and quality was collected from Ophir and East Ophir Creek to identify differences between the two streams. Both streams were classified into five habitat types (pools, riffles, sloughs, glides and side channels) to compare differences in species utilization, rearing densities and habitat quality between habitat types and between streams. Physical parameters used to define quality included temperature, depth, substrate composition, and cover (i.e. woody debris, undercut banks, aquatic and riparian vegetation). Preliminary analysis suggests that there are differences among habitats and streams, but further analysis is necessary to determine the extent of these differences and their relationship to physical parameters. The results of this study may be important for guiding current and future habitat restoration activities on Ophir Creek and other area streams.**

[1]Student Paper

Plenary Session

Tuesday, November 18

8:30 - 11:50 am

Ballroom 1

THERMAL LIMITS AND OCEAN MIGRATIONS OF PACIFIC SALMON: LONG-TERM CONSEQUENCES OF GLOBAL WARMING

D.W. Welch [1], Y. Ishida[2], and K. Nagasawa[2]

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Ocean surveys show that extremely sharp thermal boundaries have limited the distribution of all species of salmon in the Pacific ocean and adjacent seas during the past 40 years. These limits are expressed as a step-function, with the temperature defining the position of the thermal limit varying among months in an annual cycle. The sharpness of the edge, the different temperatures that define the position of the edge for different species and each month of the year, and the subtle variations in temperature with area or decade for a given month probably all occur because temperature-dependent metabolic rates exceed energy intake from feeding over large regions of otherwise acceptable habitat in the North Pacific. At current rates of greenhouse gas emissions, predicted temperature increases under a 2xCO_2 climate are large enough to shift the position of the thermal limits into the Bering Sea by the middle of the next century for sockeye salmon, and cause large-scale northward shifts in the distribution of other species of Pacific salmon. Such an increase would potentially exclude sockeye salmon from the entire Pacific Ocean, and severely restrict the overall area of the marine environment that would support Pacific salmon growth for many other species. There is a clear need to better understand the consequences on productivity of climate-induced changes in the ocean life history phase of salmon.

Session 2: Development of the Alaska Anadromous Fish Habitat Assessment (AFHA) and its Use in Revision of the Tongass Land Management Plan (TLMP)

Tuesday, November 18

1:30 - 3:00 pm

Ballroom 1

Session3: Pacific Herring Management and Research
Tuesday, November 18
1:00 - 3:00 pm
Ballroom 2

Viral Hemorrhagic Septicemia Virus in Wild Pacific Herring (Clupea pallasi)

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Viral hemorrhagic septicemia virus was first reported from wild herring in Prince William Sound following a massive disappearance of over 100,000 tons of fish in 1993. The virus has subsequently been isolated from bait herring in Puget Sound and herring collected in the vicinity of a diesel fuel spill in Prince Rupert, B.C. Studies were designed to (1) determine the prevalence rate of VHSV in wild Pacific herring, (2) to evaluate the effect of capture and captivity on the course of VHS in wild herring, and (3) to determine the immune status of wild herring that survive an epizootic of VHS. Wild herring ranging in age from 0-year to 3+ were captured by net in Northern Puget Sound and transferred to the Marrowstone Island field station (USGS-BRD), Nordland, WA. Immediately after capture a subsample of fish was frozen at -70oC for later virus assay. The remaining fish were held either individually in 30L tanks or in schools of >100 fish in 200 gallon tanks. Fish were maintained in filtered and/or UV-sterilized seawater and fed frozen brine shrimp and krill beginning the day after capture. Dead fish were collected daily and frozen at -70oC until assayed and subsamples of live fish were taken regularly and similarly frozen until assayed. No virus was isolated by plaque assay from any wild fish at the time of capture. However, by 1-3 weeks post-capture approximately 60% of the 0-year herring held in schools died with hemorrhages of the skin, fins and mouth, but mortality was significantly less (< 10%) in older fish. Plaque assays on EPC cells revealed that > 90% of the dead fish had > 1 X 106 PFU*gm-1 tissue at the time of death. Ninety percent of the live fish sampled from the same tanks carried slightly lower titers of virus from 5 to 14 days post-capture. By 10 days post-capture virus titers began to decline until they were undetectable by 4 weeks post-capture. Juveniles (1+) as well as adults (2+ & 3+) were also negative for VHSV when initially captured, but began expressing virus by 24-48 hours post-capture. Virus was detected in 10%, 33% and 10% of older live fish on days 2, 8, and 11 respectively, but undetectable by day 21 post capture. Surviving herring exposed to 1X103 to 1X106 PFU*ml-1 for 1 hour 6-8 weeks post-capture exhibited no mortalities in any age class and no virus could be isolated from tissues of these fish 10 days post-exposure. When newly captured 0-year herring were held individually in flowing filtered-seawater tanks they began dying 7 days post-capture and VHSV could be isolated from 10-13% of the fish. Although no VHSV was isolated from wild herring, the VHSV-carrier rate appeared to be about 10-13% by the time the fish were 3-4 months-old. All age classes were shedding virus and had detectable virus in their tissues by 24-48 hours post-capture, with the most severe mortality occurring in the 0-year fish. By 3-4 weeks post-capture virus was no longer detectable in tissues and the fish were solidly resistant to challenge infection with > 103 PFU*ml-1 water which is 10 times higher than the experimentally determined minimum lethal dose. These studies have demonstrated that wild herring are infected by the time they are 3-4 months old and that herring surviving an epizootic are solidly immune to reinfection. It is not clear however how the fish became infected so early in life, or if the recovered fish have cleared the virus or are carrying latent infections that can be activated under stress conditions at a later time.

Shifts in PWS Juvenile Herring Carbon Source Determined with 13C/12C: Evidence for Changes in Oceanographic Forcing During 1994-5

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The advective regime connecting the northern Gulf of Alaska (GOA) with Prince William Sound (PWS) is postulated to effect recruitment and nutritional processes in juvenile herring. The concomitant transfer of carbon from the GOA to PWS being demonstrated by using natural stable isotope tracers is providing direct evidence of these links in the PWS study area. The large herbivorous copepods of the genus Neocalanus and bulk net zooplankton were used as a carbon (nutritional) source proxy. Samples had distinctive 13C/12C signatures when sampled in the northern GOA compared to those from PWS. Analyses of 15N/14N and C/N of juvenile herring were used >to make their 13C/12C determine their affinity to GOA or PWS carbon. Juvenile pollock was used a secondary species for comparative purposes. The data suggested a range of affinity ranging from total dependency on PWS carbon to significant input of carbon from the GOA. Although there differences between the species during 1994 to 1995, the interannual differences for each species were much greater. There was a shift to greater dependency on GOA carbon in 1995. A parallel shift to increased GOA-originating copepods undergoing diapause (resting phase) in 1995 suggesting an influx of GOA zooplankton, provided a second line of evidence. The data suggest that herring and other fishes partially dependent on GOA carbon are subject to vagaries of carbon flow that fall under the domain of physical oceanographic processes that connect GOA with PWS. Increased competition for PWS carbon by all species may occur if GOA carbon is less available to those that normally use it. Shifting to increased dependency on PWS carbon by species with normal affinity for GOA carbon during years of poor GOA carbon availability would provide evidence of competition for a limited carbon supply by the increasing overlap in their 13C/12C signature. Time series measurements of natural stable isotopes in herring and other fishes in conjunction with fish population indices and physical oceanographic measurements will enable a new understanding of how bottom-up processes affect fish recruitment and interaction.

ICHTHYOPHONUS INFECTIONS IN WILD AND LAB-REARED PACIFIC HERRING (CLUPEA PALLASI)

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Several years following the Exxon Valdez oil spill, the Prince William Sound herring population unexpectedly fell from 130,000 tons to less than 20,000 tons. Survivors were lethargic, swam erratically, failed to spawn and were found to have an unexpectedly high prevalence (29%) of Ichthyophonus, a pathogenic fungus suspected to be the cause of earlier declines in Atlantic herring. Because there was no unequivocal proof that *I. hoferi* was actually responsible for the massive Atlantic herring die-offs, or was pathogenic to Pacific herring, we initiated several studies to evaluate its pathogenicity and natural history of this organism in wild Puget Sound herring and specific pathogen-free (SPF) laboratory-reared herring. The objectives of this study were to fulfill Koch's Postulates for Ichthyophonus in SPF herring, thereby establishing its role as a pathogen for this species, and to describe the organism's natural history in wild herring of various ages. Laboratory-reared SPF herring injected IP with ca 1,000 Ichthyophonus spores began dying by 11 days post exposure and had visible lesions on the heart, liver and spleen. Skin lesions (small holes) were detectable by 36 days, as were spores in the musculature under the skin. By 56 days post exposure 90% of the fish were dead. Ichthyophonus was cultured in MEM-10 from all but one of the fish which died or presented with lesions. Infected tissues from these herring were cultured then injected IP into coastrange sculpins *(Cottus aleuticus)*, all of which became infected and/or died by 14 days post exposure. Infected sculpin tissues were fed to these fish which also became infected and cultured positive for Ichthyophonus. No control sculpins were found to be infected with Ichthyophonus. Three year classes of wild herring (0-year, 1+ and 3+) were captured from Puget Sound between June 1995 and February 1997 and examined for the presence of Ichthyophonus by gross examination and in vitro culture of heart, liver and spleen. External skin lesions were observed in 6%, 5% and 4% of the three groups respectively while 6% 23% and 52% of each group cultured positive for Ichthyophonus. There was no significant difference in weight or length between infected and uninfected fish within each age class, and when the fish were held in captivity for up to 90 days post-capture, there was no significant difference in mortality between the infected and uninfected individuals within age classes. Using pathogen-free laboratory-reared herring, Koch's Postulates were fulfilled and Ichthyophonus was shown to be a pathogen for lab-reared herring, capable of causing nearly 100% mortality. The earliest external signs of disease were skin lesions, appearing as small holes in the skin, through which the parasite presumably escapes from the host. Gross and microscopic lesions of the heart, liver, spleen, muscle and skin preceded the appearance of the skin lesions. Culture of tissues however, appears to be the most rapid and accurate method for detecting this organism. Wild herring were found to be infected by 2-4 months post-metamorphosis with a prevalence of 6%, while the highest prevalence (52%) was found in adult spawners. There was no evidence that the organism affected the health or survival of wild fish, but different environmental conditions and levels of infection could result in a significant level of morbidity and mortality. Based on the sculpin feeding studies, carnivorous fish are potentially at risk of becoming infected by eating infected herring.

Session 4: Contributed Papers
(salmon, steelhead and trout)
Tuesday, November 18
3:20 - 5:00 pm
Ballroom 1

Ecological Differences Between Sockeye Salmon Populations Originating From Proximate Streams within the Tustumena Lake Watershed

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Sockeye salmon (*Oncorhynchus nerka*) originating from a specific lake system are generally managed as a single population for commercial exploitation. However, historic and contemporary evidence indicate that sockeye salmon originating from a single lake system may actually be comprised of unique subpopulations originating from different natal habitat types. The ecology of sockeye populations originating from two unique tributaries to Tustumena Lake were characterized in 1994 and 1995. Heritable traits such as run timing, age and size at maturity, fecundity, and egg size were compared. Stream entry condition and behavior were monitored. Potential selection factors such as water velocity, depth, substrate composition, annual thermal and discharge regimes and bear predation were documented. Nikolai Creek is a more diverse, stained, larger, deeper, faster and colder stream than Glacier Flats, a small, clear, spring-fed, slow, shallow system. The Nikolai salmon population exhibited earlier run timing, were older, and larger in comparison to Glacier Flats fish of the same age and produced more and larger eggs. The majority of Glacier females entered the stream ripe and were observed spawning in an average of 3.25 days while most Nikolai females entered the system green and were observed spawning in an average of 10.2 days. Run timing differences are attributed to stream thermal regime, age and size differences may be related to stream size and velocity, and it is hypothesized the populations differ in entry condition because Glacier Flats fish experienced a high rate of bear predation (33%). This information has implications for commercial fishery management, watershed management, and stock rehabilitation efforts.

Assessing Rainbow Trout Movements on the Alagnak River, Southwest Alaska

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Concerns have been raised about the health of the prized rainbow trout (*Oncorhynchus mykiss*) populations of the Alagnak Wild River and its tributaries upstream in Katmai National Park. The ultimate goals of this study are to increase basic understanding of the population dynamics of Alagnak watershed rainbow trout and to improve the technical capabilities for assessing health of Alaska trout populations. Before routine assessments of population status can be initiated, some basic questions regarding the population structure need to be addressed. It is presently unknown whether the rainbow trout in the various rivers, lakes, and tributaries of the watershed consists of a single, well mixed population with readily mixed spawning aggregations or whether there are discrete populations having independent spawning groups. In this first phase of the study we used radio telemetry and external tags to assess movements of Alagnak River drainage rainbow trout. Fish were tagged (radio and floy) in five locations in the drainage. Our initial findings indicate different spatial groups may move independently. We plan to use this preliminary data to design future studies that will determine whether discrete populations of rainbow trout exist in the Alagnak drainage.

Life Histories and Migrations of Copper River Delta Cutthroat Trout, Oncorhynchus clarki, Inferred from Radio Telemetry

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We identified four migratory forms of cutthroat trout, (*Oncorhynchus clarki*) on the Copper River Delta. Large migratory cutthroat trout in the Copper River Delta are often assumed to be anadromous because they are large (300-450 mm), near saltwater, and undergo seasonal migrations. Our surveys, using radio telemetry, suggest that most of these large fish are potamodromous. We identified a "stream-dwelling" potamodromous form which spends its summers and spawns in the stream, a "river-dwelling" potamodromous form which spends the summers in the mainstem of rivers after spawning, and two anadromous forms. One enters freshwater streams in autumn, and the other enters freshwater streams in the spring. However, our surveys indicate that most of these large fish are potamodromous, migrating between lakes in winter and rivers and streams in spring and summer. Low numbers of anadromous fish were seen. Radio-tagged fish were observed spawning in small headwater streams 2-3 feet wide, 6 inches deep, and fed by surface runoff in muskeg meadows. Although buffer zones are required on all anadromous streams, many small surface-runoff fed streams on the Copper River Delta such as these may not be recognized as anadromous streams requiring protection. We observed smaller resident trout spawning with larger migratory fish. Resident cutthroat trout populations may play an important role in sustaining the larger fish of migratory populations. Our surveys have shown mature spawners to be less than 10" in length. If populations are perceived to be low, it may be prudent to modify existing sport harvest regulations that protect these smaller fish, to increase recruitment and ensure optimal production.

Variability of Family Size and Marine Survival in Pink Salmon Has Implications for Conservation Biology and Human Use

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The short-term dynamics of salmonid populations are directly related to the mean sizes of individual families. The amount of genetic variation maintained in the population is directly related to the variance in sizes of individual families. Both the mean and variance of individual family sizes have important implications for conservation actions and sustainable levels of harvest of salmonid fishes. We develop a context for examining variation in family size, and we provide estimates of mean and variance of family size from five groups of marked pink salmon (*Oncorhynchus gorbuscha*) released into the north Pacific Ocean. We then present two important results: a) a statistically detectable genetic component of marine survival existed in groups with high marine survival, and b) ratios of variance-to-mean family size were linearly related to mean family size over the interval that we observed. These results imply that short-term population increases come from a small fraction of the population's families, that salmon encounter a fluctuating marine environment, and that the most favored phenotype changes from generation to generation. These results also support the widely-held view that protecting genetic variation in recovering or exploited salmon populations has important economic benefits.

Changes Associated with the 1989-90 Ocean Climate Shift, and Effects on British Columbia Steelhead & Coho Salmon Populations

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Recent changes in ocean climate may signal the beginning of another regime shift in the North Pacific. We describe the response of British Columbia (BC) steelhead trout (*Oncorhynchus mykiss*) populations since 1963, and more recent changes for coho salmon, and relate these changes to the 1977 regime shift and a possible 1990 regime shift. From 1963 until the late 1980s the increases and decreases in adult recruitment was strongly coherent for all populations in BC. A major increase in recruitment occurred in all regions following 1977, the time of the first "modern" regime shift. However, an out-of-phase response occurred after 1990, indicating that the effect of the 1990 regime shift had both temporal and geographical structure. In general, steelhead entering northern coastal regions have had increasing recruitment, while steelhead entering southern BC coastal regions have had sharply decreasing recruitment. Similar changes also appear to be occurring for other species of Pacific salmon in BC and Oregon such as coho (*O. kisutch*), but the evidence is currently less complete. For one well studied steelhead population located in southern B.C., the evidence clearly indicates that the overall recruitment response since 1977 was primarily shaped by changes in marine (not freshwater) survival. The likely reason is that ocean productivity declined in southern BC after 1990, reducing the marine growth of juvenile salmon. We conclude with a review of possible oceanographic and meteorological mechanisms that are consistent with the observed regime changes, and which could give rise to strong coherence within geographic regions, and out-of-phase differences between adjacent geographic regions.

Session 5: Linkages in Marine Ecosystems
Wednesday, November 19
8:00 - 10:00 am
Ballroom 2

The Gulf of Alaska and the Bering Sea: The Physical Basis for Marine Productivity

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The Gulf of Alaska (GOA) and the Bering Sea each support a productive marine ecosystem. While both regions appear highly productive the physical processes underlying this productivity are distinctly different. The Gulf of Alaska is a deep (~200 m) narrow (~100 km) shelf bounded on its inshore perimeter by a coastal mountain range (1-3 km elevation) and a relatively well-organized counterclockwise current along the continental slope. The latter consists of the poleward limb of the North Pacific Ocean's subarctic gyre and it provides the oceanic connection between the GOA and Bering Sea shelves and the Pacific Ocean. The dynamics of the GOA basin and the shelf are intimately linked to storm systems associated with seasonal changes in atmospheric pressure patterns. From fall through spring the Aleutian Low dominates the region while the North Pacific High prevails in summer. The position of the Aleutian Low directs storms into the GOA where they often stall because of orographic blocking. Consequently the wind field is strongly cyclonic and precipitation rates are high. The wind-stress pattern forces cyclonic circulation in the deep GOA. Over the shelf these winds impel an onshore surface Ekman drift and establish a cross-shore pressure gradient that drives the circulation. The high rates of precipitation, up to 8 m yr-1, causes an enormous freshwater flux (~20 % larger than the average Mississippi River discharge) that feeds the shelf as a "coastal line source". The coastal discharge and the winds largely determine the hydrography and both force a vigorous and persistent shelf circulation, with the Alaska Coastal Current being the most striking feature of this circulation. This is a swift (0.2 - 1.8 m s-1), coastally trapped current that lies within 35 km of the coast. It originates as far south as British Columbia and extends some 2500 km around the GOA shelf to where it enters the Bering Sea in the western gulf. The offshore edge of the coastal current is bounded by a salinity front whose strength varies seasonally in conjunction with the annual cycles in wind stress (maximum in winter) and discharge (maximum in fall). This front appears to be a region of convergent flow and it is very likely an important feeding area for fish, seabirds, and marine mammals. The Bering Sea shelf is shallow (30 - 200 m), broad (~800 km) and gently sloping. Tidal energy, in conjunction with gradients in bottom topography, wind energy, freshwater influx along the Alaskan coast, sea ice, and the onshore flux of water from the deep basin across the continental slope affect the circulation here. These lead to the formation of three fronts that parallel the isobaths and that lie between the coast and the shelf break. The hydrography and dynamical characteristics of the shelf differs between each front leading to distinctly different biological regimes in each domain. While the mean subtidal flow is very weak (<~ 5 cm s-1) and northwesterly, wind-driven currents are strong and highly variable on time scales ranging from the synoptic to the interannual. Communication between the shelf and the Pacific Ocean occurs along the shelf break with the Bering Slope Current. This current originates along the northern flank of the Aleutian Island archipelago where it receives North Pacific Ocean waters flowing through the passes among these islands. Interannual variability is high on both shelves with much of the variability being associated with changes in the strength and position of the Aleutian Low. These features affects wind speed and direction, precipitation, ice advance and retreat and the surface heat budget of the ocean. Other effects, including some associated with El Nino, appear to be related to the propagation of anomalous oceanic conditions.

Relationship Between Winds, Sea Surface Temperature, and Year-Class Strength of Tanner Crabs in the Southeastern Bering Sea

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I conducted correlation analysis between Tanner crab recruitment estimates from length-based modeling by Zheng et al. (*in press*) and time series of winds and sea surface temperatures (SST) in the Bering Sea to explore 2 hypotheses: (1) year-class strength of Tanner crabs depends on larval survival which increases when the abundance of copepod nauplii increases due to warm SST and wind-driven transport of nutrients into the euphotic zone; and (2) wind-driven advection affects year-class strength by transporting pelagic Tanner crab zoeae to suitable or unsuitable habitat for settlement. The intensity of May-June winds from the northeast and recruitment to the length-based model were positively correlated at time lags of 7 years for male Tanner crabs and 6 years for females, while SST was positively correlated at lags of 9 years and 8 years. Closer examination of the data combined with a literature review lent some support for 7 years and 6 years lag from hatching to recruitment for male and female Tanner crabs and a significant affect on year-class strength due to the abundance of *Pseudocalanus* spp. copepods over the middle shelf of the Bering Sea. Visual inspection of the time series of recruitment estimates, winds, and SST reveals the "cause" of the positive correlations and suggests that these environmental variables may not be useful as predictors of future recruitment.

Recruitment Patterns of Alaskan Crabs and Relationships to Decadal Shifts in Climate and Physical Oceanography

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In Alaska crabs support many large fisheries that have been unstable due to wide fluctuations in recruitment. An understanding of recruitment patterns is an important step to designing optimal management strategies. Data from bottom trawl and pot surveys and commercial fisheries were used directly to derive recruitment series for 15 stocks of king *(Paralithodes camtschaticus* and *P. platypus)*, Tanner *(Chionoecetes bairdi)*, and snow crab *(C. opilio)* in the Gulf of Alaska, along the Aleutian Islands, and in the Bering Sea. Recruitment to most crab stocks is periodic and strongly autocorrelated. Recruitment to red king crab stocks in Bristol Bay and in the northern Gulf of Alaska and along the Aleutian Islands has similar trends and has been weak since the mid-1970s; recruitment to Tanner crab stocks differ between the Bering Sea and Gulf of Alaska. Seven of 15 stocks had recruitment trends that appear to be related to decadal climate shifts: periods of strong winter Aleutian Lows are coincident with periods of weak crab recruitment. Associated with deeper Aleutian Lows, warmer incubation temperatures may hasten egg hatching in advance of the spring plankton bloom. In addition, strong vertical mixing and an unstable water column associated with a strong Aleutian Low inhibits growth of diatoms, *Thalassiosira* spp., which provide high-quality nutrition to crab larvae. Recruitment of many crab stocks may be influenced by local conditions not indexed by the Aleutian Low.

HINDCASTING PRIMARY PRODUCTIVITY IN THE BERING SEA: A 47 YEAR RECORD FROM CARBON ISOTOPE RATIOS IN WHALE BALEEN

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Recent work on the interrelationships between carbon isotope ratios in marine phytoplankton and cell growth rates have shown that a close relationship exists that is consistent over many sites in the world oceans. The implication is that if sequential measurements of isotope ratios from a region can be compared, the relative rates of primary production can be inferred. Since carbon isotope ratios are conservative in consumers, animal tissues can be used as a proxy. Bowhead whale (*Balaena mysticetus*) baleen grown while the whales were feeding in the Bering-Chukchi seas provides a multi-year temporal record of isotope ratios in their zooplankton prey and by proxy, the phytoplankton supporting the consumer food webs. By using baleen plates from 26 whales archived at the Los Angeles County Museum and recently taken by native hunters, an isotopic record was constructed that extends from 1947 to 1995. From this, we infer that seasonal primary productivity in the Bering Sea was at a higher rate over the period 1947 - 1966 and then underwent a general decline that continues to the most recent samples (1995). Assuming a close similarity to the published relationships between primary productivity and carbon isotope ratios, the decline in the Bering Sea carbon isotope ratios suggests a loss of 35-40 percent of the carrying capacity that existed 30 years ago. This drastic decline is evident in recent zooplankton biomass estimates and is very likely implicated in the continuing decline of marine mammal populations in the western Gulf of Alaska and Bering Sea. A comparison between archived marine mammal tissues and those from recent collections shows the same decline and implies decreased food availability to apex organisms in Bering Sea food webs.

Forage Fish Availability to Seabirds in Prince William Sound

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We assessed the abundance and distribution of forage fish in three areas (north, central, and south) of Prince William Sound (PWS) in the summer of 1995 and 1996. Offshore surveys were conducted in both years and nearshore surveys were added in 1996. There were some differences in fish biomass estimates among areas in both years. The north study area had the highest biomass of fish offshore in 1995 and 1996. Young of the year (YOY) pollock were abundant offshore in the central area in 1995, but were absent in 1996. In 1996, pollock of at least two years of age were sampled offshore in the central and north areas. Most fish were found nearshore in 1996, with the highest mean biomass in north PWS. Large schools of fish typically resulted in biomass estimates greater than 10 g/m^2 per transect. The proportion of transects with a biomass greater than 10 g/m^2 was significantly higher in the north (0.12) than in the central (0.02) or south (0.05) areas. Much of the biomass within each 12 km sampling site was due to one or two schools of fish on one or two of the twenty transects (zigs and zags) that made up a site. The areas that had the highest mean biomass of fish were: Port Gravina in the north area, the north end of Knight Island in the central area, and in Prince of Wales Passage in the south area. During the 1996 nearshore survey, herring were the most abundant species found in all areas, with some differences in age and size distribution. Juvenile herring were found in all areas, YOY herring were found mainly in the north, and adult herring occurred mainly in the south. Sand lance and YOY pollock were also found in the north, and sand lance and juvenile salmon were found in the central area. Overall, the highest biomass of fish was found in the north area, both offshore and nearshore, and the most abundant species found was herring. Physical conditions were similar among areas, and therefore did not explain differences in fish distribution among areas. Water column structure did not appear to explain the distribution of fish within an area or over a 24 hour period. There were no changes in water column structure along CTD transects from near to offshore or over a 24 hour period. The energetic content of herring sampled in 1996 varied among areas and may be an indication of the quality and/or quantity of food available to them. Overall, there were differences in distribution of fish species, biomass of fish, and energetic quality of fish, which in turn may affect the distribution and condition of the birds feeding on them.

Linkages in Marine Ecosystems: Dungeness Crabs and Sea Otters

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Since their reintroduction to southeastern Alaska in 1965, sea otters have increased to a current estimate of approximately 8,000 animals and are increasing approximately 20% annually. Since crabs have been reported to represent a sizable portion of the diet of sea otters, the continued expansion of the range of the sea otter into areas where Dungeness crabs are harvested poses potential conflicts with a commercial fishery that employs more than 300 crabbers with limited entry permits. The potential for conflicts between sea otters and subsistence and sport users of Dungeness crabs also exists. Are Dungeness crabs a major dietary item, and do sea otters represent the possible demise of the commercial fishery? Might the industry persist with different fishing techniques, or will the range expansion of the sea otter be limited to coastal bays or the outer portion of bays? In order to answer these questions and others, from 1993-1996 we have conducted studies on the influence of sea otters on crab abundance and distribution in Dundas Bay and other bays currently being occupied by sea otters, surveyed the distribution and abundance of sea otters, and analyzed their diet between Cross Sound and Icy Strait. Separate studies in the same area using time-depth recorders and radio and ultrasonic transmitters on foraging depths of sea otters were conducted over the past two years, and studies on the depth distribution of Dungeness crabs in the presence and absence of sea otters are planned for 1998.

Session 6: Function and Management of Headwater Streams in the Pacific Northwest

Wednesday, November 19

8:10 - 12:00 pm

Ballroom 1

Changes in Subsurface Flow and Piezometric Response to High Intensity Rainfall in Headwater Streams in Southeast Alaska

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High soil moisture levels, steep slopes, and convergent groundwater flows are characteristics common to headwater depressions in coastal Alaska. Due to high infiltration rates and hydraulic conductivities of forest soils at these headwater sites, water moves almost exclusively by subsurface flow except during periods of high intensity rainfall. During these storm periods, local saturation, development of temporary water tables, and flow at the surface greatly enhance the potential for soil mass movement and accelerated down slope transport of sediment and nutrients following natural and man-made disturbances. Preliminary seasonal monitoring of groundwater response to rainfall in six undisturbed headwater streams designated for different levels of alternative harvesting (non-clearcutting) indicate extremely rapid responses at all sites despite differences in soils and topography. Results suggest that piezometric response times ranged from minutes to hours. The timing, magnitude, and frequency of water table rise is dependent on precipitation intensity, slope gradient and contributing area. The water table reached the surface at the majority of sites.

The Influence of Clearcutting and Natural Forest Death on Sediment and Woody Debris Generation in Headwater Catchments of Southeast Alaska

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Landslides commonly initiate in unchannelized hollows on steep topography, deliver sediment and woody debris to headwater channels, and consequently, influence anadromous fish habitat. A prediction of the stability of hollows is estimated by a determination of the ratio of shear strength to shear stress. Parameters influencing this ratio include slope gradient, soil depth, degree of soil saturation, root cohesion, and engineering properties of the soil. The relative importance of cohesion due to root strength and soil saturation, the parameters deemed most transient and perhaps most influenced by management practices, were examined within clearcuts, naturally declining yellow-cedar forests, and "healthy" forests of cedar and spruce/hemlock. Rates, timing, and composition of landslides within the different forest types were also assessed. Landslide frequency in both cedar decline and clearcuts was approximately three times the rate found in "healthy" forests. Soil saturation was common within all the forest types. Maximum root decay was estimated to occur within 3-5 years following clearcutting and 51 years following the initiation of death in cedar decline areas. Where soils were shallow (<0.50 m), changes in root strength had a dominant role on hillslope stability. Soil saturation played a dominant role where soil depths were deeper (>0.75 m). Landslides were dominated by woody debris when originating in cedar decline and "healthy" forests, but were dominated by sediment in clearcuts.

PHYSICAL PROCESSES IN HEADWATER CHANNELS

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Headwater channels are the upslope component of a watershed's channel network and the interface between hillslopes and the stream system. They are conduits along which watershed materials are routed toward the valley floor. Inorganic materials include water, sediment, and nutrients. Organic components include large woody debris (LWD), detritus from riparian vegetation, and invertebrate organisms. Headwater channels are a continuum in form and process that includes both colluvial and alluvial components. On the upper slopes colluvial processes including debris flows, landsliding, and soil creep dominate, while lower in the channel network alluvial processes become progressively more important. A generally predictable sequence of channel types exists between the drainage divide and valley bottom. Progressing in a downslope direction, these reflect decreasing colluvial and increasing alluvial characteristics, decreasing gradient, energy, and substrate size, and increasing drainage area and discharge. Effective ecosystem management requires an understanding of headwater channel form and process in order to anticipate potential consequences of land use, which may include changes in the ground or surface water flow regime, sediment supply and transport, or the role of riparian vegetation in sediment routing. In channel networks with sufficient connectivity, debris flows can deliver material directly to valley bottom mainstems. However, in glaciated terrain with wide valley bottoms, masses of organic and inorganic sediment may be deposited at valley walls or in lower-gradient reaches of tributary channels. This sediment is delivered over time to the valley bottom stream from tributary storage sites and through channel migration that brings the mainstem into contact with deposits at valley walls. Studies are underway in southeast Alaska to quantify the effects of land use on channel stability, LWD characteristics, and sediment storage in headwater channels.

The Stochastic Behavior of Steep, Low-Order Channels and its Consequences to the Dynamic Morphology of Aquatic Habitats

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Steep, low-order channels (typically of first- and second-order), comprise approximately 80 to 90% of the cumulative channel length of drainage networks in mountainous watersheds and hence they strongly influence the behavior of lower-gradient, fish-bearing streams and rivers. Low-order channels are often highly retentive of sediment and wood which may accumulate for centuries before being transferred downstream episodically by debris flow. The release of stored sediment and wood to lower-gradient channels by debris flows is related to rainstorms, windstorms, and fires, of varying intensities and sizes. Hence, the influx of sediment (and to a lesser extent wood) to channel networks occurs as a complex series of pulses, circumscribed in space and time. The discrete nature of hillslope erosion may manifest itself in the lower-gradient portion of channel networks as waves of sediment. Sediment waves are neither regular in form or behavior and may range in size from a single gravel bar to several kilometers-long-reaches of valley floor that become inundated with sediment moving through a series of stationary point bars. The passage of a sediment wave can be associated with a transient rise in the channel bed, shallowing of pools and an increase in riffles, increased meandering and bank erosion (which may increase the recruitment of trees), reduction in particle sizes, and the creation of terraces; duration of effects may range from years to decades. As a consequence, aquatic habitats have a dynamic component, the temporal and spatial characteristics of which can be quantitatively related to the stochastic behavior of the climate, the nature of the heterogeneous topography, and the spatial pattern of the channel network.

Headwater Streams Relevant to Fish Production in Oregon

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Small streams are dominant features of mountainous watersheds in the Pacific Northwest. They can be important sources of water and large wood and storage and processing sites for nutrients. They can also be very dynamic in space and time. The quantity and quality of fish habitat and the conditions of the fish community are tightly coupled to the integrity of small streams. Management activities have up until recently ignored their ecological importance. Additionally restoration efforts have not directed much effort towards these streams. Examples of the long-term dynamics and importance of small streams and some of the management implications for them is discussed for examples in coastal Oregon.

Physical Characterization of Stream and Riparian Functions For Use in Designing Forest Management Strategies

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Managers of privately owned forest lands are increasingly encouraged to apply more flexible approaches to riparian management and stream restoration by tailoring activities to landscape and local stream conditions. These activities can have greater assurance of success in meeting biological goals if they are based on a sound understanding of the key elements of the physical environment that most directly translate into critical biological needs. While the habitat requirements of fish and other aquatic organisms are complex, the linkage between a relatively few physical processes in and near the stream and key environmental factors can be established and measured sufficiently to guide management as examples will show. This approach differs from but is compatible with managing for a particular "state" of the riparian system, such as old growth conifer. However, this "functional" approach promises to be more measurable, amenable to hypothesis testing and model-building, and likely to succeed in shorter time periods on already disturbed lands by encouraging continual improvement in conditions with adaptive management.

Trophic Links Between Headwater and Fish-Bearing Streams: Are Headwater Streams Important Sources of Energy for Anadromous Salmonid Streams in Southeast Alaska?

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This study was conducted to determine if forested headwater streams (class III and IV) are sources of food for downstream fish-bearing streams. Macroinvertebrates and organic matter transported from headwater areas to downstream habitats were sampled in 35 streams in southeast Alaska between April 1996 and May 1997, either once every two weeks or three times annually--spring, summer, and fall -- depending on site. Organic matter was sampled because it is the main food for aquatic invertebrates (detritivores) in small forested streams; macroinvertebrates (terrestrial and aquatic) were sampled because they are the main food for juvenile salmonids. Preliminary results indicate that these small streams, both ephemeral and permanent, transported organic matter and invertebrates downstream, potentially reaching fish-producing habitats (class I and II streams). This transport occurred throughout the year but was most prevalent during spring and summer. Oligochaete worms, and midge and cranefly larvae, which feed predominantly on allochthonous inputs from riparian vegetation, were most abundant. Also, in-stream and streamside woody debris helped retain organic matter and invertebrates. Because timber harvesting changes riparian vegetation cover, which in turn affects allochthonous inputs and sunlight penetration into streams, it inevitably affects trophic pathways centered around invertebrates. It appears that clearcutting may elevate aquatic production and transport in the short-term (<25 yr), but may reduce production and transport in the long-term (>25 yr). Further, some alternatives to clearcutting are expected to elevate production and transport in both short and long-terms. Additionally, these headwater areas contribute to the overall aquatic biodiversity; they support species that don't occur in larger streams in southeast Alaska.

Aquatic Vertebrates in Western Washington Headwaters With Different Natural Disturbance Regimes: Recovery Patterns and Potential Sensitivity to Human Disturbance

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We compared headwater fish and amphibian communities in the Olympic Peninsula of northwestern Washington with those of the Cascade Mountains in the vicinity of Mt. St. Helens. The two areas have different natural disturbance regimes; the Olympic Peninsula possesses a cool maritime climate with exceptionally high rainfall, frequent floods, occasional hurricane-force windstorms, and relatively infrequent fires. Near Mt. St. Helens, headwaters have a more xeric environment and are dominated by fires, droughts, occasional winter floods and windstorms, and periodic volcanic eruptions (approximately 100-200 y recurrence interval). The aquatic vertebrate faunas of the two areas typically contain several species of amphibians, one or two sculpins, and one to several species of salmonids depending on access to streams by anadromous forms. Monitoring of populations after the 1980 Mt. St. Helens eruption has facilitated one of the most complete long-term records of ecosystem recovery, but monitoring of headwater vertebrate communities on the Olympic Peninsula did not begin until 1996. Nevertheless, based on preliminary findings as well as prior research there, amphibians and fishes appeared to respond negatively to logging-related activity whereas those at Mt. St. Helens often responded positively to similar land management actions. We suggest that the nature of the natural disturbance regime has conditioned populations to different types of disturbance events. Vertebrate populations on the Olympic Peninsula appear to be rather poorly adapted to removal of riparian trees and to frequent sediment inputs. In contrast, populations near Mt. St. Helens appear well adapted to exploiting temporarily abundant food and the absence of predators created by the volcanic eruption; additionally, some of the amphibians possess remarkable dispersal abilities and recolonize vacant habitats quickly. The slow recovery of headwater vertebrates in the Olympic Peninsula after logging suggests that these communities may be more sensitive to forest management effects than similar communities near Mt. St. Helens because the types of disturbances created by logging differ from those to which they have been exposed over long time periods.

Headwater Streams in Northwestern Oregon: Channel Characterizations and Vertebrate Assemblages in Young Forests

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Stream habitats and vertebrate assemblages were characterized in headwater channels of 12 subdrainages in northwestern Oregon. Sites were located on managed federal lands from Mount Hood to Coos Bay as part of a larger experimental study of alternative riparian buffer widths with upslope forest density management. Pretreatment surveys were conducted prior to upslope thinning at 9 sites in forests of 30-50 yr. and 3 sites in 70-80 yr-old forest. Sampling methods were drawn from Hankin and Reeves methodologies and techniques developed to census both fishes and amphibians, and their habitats. Within the 12 sites, 125 headwater reaches (minimum length 180 m), >3000 amphibians (12 species) and >1100 fishes (trout, sculpin, lamprey) were sampled. Using both wet and dry season surveys, 7 channel types were identified in headwaters based on flow occurrence and continuity, spatially and seasonally. Reaches with spatially discontinuous flow (i.e. "intermittent" flow along the channel length, but not seasonally "ephemeral" with total drying) were the most frequent stream type sampled in both 30-50 and 70-80 yr old stands. Additional channel categorizations were made using stream size, gradient, substrate, and downed wood. Associations of species patterns with channel characterizations were apparent. A dominant theme emerging from the animal sampling is the spatial and temporal variability of the taxa censused. Although 15 taxa and several thousand animals were found across sites, occurrences were often low within reaches (e.g., 1-3 individuals per species) with different assemblages observed among neighboring reaches or during different site-visits to the same reach among seasons or years. This may be a legacy of past site disturbances, reflect the variable patterns of stream-use of these diverse taxa, or the variable detectability of species with the sampling methods utilized. However, consistent across reaches and sites is the use of streams and streambanks in headwaters by pond-breeding and terrestrial-obligate amphibians. As riparian buffers are installed, this association may have important conservation implications.

Session 7: Contributed Papers (population assessments)
Wednesday, November 19
10:20 - 12:00 pm
Ballroom 2

Riverine Fisheries Acoustics in Alaska, Where We've Been, Where We Are, and Where We Are Headed

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The salmon management strategy of the Alaska Department of Fish and Game (ADF&G) is to achieve specified ranges of annual escapements for each stock or run. Measures of escapement and in-season abundance estimates are key components to this strategy. Since many streams in Alaska are laden with glacial silt and too turbid for visual counting techniques an acoustical means for acquiring abundance estimates was developed for these systems. During the 1960's, the ADF&G along with Bendix Electrodynamics Corporation developed sonar techniques and equipment for counting up-migrating adult salmon. These techniques and equipment were improved upon and even now, decades later, these matured Bendix systems are still in use on many of Alaska's highly valued commercial salmon streams. Within recent years, improvements in digital and computer technology has lead to the development of new techniques and equipment for detecting and analyzing fish echoes. Currently, the State has integrated both dual and split beam sonar in river systems such as the Yukon and Kenai rivers. Since growth and expansion will continue to occur, the ADF&G is developing protocols for integrating newer hydroacoustic developments into the State's riverine sonar program. In March of 1997, the ADF&G hosted the Riverine Sonar Workshop and invited experts in the fields of hydroacoustics and fish behavior to join in discussions about the development of a new riverine sonar system and procedures for the State of Alaska. As a result of this meeting and subsequent discussions, the ADF&G will soon issue a "Request for Proposal" for development of this new system. Also, the ADF&G will be taking an active role in the development of post-processing software needed to run the statistical analysis of the system and continue to improve upon the sonar based fish abundance estimates.

Using Sonar to Index the Abundance of Chinook Salmon in the Kenai River, Alaska

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Chinook salmon returning to the Kenai River support one of the largest and most intensively managed recreational fisheries in Alaska. These chinook salmon are among the largest in the world and have sustained in excess of 100,000 angler-days of effort annually. Chinook salmon returning the Kenai River are managed as two distinct runs, an early run (May 16 - June 30) and a late run (July 1 - Early August). In 1988 the Alaska Board of Fisheries set optimum spawning escapement goals of 9,000 and 22,300 chinook salmon for the early and late runs respectively. Because of the intensity of this fishery and the pressure on these two important stocks they are managed using a variety of tools including an index of abundance estimated daily, by sonar. Dual beam sonar was used from 1987 through 1994 and split-beam sonar, which also provides direction of travel information, has been used since 1995 to estimate the number of returning chinook.

The Status of Alaska Salmon Populations Geographic Information System (SASPop GIS)

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The Alaska Department of Fish and Game (ADF&G), in conjunction with the National Marine Fisheries Service (NMFS), developed SASPop GIS for the query and mapping of ADF&G's extensive escapement and catch databases. This system provides remote access over the Internet to staff at NMFS's Auke Bay Lab, who will use the data for of research and for meeting their statutory responsibilities. ADF&G will use a similar system for research and in-season salmon management. SASPop consists of multiple components: A database of geo-referenced escapement and catch data, digital basemaps of regulatory and statistical areas, a user-friendly ArcView application that

A CONTINUOUS FOX-FORM OF THE SURPLUS PRODUCTION OBSERVATION-ERROR ESTIMATOR [1]

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A surplus production model based on the Fox surplus production function is suggested, which differs from previous such models in that the continuous rather than discrete form of the biomass dynamics equation is considered. The observation-error assumption is used to estimate the parameters of this model. The Marquardt algorithm is used as the minimization scheme for this nonlinear model. The model is applied to New Zealand rock lobster and south Atlantic albacore fisheries. The validity of the model is tested by means of Monte-Carlo simulation method and the experiment population data sets of Silliman and Gutsell (1958). The simulations show that the estimator could provide approximate unbiased parameter estimates and have some ability to resist the disturbance of stochastic errors. The model provides stable and relative accurate parameter estimates for Silliman and Gutsell data. It also shows that the model has relatively good predictive ability.

[1] **Student Paper**

Population Assessments of Arctic Grayling and Dolly Varden in Featherly Creek, 1994-96

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Featherly Creek is a small stream located in the northwest portion of Island Arm in Becharof Lake. Historically, the stream was well known as a quality fishery for Arctic grayling *(Thymallus arcticus)*, but recent reports indicate that the fishery has evolved to a Dolly Varden *(Salvelinus malma)* fishery. A study conducted in 1991-92 indicated that the Arctic grayling population in Featherly Creek exhibited the lowest abundance, smallest maximum length, and youngest maximum age of three streams sampled in the area. Hook and line sampling was used to conduct a population assessment and mark-recapture abundance estimate of both species during June-September 1994-96. Six hundred twenty-nine Arctic grayling were captured during the study. Length and age ranged from 114-530 mm and 1-11 years. Comparison with data from 1991-92 indicated that changes in the population structure may be cyclical. The mark-recapture experiment estimated that 1,162 Arctic grayling resided in the stream. The density estimate (89 fish/km) from 1994-96 was similar to the estimate from 1991-92 (91 fish/km). Individual Arctic grayling were recaptured up to four times in a season with few fish moving within the stream and even fewer moving to other streams. Two thousand five hundred eighty-five Dolly Varden were also captured during the study with lengths ranging from 161-752 mm. Ages from a subsample of Dolly Varden ranged from 2-11 years. Abundance was estimated at 4,083 for a density of 314 fish/km. Individual Dolly Varden were recaptured up to three times in a season and exhibited similar patterns of intra- and inter-stream movement as Arctic grayling. Although the population structure of Arctic grayling has fluctuated, the abundance has been stable. The population structure of Dolly Varden appears to be stable, but these data are limited. With the light fishing pressure, these populations will support continued angling at current levels, and there appear to be no immediate threats to either population. However, the populations in Featherly Creek are only one of many in the Becharof Lake drainage. Studies of these two species should be expanded to other streams in the system to gain a broader understanding and to provide better information for management.

Session 7: An Introduction to the Public Trust Doctrine and its Relationships to the Alaska Statehood Act, Alaska National Interest lands Conservation Act (ANILCA)and Alaska Native Claims Settlement Act (ANCSA): A Panel Discussion

Wendesday, November 19

1:00 - 3:00 pm

Ballroom 2

An Introduction to the Public Trust Doctrine and its Relationships to Alaska Statehood Act, Alaska National Interest Lands Conservation Act (ANILCA), and Alaska Native Claims Settlement Act (ANCSA): A Panel Discussion

Christopher Estes

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The Public Trust Doctrine (PTD) has been referred to as "a sleeping giant" because it may prove to be one of the most powerful tools for protecting fish and wildlife habitat and public access to navigable waterways, especially when other mechanisms fail It is based on common law (judge made law) and applicable to all 50 states. Application of the Public Trust Doctrine in Alaska remains in its infancy. The PTD panel will provide an introduction to the applications of the PTD in Alaska and its relationships to the Alaska Statehood Act of 1958, Alaska Native Claims Settlement Act (ANCSA) of 1971 and Alaska National Interest Lands Conservation Act (ANILCA) of 1980. Among the PTD applications to be explored and addressed will be fish and wildlife habitat protection, recreational opportunities, access to navigable waterways and their tributaries, and allocation of fish and wildlife resources.

Panel:

Richard Roos-Collins

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Gregory Cook

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Jude Pate

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Session 8: Salmon Management
Wednesday, November 19
1:00 - 3:20 pm
Ballroom 1

Management and Assessment of Transboundary Taku and Stikine River Sockeye Salmon Stocks

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Management of transboundary river sockeye salmon has evolved dramatically in the last 20 years. These fish have supported drift gillnet fisheries in southeast Alaska since the 1880's. Canada instituted new commercial fisheries in the Taku and Stikine Rivers in the late 1970's. Formal harvest sharing of transboundary sockeye salmon runs with Canada began in 1985 when the Pacific Salmon Treaty was signed. Joint U.S./Canada enhancement of Taku and Stikine River sockeye runs began in 1989. Rapid improvements in management and stock assessment programs have been necessary to ensure escapement goals and harvest sharing guidelines are met. In-season escapement estimation and stock identification programs have provided data for effective management of Taku stocks. Management of Stikine River sockeye has been aided by development of a model that uses fishery performance and stock identification data to predict run size during the season. Further refinement of management and stock assessment programs will be necessary as enhanced returns of transboundary and domestic sockeye salmon increase.

Historical Abundance and Management of Coho Salmon in Southeast Alaska

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The history of Southeast Alaska coho salmon fisheries from 1907-1997 is characterized by distinct periods of high and low average abundance combined with increasing intensity of utilization and management. Historical fishery performance suggests a stable trend of high abundance from at least as early as 1907 until 1951 followed by a rapid transition in 1952 to 1956 to much lower average abundance. Wild production remained at only one-third to one-half of the 1907-1951 average for a 26-year period from 1956 to 1981. Production began to recover in the 1980's while recent peak wild-stock abundance in the early 1990's reached a level approaching the first half of the century. This recent period of recovery in wild-stock abundance coincided with a commensurate increase in marine survival rates for tagged smolts. Exploitation pressure has increased dramatically over the past 90 years from average rates of less than 30% before 1940 to about 70% in the past decade. Although targeting of coho salmon by commercial trollers was documented as early as 1908, widespread directed trolling for this species over much of the summer season did not occur until the 1940's when coho salmon began to equal or exceed chinook in importance to the troll fishery. Net and trap fisheries during the period of federal management before 1960 were for the most part less intensive in harvesting coho than current fisheries. These early fisheries were managed passively for the most part using preseason established closed periods of extensive duration during the coho migration. In-season management adjustments were rare. Following statehood, active in-season management for coho was limited largely to set and drift gillnet fisheries until the late-1970's when the troll fishery came under increasing regulation. Intensification of the fisheries and the addition of hatchery-produced fish since the mid-1970's has brought about more complex management and increased regulation. Development of wild indicator stocks with complete run reconstructions and a more systematic escapement survey system has aided greatly in the establishment and achievement of management goals for these intensive fisheries. Most of the harvest occurs well in advance of the time when escapement to the streams can be estimated. Since 1981, dockside interviews to determine fishery performance in the troll fishery have become an essential management tool for the timely estimation of abundance. While fishery performance remains the central method of gauging overall abundance during the fishing season, new sources of information have aided in the accurate inseason interpretation of abundance indicators. Tagging of wild and hatchery stocks combined by rapid tag processing, has made it possible to estimate fishery performance for wild stocks separately from hatchery production and to accurately project survival and abundance of specific stock groups well in advance of their segregation in terminal areas. The composition of tag recoveries from specific fishing areas over the season has aided in determining run timing, distribution and relative abundance of specific stock groups in the fishery. The relationship between pink salmon and coho returns from specific areas provides an additional source of information for inseason assessment of coho abundance. All of these sources of information were closely reviewed and contributed to accurate decision making during the 1997 fishing season.

Management of the Commercial Troll Fishery in Southeast Alaska

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The commercial troll fishery in Southeast Alaska dates to the turn of the century, and plays a vital role to the economies of such small towns as Elfin Cove, Pelican, Hoonah, Angoon, Port Alexander, Point Baker, and Point Protection. Trollers use hook and line to catch salmon one at a time. Chinook and coho salmon are individually cleaned and iced on board soon after capture, producing a premium wild seafood product. Two types of gear, hand troll and power troll, participate under limited entry, with recent effort at historic lows. The chinook harvest consists of stocks from Alaska, Canada, Washington and Oregon. The chinook catch is regulated under quota agreement through the Pacific Salmon Commission (PSC). Allocation of the PSC quota among user groups originates from the Alaska Board of Fisheries. Trolling for chinook salmon occurs during most months each year, with seasonal time and area restrictions. The coho salmon troll fishery occurs from June 15 through Sept. 20, and consists primarily of Southeast Alaska stocks. The troll coho catch is managed inseason using CPUE, catch, coded-wire tag and escapement data to achieve escapement and allocation goals. Coho catches in recent years have been at historic highs. In addition to coho and chinook salmon, trollers also harvest chum, pink and sockeye salmon, as well as lingcod and halibut.

Purse Seine Fishery Management in Southeast Alaska

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The commercial purse seine fishery in Southeast Alaska is primarily managed to target on domestic pink salmon returns. The purse seine fishery accounts for between 70% to 90% of the total commercial salmon harvest in Southeast Alaska. Pink salmon are the primary species targeted by the seine fleet and management actions are therefore based primarily on inseason assessment of the abundance of pink salmon. Annual harvest levels since Alaskan statehood has averaged over 20 million pink salmon. The average annual harvest during the ten-year period 1987 through 1996 has been 40 million pink salmon with a peak harvest of 62 million in 1996. The fishing season starts in late June and ends in early September, on average 25 days of purse seine fishing is allowed. The Southeast Region contains over 2,500 salmon streams with various production levels. A distinct entry pattern is exhibited by pink salmon returning to the northern and southern districts of Southeast Alaska. The purse seine fishery is under a limited entry system, which allows no more than 395 boats to participate. Management of the Southeast salmon fisheries is accomplished via coordination of the area management biologists and a regional management biologist. Four area management biologists are responsible for the daily management of the purse seine fishery. Inseason assessment of pink salmon run strengths are determined primarily from spawning escapement information obtained from aerial surveys, fishery performance data, run timing analysis, run size projections, Pacific Salmon Treaty obligations, and fish quality. Successful pink salmon management in Southeast Alaska has incorporated harvesting salmon away from terminal areas, aggressively harvesting fish in the early portion of the run when males are predominate, achievement of good distribution of escapement, and the ability to quickly react to various inseason run strengths.

Projected and Actual Alaska Pacific Salmon Catch Statistics From 1970 to 1997, With a Focus on the 1997 Season

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For the first time since the projected harvest series began in 1970, statewide chum, pink, coho, and sockeye commercial salmon catches were below the Alaska Department of Fish and Game projected levels. While statewide catch levels were expected to decrease, they decreased more sharply than expected in 1997. Local salmon biologists prepare harvest projections or harvest outlooks for all areas. Projections are based on extensive information, when available; otherwise local biologists use average historical catches and local knowledge of recent events to develop these outlooks. While these projections are not an exact science, they have tended to follow the general trend of the catch statistics for the five major commercially harvested salmon species in Alaskan waters. We show the historical context and the spatial distribution of the commercial catch and discrepancy with the projection for the 1997 harvest. The discrepancy was greater in the west and greater for coho salmon than any other species.

Appropriate Scale of Salmon Management Units for Maintaining Sustainable Abundance and Biodiversity

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Interfacing the harvest management system with salmon population structure and biological diversity is one of the most difficult challenges precluding maintenance of sustainable salmon fisheries and recovery of depleted stocks. Recent genotypic and phenotypic evidence from our studies, as well as others, supports the hypothesis that intraspecific spawning aggregates in relatively close proximity are sometimes distinct populations. When this is the case, it can be conjectured that, when these populations have unique and different productivity rates, common harvest rates estimated for the more productive stocks will lead to overharvest of the less productive stocks. While this has been fairly well understood on a relatively broad scale, the new data demonstrates the importance of reducing the scale of management units because loss of smaller and/or less productive stocks continues to contribute to declining abundance and biodiversity in many areas. Recommendations are made to protect and sustain abundance and biodiversity by developing new and innovative harvest management strategies and technology.

THE PACIFIC SALMON TREATY AND COASTWIDE MANAGEMENT OF CHINOOK SALMON

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The chinook salmon fisheries of the Pacific Northwest Coast are managed under fishing regimes agreed to by the United States and Canada through negotiations of the Pacific Salmon Commission (PSC). Chinook salmon undergo varying coastal migrations resulting in different aggregates or stock groups being harvested in the different ocean fisheries. These stock aggregates have either increasing or decreasing trends in abundance that reflect the health of the component stocks. Upon signing the Pacific Salmon Treaty (PST) in 1985, Alaska agreed to a reduction in pre-treaty harvests of 21% and a catch ceiling (set quota) of 263,000 far-north migrating chinook for the Southeast Alaska (SEAK) fishery. Three similar ceilinged fisheries were also established in Canada. Catch ceilings were established as part of a broader program to rebuild coastwide chinook stocks by 1998. By the early 1990's, the parties to the PST recognized that ceiling management did not adequately respond to fluctuations in chinook abundance. In 1996, the U.S. signed a letter of agreement for the SEAK chinook fishery that replaced a set quota with an abundance-based fishing regime. This regime featured a 30-45% reduction in harvest rates relative to pre-treaty years with higher harvest rates when abundance is high compared to lower rates when abundance drops. The agreement recognizes the need to conserve the stocks at low abundance, and allocates an increased share of the harvestable surplus to SEAK when abundance increases.

Session 9: Contributed Papers (stream habitat)
Thursday, November 20
8:00 - 10:00 am
Ballroom 1

Invertebrates Colonizing Anadromous Salmonid Carcasses in Southeastern Alaskan Freshwater Systems

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Large numbers of anadromous salmonid carcasses are a feature of many southeastern Alaskan freshwater systems. However, there are few studies of salmon carcass decomposition, or the invertebrates that are likely to rapidly colonize the carcass during this process. Recently, the aquatic macroinvertebrates colonizing the carcasses of pink salmon (*Oncorhynchus gorbuscha*) were studied in the vicinity of Margarita Bay, near Ketchikan, southeastern Alaska, using artificial stream channels and natural stream experiments. The macroinvertebrate fauna was composed of immatures from several aquatic insect groups, including chironomid midges (Diptera: Chironomidae), stoneflies (Plecoptera), mayflies (Ephemeroptera) and caddisflies (Trichoptera). These taxa have been observed in other studies of fish carcasses, but chironomids were far more abundant, were present in areas other than the carcasses surface, and persisted for longer on carcasses than has previously been indicated. The presence of these invertebrates, especially chironomids, has important consequences for fisheries management as they represent an important food source for higher trophic levels, such as juvenile salmonids. Invertebrates may also be assisting in carcass breakdown, especially those chironomids that burrow into the carcass tissue. Efficient carcass breakdown, and subsequent release of nutrients and carbon, will ultimately affect freshwater productivity, and the ability of these systems to sustain juvenile salmonid populations.

Salmon Carcasses Increase Stream Macroinvertebrate Abundance in Alaska

John Hudson, Mark S. Wipfli, and John Caouette

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This study was conducted to determine if salmon carcasses (from spawning adults) influenced benthic macroinvertebrate abundance in streams. Experiments took place in natural and outdoor experimental streams in southeastern Alaska from August into November, 1996. Thirty-six linear once-through 18-cm-wide x 240-cm-long experimental streams were situated along, and received water and drifting invertebrates from, a second order stream. They contained pool and riffle habitats, and mineral substrata from the natural stream. Two treatments (salmon carcass, control) were replicated three times across six time periods (over three months), in a randomized incomplete block design with a 2 x 6 factorial treatment structure. In addition, two sites were sampled for macroinvertebrates in a natural stream (Margaret Creek), one that had about 75,000 adult salmon migrate past during 1996, the other higher in the watershed upstream of spawning salmon. Carcasses lost 60% of their original mass over 90 days in the experimental streams. Macroinvertebrate densities were significantly higher in carcass-enriched areas, in both experimental and natural streams, reaching total densities up to eight times greater than areas not enriched. Densities remained higher for most taxa, including Chironomidae (the most abundant taxa), *Baetis*, *Cinygmula*, **and** *Zapada*, **throughout the 3-month experiment in the carcass-enriched streams. These results showed that salmon carcasses increased benthic macroinvertebrate abundance, suggesting that salmon escapements may elevate freshwater productivity. This positive feedback mechanism may be crucial for sustaining long-term salmonid population levels and freshwater ecosystem productivity.**

The Effects of Urbanization on Salmonid Abundance and Life History Strategy in Duck Creek, a Small Coastal Stream

J. Mitchell Lorenz and K V. Koski
NMFS Auke Bay Laboratory
Auke Bay, AK

Fish abundance in Duck Creek has declined drastically since the 1960s. Spawning runs of up to 10,000 chum salmon and 500 coho have been reported in Duck Creek, whereas no native chum and less than 20 coho now return. Baseline data on anadromous fish populations and habitat is being collected to identify watershed problems and specific factors limiting salmonid abundance in Duck Creek and to develop recommendations for appropriate restoration activities and habitat protection. Studies have focused on the effects of water availability, water quality, and channel morphology on anadromous fish abundance and spawning, rearing, and migration habitats. Dredging of stream gravel, accumulation of fine sediment, and periodic stream drying has nearly eliminated chum salmon habitat and has reduced coho spawning habitat in the basin. Habitat surveys show that less than 6% of the stream bottom is gravel that could be used by spawning salmonids, and much of that occurs in reaches that are dry from early summer through early fall. Over 90% of the stream bottom is covered with sand, silt, or organic muck. Diversion of water coming from hillslope areas has also eliminated sources of new gravel. From 1993 through 1997, juvenile coho salmon abundance, size, age, and distribution were estimated throughout the Duck Creek basin and coho smolt were counted as they migrated to sea. Mean density of juvenile coho at Duck Creek sites has been less than about 30% of that at the control site, Jordan Creek. Winter survival of coho salmon was generally lower than that at the control site because many of the ponds used for overwintering stratify due to lack of flow, causing dissolved oxygen to drop to lethal levels. Lack of streamflow because of water percolating into the streambed also affects anadromous fish that rear in the basin by limiting availability and access to habitat. Lack of water in spring in some reaches that eventually dried up have trapped and killed up to 70% of the coho smolt population. Coded wire tagging indicates that ocean survival of coho smolt from Duck Creek is about half of that in the control stream. Salmonids rearing in Duck Creek have a 15% higher incidence of observable ectoparasites and scoliosis is present in over 1.5% of the fish. Studies indicate that there is no natural production of coho salmon fry from spawning because of the high fine sediment content and the low oxygen levels and that probably all the coho production in the basin is a result of fish immigrating into Duck Creek in the fall from the Mendenhall River wetlands and estuary. Cutthroat trout, however, have been successful at spawning and producing fry in certain reaches of Duck Creek.

Restoration of Water Quality and Anadromous Fish Habitat in Duck Creek: an Impaired Urban Stream in Juneau Alaska

K V. Koski and J. Mitchell Lorenz
NMFS Auke Bay Laboratory
Auke Bay, AK

Scientists in Juneau are involved in a community-based effort to restore water quality and anadromous fish habitat in Duck Creek in Juneau, Alaska. The project is intended to demonstrate to the community the benefits of restoration and the importance of aquatic habitat protection in maintaining healthy aquatic ecosystems. Duck Creek is one of 54 surface water bodies in Alaska that is impaired by urban runoff from nonpoint source pollutants including turbidity, heavy metals, hydrocarbons, iron flocs, and excess nutrients. Duck Creek is a small coastal stream (5 km long) that originates from a small spring and drains runoff from the Mendenhall Valley, a relatively high density residential and business area. The stream has remnant wild populations of anadromous salmonids including pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), and coho (*O. kisutch*) salmon, cutthroat trout (*O. clarki*), and Dolly Varden char (*Salvelinus malma*). Historically, there were runs of nearly 10,000 chum salmon in Duck Creek. In the late 1960s, the coho run numbered about 500 fish. Currently, the chum run is extinct, the coho run is less than 20 fish, and the once excellent trout fishing is closed. The anadromous fish habitat has suffered significantly from physical habitat alteration, poor water quality, loss of riparian vegetation, and loss of estuarine wetlands as a result of water diversion, sedimentation of pools and riffles, channelization, road building and stream crossings, airport construction, and littering. A community-based forum, the Duck Creek Advisory Group (DCAG), was formed to seek and coordinate sources of funding, expertise, and labor to restore Duck Creek. DCAG is composed of representatives from state and federal agencies, public organizations, conservation groups, school and youth groups, and local homeowners. A comprehensive management plan is being drafted that will identify problems and outline potential management and restoration strategies for the Duck Creek watershed. The basic approach to restoring Duck Creek has four phases that will be implemented sequentially over several years: (1) establish baselines of ambient conditions; (2) implement pollution abatement activities and BMP's; (3) implement restoration activities to enhance recovery of water quality and fish habitat; and (4) evaluate effectiveness of restoration and pollution abatement activities.

Seasonal Movements and Distribution of Juvenile Steelhead and Coho Salmon in a Southeastern Alaska Drainage Basin

Robert Bramblett[1], Brenda E. Wright[2], M. D. Bryant[2], and R. White[1]

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The early life history of steelhead in southeast Alaska is poorly understood. Earlier findings in the Staney Creek basin on Prince of Wales Island suggested that low-order tributaries were important winter habitat. We identified periods of immigration/emigration and residence of juvenile steelhead and coho salmon in two low-order tributaries by intensive year-round monitoring with weirs. Distribution in the Staney Creek basin was examined with spring, summer, and fall surveys at ten tributaries and ten reaches of Staney Creek. Steelhead exhibited pronounced seasonal shifts in habitat use. In summer, juvenile steelhead were common in reaches of main Staney Creek but rare in low-order tributaries. In October, large numbers of steelhead, ages 0-4, entered low-order tributaries although some steelhead remained in Staney Creek. Juvenile steelhead remained in low-order tributaries until April or May when they emigrated to the mainstem of Staney Creek. In contrast, juvenile coho salmon remained common in low-order tributaries in summer, although many juvenile coho salmon exhibited similar movement patterns to juvenile steelhead. Because low-order tributaries are important habitat for juvenile steelhead and coho salmon, they must be protected from potential impacts such as timber harvest and road building, and surveys for juvenile steelhead must be appropriately scheduled.

Session 10: Shellfish Research and Management
Thursday, November 20
9:00 - 11:00 am
Ballroom 2

Difficulties in Determining Sustained Yields for Developing Red Sea Urchin Fishery in Southeastern Alaska

Doug Woodby

Alaska Department of Fish and Game

Commercial harvests of red sea urchins in Southeast Alaska are limited to putatively conservative quotas based on a simplified application of a surplus production model. Research results and fishery experience from other pacific coast jurisdictions indicate several features of urchin population biology, which may warrant changes in management. These features include growth rates that may be far slower than assumed, response to harvests that are not predictably density-dependent, and depth dependence in productivity. A research program to address sustainability of red urchins in Southeastern Alaska will be presented based on a coast-wide review of research at a workshop in Ketchikan in September, 1997.

Hatchery Production of Littleneck Clams and Purple Hinge Rock Scallops in Alaska

Jon Agosti

Qutekcak Shellfish Hatchery

In September of 1993, the Qutekcak Native Tribe of Seward opened Alaska's first, pilot shellfish hatchery in an IMS laboratory. They had recently procured funds from the State legislature for the construction of a commercial scale shellfish hatchery in the Exxon Valdez oil spill region. The initial goals of the hatchery is to meet the long sought industry need of a more reliable, instate source of Pacific oyster seed and to provide seed for new species of commercially valuable bivalves to Alaskan sea farms. Hatchery staff training and the development of culture techniques for Littleneck clams, Protothaca staminea, Pacific oysters Crassostrea gigas, and Purple Hinge Rock scallops, Crassadoma gigantea, have proceeded in preparation for large scale production in the new $2.1 million hatchery constructed adjacent to our pilot hatchery. The presentation is a summary of the results these research and development activities.

Littleneck Clam Hatchery Seed Culture and Growout Studies in Southcentral Alaska

Jeff Hetrick

Chugak Regional Resources Commission

The Exxon Valdez Oil Spill Trustee Council is funding a project to enhance clam populations near Native villages in Prince William Sound and lower Cook Inlet for subsistence purposes. The major facet of this project is developing hatchery seed culture techniques and studying growout characteristics of the littleneck clam (Protothecа staminea). This presentation will review the results of preliminary population surveys of littleneck clams, seed culture, and initial results from growout studies.

Larva Sampling and Setting Studies for the Pink and Spiny Scallop in Sitka Sound, Alaska

Raymond RaLonde

Aquaculture Specialist
University of Alaska Fairbanks
Marine Advisory Program

Alaska has 56 permitted aquatic farms utilizing 219 acres of tidelands for shellfish culture. Currently, Alaskan aquatic farmers can purchase only Pacific oyster (Crassostrea gigas) seed from shellfish hatcheries in Washington to stock their farms. A major problem now facing the Alaska shellfish culture industry is the need to diversify into farming of other shellfish species. Of the species feasible for farming, scallop is a preferred option for the majority of aquatic farmers. The main factor constraining scallop culture is the inability to acquire seed to stock the farms. Initial attempts in the mid-1980s to capture seed of weathervane scallop (Patinopectin caurinus) were not successful, however, capture of seed from the smaller species of pink (Chlamys rubida) and spiny (Chlamys hastata) scallops was highly successful. This presentation will summarize the results of scallop larva sampling and seed collection studies that occur in Sitka Sound from 1986-88.

The Geoduck Fishery, Enhancement and Aquaculture Efforts in Puget Sound, Washington

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Geoducks represent an important resource and valuable fishery in both Washington State and British Columbia (B.C). In each of Washington and B.C. the annual total allowable catch is about 3 million pounds. At a current ex-vessel value of $8 to $9 per pound, the combined Washington/BC fishery represents a value to the fishermen of about $50 million. In the early 1980's the Washington Department of Fish and Wildlife (ex Washington Department of Fisheries) developed hatchery and nursery methods for geoduck clams. By the late 1980's this hatchery was producing up to 7 million seed per year. Unfortunately all plants of this early seed failed due to low survivorship owing to predation. In the early 1990's WDFW biologists developed predator exclusion methods that resulted in higher survival - 30 to 40 percent. WDFW is presently employing these methods to enhance the geoduck resource for recreational harvest on public tidelands. By 1993 interested private sector parties started adapting geoduck hatchery and planting techniques. In B.C. there are presently two entities: one interested in farming and one in enhancement for the existing fishery. To date, all work in B.C. is subtidal. Seed comes from the Island Scallops shellfish hatchery where production was 2 million seed in 1997. In Washington several endeavors to culture geoducks are ongoing including non-Indian commercial and tribal. Using various hatcheries, the combined production of the Washington groups exceeded 3 million geoduck seed in 1997. In Washington state all culture work is in the intertidal. In both Washington and B. C. there is strong interest by other groups to begin geoduck culture. Effect on the market of cultured geoduck may be a concern. At a conservative 20 percent survival, combined Washington and B.C. 1997 seed production would yield 1 million geoducks at harvest. Average harvest weight of a 4 to 6 year old geoduck is 2 pounds. Harvest of these animals would represent a 33 percent of present harvest levels.

Session 11: Stream Habitat Surveys
Thursday, November 20
10:20 am - 12:00 pm
Ballroom 1

The Effectiveness of Riparian Buffer Zones to Protect Salmonid Habitat in Alaska Coastal Streams

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The 1990 Alaska Forest Resources and Practices Act requires that riparian buffer zones be retained along streams with anadromous salmonids to prevent significant adverse effects of timber harvest activities on fish habitat and water quality. To determine the effectiveness of this new regulation Sealaska and the Alaska Forest Association are conducting a fish habitat and riparian buffer monitoring program in 31 basins that are located in the coastal regions of Southeast Alaska and the Kenai Peninsula. Stream basins with no timber harvest and with varying levels of harvest were surveyed from 1992 to 1997. Data collection was focused on measuring fish habitat composition, large woody debris (LWD) recruitment, and riparian stand composition. On average 95% and 5% of the LWD recruited from undisturbed riparian zones is derived from 0 to 10 m and 10 to 20 m from the stream bank, respectively in flood plain (FP) and moderate gradient mixed control (MM) channel types. Approximately, 62% and 31% of the potentially recruitable LWD (functional size) in undisturbed riparian zones occurs at 0 to 10 m and 10 to 20 m from the stream. The amount of blowdown is highly variable among logged and unlogged streams (ranging from 2 % to 26 % of the standing timber). Timber blowdown following logging can increase the proportion of LWD that is recruited from > 10 m away from the stream bank. Annual recruitment of LWD ranged from 0 to 38 pieces/km at the pre-harvest basins and from 0 to 104 pieces/km at post-harvest basins. Increases in the LWD recruitment rate at some post-harvest basins cause a predictable response in pool habitat. At basins with a deformable stream bed (e.g., MM and FP channel types) the pool spacing varied according to the LWD load. At an LWD loading below 300 pieces/km, pool spacing ranged from 4 to 10 cw/pool, but at higher LWD loadings the pool spacing only ranged from 1.5 to 4 cw/pool. Based on the relationship between channel type, pool habitat, LWD loading, and potential LWD supply; and, on observations of habitat responses to changes in LWD loading, the new buffer regulation is effective in maintaining pool habitat in the short-term. In the long term the buffer regulations will maintain an adequate supply of LWD when channel and wood loading characteristics are incorporated in the buffer design.

Session 12: How Many Fish Are There?
Problems Estimating the Abundance of Fish Populations
Thursday, November 20
1:00 - 3:00 pm
Ballroom 1

Observer Bias in Escapement Estimation

Edgar L. Jones III

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Observer bias in aerial and foot survey estimates of spawning pink salmon (Oncorhynchus gorbuscha) and coho salmon (O. kisutch) was determined for Alaska Department of Fish and Game survey counters. Chaik Bay Creek on southern Admiralty Island was used as the test site for the pink salmon study, 1992-1994. Steep Creek, a tributary of Mendenhall Lake near Juneau, was used as the test site for the coho salmon study in 1996. Mark-recapture experiments were used to calculate the abundance of fish in each study which was then used to test for accuracy and precision of aerial and foot survey estimates made by observers. A laboratory study was also performed using a computer simulation consisting of four object types at predetermined numbers. Results from each study indicate that observers tend to undercount the actual number.

The Trouble with Tagging

Dana Schmidt, Pat Shields, Gary Kyle, and Stan Carlson

Adult sockeye salmon were captured and tagged using four different techniques while entering Larson Lake (located in the Upper Susitna River drainage near Talkeetna) to evaluate potential biases in mark-recapture studies. The planned constant tagging deployment rate at the weir was not maintained because of a mortality event related to elevated water temperatures, which reached 26° C. Because tags were individually numbered and multiple-color codes were deployed, temporal strata were used to evaluate mark recovery rates over time within the lake. Tag recoveries were obtained by beach seining shoal spawning areas for about 6 weeks after marking was completed. As with other studies, tag loss was a significant factor with spaghetti type tags and Hallprint dart tags but was higher with jaw tags. However, even when corrections were applied for tag loss and temporal stratification to account for variation in tagging rates, tag recovery rates declined over time. Because shoal spawning in the lake precludes significant selective predation by bears and birds and tag color did not effect recovery rates, we hypothesize that the decline in tagging rates over time is caused by handling-induced reduction in stream life. This reduction in stream life may be related to increased pre-spawning mortality or stress related changes in behavior, which decreased the time available for recapture. Jaw tagging may have been an important factor in pre-spawn mortality because carcasses examined with spaghetti and jaw tags had a higher proportion of jaw tags than were deployed. These findings suggest that spawning ground surveys of marked sockeye salmon may result in an uncorrectable bias causing over-estimation of the escapement.

Estimating Fish Populations in Streams: Removal Methods Using Minnow Traps

M. D. Bryant

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Mark-recapture experiments in streams are often subject to unknown immigration or emigration between the mark sample and recapture sample. While juvenile coho salmon appear to be recaptured at expected rates, other species such as cutthroat trout and steelhead are not easily recaptured and appear to be "trap shy" after handling. Electrofishing in the low conductivity water of most streams in southeast is not effective and often results in injury to fish; therefore, it can not be used effectively to estimate fish numbers by removal. Passive methods, such as minnow traps, are not generally used to estimate fish numbers by removal. We used multiple sets of minnow traps to estimate fish numbers in selected sections of various size streams. Using 3 to 4 sequential sets of 90 minutes, we were able to estimate population sizes of coho salmon fry and juveniles, Dolly Varden, cutthroat trout, and juvenile steelhead. In most instances, confidence intervals were less than 40% of the estimate, but in other estimates were not reliable and violations of one or more assumptions in the model may have occurred. Coho salmon fry tended to show the greatest variation and cutthroat/steelhead showed the least variation. Samples with 4 sequential sets provided the best results. The method appears to provide more reliable estimates for steelhead and cutthroat trout than mark-recapture and population estimates can be completed during one visit to a sample site.

Discrepancies Between In-season and Multiple-Year Abundance Estimates for Resident Cutthroat Trout Populations in Several Southeast Alaska Lakes

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The ability to accurately estimate cutthroat trout abundance in lakes using a 2 event, in-season mark-recapture estimator has played an important role in the Alaska Department of Fish and Game, Division of Sport Fish's Southeast Alaska cutthroat trout stock assessment and management program. Recently completed three- and four-year Jolly-Seber experiments at Turner, Baranof, Florence, and Eva Lakes have provided abundance estimates that are 57% to 70% of estimates generated with in-season Petersen and Darroch models. One explanation for this discrepancy is that the catchability of marked fish decreases for a short period after capture, handling, and tagging. A recent experiment at McKinney Lake in Southeast Alaska suggests that if this hypothesis is true, the lowered catchability is associated with an overall stress of catching, handling, and tagging, and not the method of capture (trap avoidance) or the type of tag applied (Anchor T-bar or Visual Implant). Other explanations for the discrepancies between abundance estimates will be discussed.

Problems Associated with Jolly-Seber Estimates of Outmigrating Chinook Salmon in the Chena River, Alaska

Lambert, T.M. and J. B. Reynolds

Cooperative Fish and Wildlife Research Unit
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Fairbanks, Alaska

During studies in 1995-96 to evaluate the effects of the Chena River Lakes Flood Control Project on outmigrating chinook salmon (Oncorhynchus tshawytscha), we demonstrated the usefulness of the Jolly-Seber model to estimate abundance of the out-migration. However, we became concerned about the violation of certain assumptions for the Jolly-Seber method, and in 1997 conducted experiments to test for these assumptions. Cause for suspicion was that significant numbers of chinook were caught at night only, either because migration occurred only at night (no violation) or that day migration occurred but was masked by trap avoidance. Our goal was to test for heterogeneity of capture probability as affected by differences, if any, in day- versus night-migrating fish. Heterogeneity would create negative bias in the abundance estimates. An inclined plane trap, fished surface to bottom, was used to capture outmigrating chinook during May-June 1997. Fish caught during the day were fin-clipped differently from night-caught fish. Day- and night-marked fish were released at various times for possible recapture at a screw trap 8 km downstream. We found that chinook migrated during the day, but apparently at lower rates than at night. Of 670 day-marked fish released, 18 (3.1%) were recaptured; only 24 of 1,912 night-marked fish (0.9%) were recaptured. A one-tailed Z-test indicated a significant difference ($P<0.05$) between these two recapture rates, confirming that heterogeneity in capture probability existed during our previous work. We concluded that our abundance estimates were too low.

The Lack of Randomness in Mark-Recapture Experiments

David R. Bernard

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Most mark-recapture experiments to estimate fish abundance are based on statistical models of random sampling. In reality, capturing fish is never the result of a random process, but is a function of concentrating sampling effort at particular times and locations. Concentrating sampling effort may increase sample sizes in experiments, but is often at odds with the distribution and behavior of the fish population being studied. Non-random sampling and subsequently bias can arise from how, where, and when fish are captured and how captured fish are handled. Diurnal differences in migratory rates of coho salmon smolts, seasonal differences in onshore-offshore mixing of lacustrine rainbow trout, daily changes in habitat preferences of lacustrine northern pike, and adult chinook salmon that "sulk" when released are some examples of fish behavior and distribution that can bias estimates when sampling is concentrated. Getting accurate abundance estimates from non-random sampling depends on using knowledge of fish behavior and distribution to tailor sampling for specific mark-recapture experiments.

MINUTES FROM THE 1996 ANNUAL AFS ALASKA CHAPTER
BUSINESS MEETING
NOVEMBER 20, 1996

Quorum was determined by a show of hands, 28 members of the Alaska Chapter were present. Meeting called to order at about 1540.

The Executive committee of the Alaska Chapter was introduced: Kate Wedemeyer, Past-president; Dana Schmidt, President; Peggy Merritt, President-Elect; Buck Bryant, Vice-president; and Brenda Wright, Secretary-Treasurer. Past-president's present at the meeting were also introduced

A motion was made by Joe Webb to approve the minutes from the 1995 Chapter business meeting. Dennis Tol seconded. The minutes were approved by voice vote.

Treasurer's Report: Secretary-Treasurer Wright reported a balance of $66,178.60 divided among the five chapter accounts: Alaska Chapter account = $23,259.84; Certificate of Deposit = $11,728.77, Fishes of Alaska Key = $3,326.09, Raffle account = $2,326.42.

Installation of New Officers: President Schmidt introduced the newly elected officers: Cindy Hartmann is Vice-President and Allen Bingham is Secretary-Treasurer.

COMMITTEE REPORTS:

Membership: Committee chair Buck Bryant reported that the total membership for 1996 was 435, down 26 from the 1995 total of 461. Of the 1996 total; there were 334 active, 53 life, 9 retired, and 39 student members. Over 60 members had not renewed from the previous year. Letters have been sent to more than 20 of these; other have been contacted by telephone.

Arctic Sub-Unit: President Klaus Wuttig reported on the subunit activities. Activities of the student unit since the last Alaska Chapter AFS have consisted of four meetings and our fund raising projects. The first meeting was attending the 1995 Alaska Chapter AFS meeting in Wasilla. In April of 1996, the spring social and officer elections were held. At the time of the meeting the student unit consisted of three active members and each was assigned to a position. Klaus Wuttig was elected president, Mike Daigneault vice president, and Ted Lambert treasurer. During the fall of 1996 we have held two meetings and plan on attending the Alaska

Chapter meeting in Fairbanks. In October, the annual fall potluck and social was held featuring a video of "hook and line sampling for sheefish on the Kobuk River". From this meeting the student unit recruited five new members raising our total to seven members. In November, the student unit presented a guest speaker, Dr. Brian Himmelbloom from the Fishery Industrial Technology Center in Kodiak, Alaska. All AFS members are urged to buy cookbooks and t-shirts to help finance the subunit activities.

Discussion at the business meeting centered around the fact that currently the Student Subunit consisted entirely of students from the Fairbanks campus and that at previous meetings it was resolved that voting privileges in ExComm of the Chapter were dependent on statewide status.

Resolutions and Bylaws: Committee chair Dennis Tol reported that no resolutions were submitted to the committee this past year. Dennis suggested that resolutions should be dropped from this committee, which would require a Bylaws change.

Cultural Diversity: Committee chair Judy Gordon: Western Division of the AFS has pledged $1,000 to award fund to be matched by Excom matching funds. Thanks to donators LGL Engineering and Prince William Sound Science Center have both donated to the travel funds. The committee report is posted on the Alaska Chapter Internet homepage. Judy Gordon reported that she was stepping down as committee chair.

Internet Homepage Chair Norma Jean Sands: Update on page and contents. Procedures Manual, bylaws, abstracts from annual meeting. Please send submittals to Norma for items to be included.

Awards Committee: Committee chair Susi Hayes announced recipient of the meritorious service award as Lyman Thorsteinson for his continuing work on the Fish Key of Alaska project, especially for his efforts in obtaining a $150,000 grant from NBS for editorial work on the Key. Lyman was unable to attend, Bill Wilson accepted the award on Lyman's behalf. The Wally
Noerenber award was not given this year. Committee members judged both posters and presented papers. The 1995 Best poster was by Mary Whalen et al., the 1995 Best student paper by Gretchen Bishop, and the 1995 Best Paper was by Rich Yanusz. The possibility of creating a new award to recognize persons who further recognition of chapter goals was discussed, no resolution at this time.

Aquatic Education: Committee chair Pat Holmes reported on Committee activities. The British Columbia "Salmon in the Classroom" intermediate curriculum is being "Alaskanized" along with a de-emphasizes of hatcheries as a total answer to fisheries problems. Committee members modified a class curriculum on salmon life history suitable for primary school. Jeff Adams has helped to reformat educator's directory.

Arctic Fish Symposium: (Alex Wertheimer chair): Jim Reynolds, editor, reported that the Symposium Proceedings will be published in late 1996 as Number 19 in the national AFS symposium proceedings series.

Past President's: (Chuck Meacham chair): Bill Wilson reported that the committee report was in the back of the room, he also reported on suggestions for Science Board, modifications of the procedures manual, and special education in the chapter.

Fishes of Alaska Key: Committee chair Bill Wilson: Short history of book. Rae Baxter began to edit-clean 1990, left 3 versions with copious written notes. After Baxter's death tried to find funding for editors to finish this book. Pt. Stephens Press was awarded a contract to finish the Fishes of Alaska Key by Sept 1998. One-third

of the editing is finished. Question: is more funding necessary to publish? Money is needed to fund publishing. Dana Schmidt indicated that publishing cost may be minimal (<$15,000).

Environmental Concerns Committee: Co-chairs Rod Simmons and Bill Bechtol: Assigned specific members to specific environmental issues. The Committee actively monitored the reauthorization of Magnuson Fisheries Conservation and Management Act. Letters were send to congressional delegates in support of limiting bycatch, etc. Law was signed by Clinton on 11 November 1996. A full report of committee activities was posted in the back of the meeting room.

Rod mentioned that E-mail is has become an essential tool in the Committee's activities allowing for daily update on concerns or letters sent. Rod also reports that he was resigning as co-chair of the Committee, although he remains a Committee member.

Habitat Restoration Symposium: Editing was completed in August. A more complete report from K Koski is expected on 12 December 1996.

Stocks at Risk: Article regarding this committee's work was published in the October issue of Fisheries.

Continuing Education: Committee co-chair Pat Hansen reported on 3 classes planned in 1996. The first was a mark-recapture workshop held in Anchorage in February 1996; the second course on Applications of Recruitment Models to Fisheries Data was held in early October 1996; the third course was a Technical Writing and Editing Course that was to be held in Fairbanks, but was canceled due to illness of the instructor. A second session of the writing and editing course is scheduled for February 1997 in Anchorage.

International Relations: Committee chair Mark Stopha, full report posted in the back of the meeting room.

Outgoing President's Address: President Schmidt's Completion and stuff: Excom meets to talk about what others do...the chapter works as well as it does because of the efforts of the members. Participate!

Changing of the Guard: Peggy Merritt accepts the gavel and officially takes office:
"As a chapter, we achieve our goals primarily through two means: education and advocacy. For a volunteer organization I think we can be proud of what we have accomplished in these areas. Now that our goal of finishing the publication of proceedings from 3 symposia is about to be realized, it's time to solicit comment from members about their interest in sponsoring another symposium. While it is critical to maintain our own identity as a chapter, I think it's also important to collaborate from time to time with related professional organizations. You get exposed to new or different ideas, meet new people, perhaps form new working partnerships, and consolidate your travel expenses and time. I'd like to pursue collaboration as a means to improve technical science. Regarding education and advocacy my goals as president are to:

1. Continue sponsoring at least two continuing education courses a year;
2. Collaborate with Sea Grant in holding a symposium with peer-reviewed proceedings;
3. Set up guidelines in the Procedures Manual to assist in planning a large project such as a symposium;
4. Continue to sponsor participation of a Pacific Rim guest scientist in annual Chapter meetings;
5. Improve visibility of the chapter by releasing articles to the press;
6. Serve as a source of information and provide recommendations to state legislators and administrators and to congressional delegates on fisheries issues; and

7. Establish a working relationship with NPIC to further causes of common interest to both chapters.

The ability of the Alaska Chapter to accomplish anything of value depends on volunteers. For example, an active ECC, composed of members of various areas of expertise, and the Past President's committee are important resources in situations requiring a quick response time. I know there are different levels of support. Even if you have zero support in your work environment to participate in AFS, there are small but important jobs you can do to help out. I encourage you to get involved in committees depending upon your interests and areas of specialty."

NEW BUSINESS:

President Merritt: Achieve goals by advocacy and education. Accomplishments in education: co-hosting symposium with Sea Grant College, 2 cont ed. Courses a year. Collaborate with another prof society, guidelines for high-cost projects. Suggest Excom funding another Pacific rim scientist to come to meeting. Get involved.

Sponsoring Western Division meeting with NPIC: Schmidt moved: The AK chap and NPIC will submit a joint proposal for co-sponsoring the 1998 Western Division meeting of the AFS. The meeting will be in the February to early May time window with the exact date and location of the meeting to be decided by negotiations between the Excom of NPIC and AK chapters. The meeting will be hosted and conducted as a substitute for the 1997 or 1998 chapter fall meeting. Wilson second.

Discussion: Schmidt gives history and rationale for joining forces to host meeting. Bryan Hebden, NPIC Excom, suggested that good meeting place is in Seattle. It was noted that our 25th anniversary of the Alaska chapter is in 1998.

Many Chapter members expressed that they desire a Chapter meeting of some sort in the fall 1998, especially if a joint Chapter/Division meeting is held in the spring of 1998 outside of Alaska. So therefore it was suggested that we might meet and jointly sponsor a Sea Grant (Lowell Wakefield) symposium in the fall of 1998 in Anchorage.

Voice vote. Motion passed unanimously.

Treasurer-elect position: Ad hoc committee of Brenda Wright and Mary Faustini. This requires a by-law change. This would be a voting position on the Excom. Bylaw amendment procedures will be followed.

Awards Committee: Suggests a Chapter contribution award as the committee interpreted that meritorious service award could not be used to recognize service to the Chapter. Discussion indicated that only a clarification in the procedures manual was necessary to clarify that this award could be for chapter service. Change procedures manual generally agreed upon to clear up confusion.

1997 Chapter Meeting: President-elect Buck Bryant: Location will be in Juneau, will gladly accept themes for the 1997 meeting. Week before Feb. Timing is BAD for North Pacific Planning teams-groundfish and other marine biologists Lowell Wakefield Symposium is also always in November.

Hauser moved to adjourn, Hartmann seconds. Motion to adjourn carried by voice vote.

Meeting adjourned at 1745.

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SEALASKA Corporation	Support for coffee break
Ed Mills	Program logo
Juneau Veterinary Clinic	Science Diet dog food (door prize)
Pizza Roma	Two pizzas (door prize)
Eric Bealer	Print "Homecoming" (raffle)
U.S. Forest Service	Coffee mugs and pins (door prize)
American Fisheries Society	Coffee mugs (door prize)

Notes