AMERICAN FISHERIES SOCIETY
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IDAHO CHAPTER

2001 Annual Meeting:

What is the proper role of genetics in fisheries management?

Agenda and Abstracts

February 22-24, 2001
Doubletree Riverside, Boise, Idaho

Idaho Chapter American Fisheries Society

Annual Meeting

Thursday, February 22 - Saturday, February 24, 2001

What is the proper role of genetics in fisheries management?

Wednesday, February 21, 2001

6:00 PM – 8:00 PM Registration

Thursday, February 22, 2001

7:00 AM – 10:00 AM Registration

8:30 AM – 8:40 AM Introduction and housekeeping

8:40 AM – 8:55 AM President's Address - Introduction to the Plenary Session

(Note: All presenters are primary authors unless otherwise indicated by *)

Plenary Session

8:55 AM – 9:15 AM **Jason Dunham** (Fisheries Scientist-USFS Rocky Mountain Research Station, Boise). Let's Do the Genetics: An Ecologist's Perspective on Selected Issues and Opportunities to Use Genetics in Fisheries Management.

9:15 AM – 9:35 AM **Jennifer Nielsen** (Fishery Supervisor, USGS/BRD, Anchorage, AK). Genetics and Ecomorphology in Fish Management: Does it matter if Reproductive Isolation Precedes or Follows Divergence Between Lineages.

9:35 AM – 9:55 AM **Paul Spruell** (Geneticist-University of Montana, Missoula, MT). The Problem with Hybrids: Setting Conservation Guidelines.

9:55 AM – 10:15 AM **Matt Powell** (Research Assistant Professor-University of Idaho, Hagerman, ID). Fisheries Management Utilizing Genetics: The Value and Limitations of this Interdisciplinary Approach.

10:15 AM – 10:35 AM Break

Thursday, February 22, 2001 cont'd

Panel discussion ***Mark Gamblin, moderator***

10:35 AM –10:40 AM	Introduction
10:40AM – 11:45 AM	Discussion
11:45 AM – 1:00 PM	Lunch Committee Breakouts

Session 1 – Applied Genetics ***Dan Schill, moderator***

1:00 PM – 1:05 PM	Introduction to session
1:05 PM – 1:25 PM	**Implications to the Management of Disease in Salmonids: Using Quantitative PCR for the Detection of IHNV and BKD.** Matt Powell, (Center. For Salmonid & Freshwater Species, University of Idaho), Ken Overturf, (USDA/ARS, Hagerman, ID) and Keith Johnson, (Idaho Dept. of Fish & Game, Eagle Fish Health Lab, Eagle, ID)
1:25 PM – 1:45 PM	**Yellowstone Cutthroat Trout in the Upper Snake River Basin: Defining Management Units and the Extent of Introgression with Non-native Salmonids**. Richard N. Williams, Matthew R. Campbell, and Matt Powell. (Center for Salmonid and Freshwater Species at Risk, University of Idaho, Hagerman, ID)
1:45 PM – 2:05 PM	**Population Structure and Mitochondrial DNA (mtDNA) Diversity of North American White Sturgeon (*Acipenser transmontanus*).** P. J. Anders, C. R. Gelok and Matt Powell (Center for Salmonid and Freshwater Species at Risk, University of Idaho, Moscow, Idaho)
2:05 PM – 2:25 PM	Break
2:25 PM – 2:45 PM	**Hybridization and Introgression in a Managed, Native Yellowstone Cutthroat *Oncorhynchus clarki bouvieri* Population, Henrys Lake, Idaho: Genetic Detection and Management Implications.** Matt Campbell (University of Idaho, Moscow, ID)
2:45 PM – 3:05 PM	Conserving Genetic Integrity of the Henrys Lake Yellowstone Cutthroat Trout Population: How pure is pure enough? Mark Gamblin and Jeff Dillon, (Idaho Dept. of Fish & Game, Idaho Falls, ID)
3:05 PM – 3:25 PM	**Evaluating Uncertainty in Genetic Data**. Chris Beasley, André Talbot, Douglas R. Hatch, and John Whiteaker (Columbia River Inter-Tribal Fish Commission, Portland, OR)
3:25 PM – 3:45 PM	**Population genetics using Highly Heritable Non-fitness Quantitative Traits.** André Talbot, Columbia River Inter-Tribal Fish Commission, Portland, OR)

3:45 PM – 4:00 PM Break

Thursday, February 22, 2001 cont'd

Session 2 – Native Species ***Jim Chandler, moderator***

4:00 PM – 4:05 PM Introduction to session

4:05 PM – 4:25 PM **Cryopreservation of Chinook Salmon and Steelhead Gametes in the Snake River Basin**. Robyn Armstrong (Nez Perce Tribe, Department of Fisheries Resources Management, McCall, ID) and Paul Kucera, (Nez Perce Tribe Department of Fisheries Resources Management, Lapwai, ID)

4:25 PM – 4:45 PM **Arrowrock Dam Outlet Works Rehabilitation: Assessment of Potential Impacts of an Adfluvial Bull Trout Population**. Richard W. Rieber and Tammy Salow (Bureau of Reclamation, Boise, ID)

4:45 PM – 5:05 PM **The Relationship Between Summer Stream Temperature and Bull Trout Abundance in the Little Lost River, Idaho Drainage**. Bart L. Gamett, Jeffrey L. Kershner (Department of Fisheries & Wildlife, Utah State University, Logan, Utah)

6:30 PM – ? Paloose Unit Student mixer at Idaho Pizza Company, 7100 Fairview Ave, Boise

Friday, February 23, 2001

Session 2 – Native Species, cont'd ***Jim Chandler, moderator***

8:00 AM – 8:05 AM Housekeeping and Announcements

8:05 AM – 8:25 AM **Length Variation in Young-Of-The-Year Westslope Cutthroat Trout across Spatial Scales and Environmental Gradients.** Kathleen E. McGrath, Bruce E. Rieman, and J. Michael Scott (Dept. of Fisheries & Wildlife, College of Natural Resources, University of Idaho, Moscow, ID)

8:25 AM – 8:55 AM **Competitive Interactions Between an Exotic Planktivore (bighead carp *Hypophthalmichthys nobilis*) and a Native Planktivore (paddlefish *Polyodon spathula*).** S. J. Schrank (Idaho Cooperative. Fish & Wildlife Research Unit, Dept. Fish & Wildlife Resources, University of Idaho, Moscow, ID) and C. S. Guy (Kansas Cooperative. Fish & Wildlife Research Unit, Div. of Biology, Kansas State University, Manhattan, KS)

8:55 AM – 9:15 AM **Have We Found the Pre-Libby Dam Spawning Location of Kootenai River White Sturgeon or has High Powered Science Lead Us Astray?** Vaughn Paragamian (Idaho Dept. of Fish & Game, Coeur d'Alene, ID), Gary Barton (USGS, Portland, WA) and Sue Ireland (Kootenai Tribe of Idaho, Bonners Ferry, ID)

9:15 AM – 9:35 AM **Snake River White Sturgeon Stock Assessment, Lower Granite Dam to Salmon River.** Scott Everett and Michael Tuell (Nez Perce Tribe, Dept. of Fisheries, Lapwai, ID)

Friday, February 23, 2001 cont'd

9:35 AM – 9:55 AM **Designing a Monitoring Plan for Tiny Endangered Snails in the Snake River.** Dana Weigel (USBR, Burley, ID)

9:55 AM – 10:15 AM Break

Session 3 – Fisheries Management Doug Megargle, moderator

10:15 AM – 10:20 AM Introduction to session

10:20 AM – 10:40 AM **Assessment and Overview of Mountain Lake Stocking in the Panhandle Region.** Jim Fredericks (ID Dept. of Fish & Game, Coeur d'Alene, ID)

10:40 AM – 11:00 AM **In-Season homing of Pacific lamprey (*Lampetra tridentata*) in the Columbia River Basin**. Douglas R. Hatch, André Talbot, Rian Hooff, Chris Beasley and John Netto (Columbia River Inter-Tribal Fish Commission, Portland, OR)

11:00 AM – 11:20 AM **A bioenergetics assessment of adult salmonid consumption and post-stocking predation on cutthroat trout *Oncorhynchus clarki utah* in Bear Lake (Utah-Idaho).** Rick Orme (McCall, ID), Mike Mazur and Dave Beauchamp (Washington Cooperative Fish and Wildlife Research Unit, Washington State University, Seattle)

11:20 AM – 11:40 AM **Trout In The Classroom Projects in Idaho**. Rick Prange, Tom Frew (Idaho Department of Fish & Game, Boise, ID), Kris Stone, and Ted Koch* (USFWS, Boise, ID)

11:40 AM – 1:40 PM Lunch – ICAFS Annual Business Meeting, Western Division AFS Update – Ken Hashagen

Session 4 - Fish-Habitat Relationships Rick Wilkison, moderator

1:45 PM – 1:50 PM Introduction to session

1:50 PM – 2:10 PM **Fires and Fish: What is the real Concern?** Justin Jimenez, Rodger L. Nelson and David C. Burns, (Payette National Forest, McCall, ID,).

2:10 PM – 2:30 PM **Quality Assurance Testing as part of a Long-term Monitoring Program for Streams and Riparian areas.** Eric Archer, Chad Mellison, Rick Henderson, and Jeff Kershner (U.S Forest Service/Fish Ecology Unit, Forestry Sciences Lab, Logan, UT)

2:30 PM – 2:50 PM **Response of an Aquatic Macrophyte Community to Fluctuating Water Levels in an Oligotrophic Lake**. Tyler Wagner and C. Michael Falter. (Dept. of Fish & Wildlife Resources, College of Natural Resources, University of Idaho, Moscow, ID)

2:50 PM – 3:05 PM **Seasonal and Diel Patterns of Habitat Use by Spotted Bass in Otter Creek, Kansas.** Travis B. Horton and Christopher S. Guy (Dept. of Fisheries & Wildlife, College of Natural Resources, University of Idaho, Moscow, ID)

Friday, February 23, 2001 cont'd

3:05 PM – 3:25 PM Break

3:25 PM – 4:00 PM **The Warmwater Fish Community in the Pend Oreille River, Idaho: Response to Higher Winter Water Levels**. Chris Karchesky and David Bennett, (Dept. of Fish & Wildlife Resources, College of Natural Resources, University of Idaho, Moscow IID)

3:45 PM – 4:20 PM **Landscape Views of Trout Populations in Small Mountain Streams**. Daniel J. Isaak and Wayne A. Hubert (Cooperative Fish & Wildlife Research Unit, Department of Zoology & Physiology, University of Wyoming, Laramie, WY)

4:05 PM – 4:40 PM **Ecotypic Variation in Rainbow Trout Morphology**. E.R. Keeley (Dept. of Biological Sciences, Idaho State University, Pocatello, Idaho), E.A. Parkinson (B.C. Ministry of Fisheries, Vancouver, B.C) and E.A. and E. B. Taylor (Dept. of Zoology, U.B.C., Vancouver, B.C.).

4:25 PM – 4:45 PM **Winter Habitat Utilization and Movement by Cutthroat Trout in The Snake River near Jackson, Wyoming**. David Harper and A_da Farag , (U. S. Geological Survey, Biological Resources Division, Jackson, WY)

4:45 PM – 5:05 PM **Anadromous Salmonid Recovery in the Umatilla River Basin, Oregon: A Case Study**. Jennifer L. Phillips, Jill Ory, and André Talbot* (Columbia River Inter-Tribal Fish Commission, Portland, OR)

6:30 PM – 11:00 PM Raffle and auction with absolutely not-to-be-missed entertainment at 7:00pm

Saturday, February 24, 2001

Session 5 - Anadromous Resources Dan Herrig, moderator

8:00 AM – 8:05 AM	Housekeeping and Announcements
8:05 AM – 8:25 AM	**Adult Sockeye Tagging at Lower Granite Dam and Tracking to Redfish Lake.** Megan J. Heinrich and Ted C. Bjornn (Idaho Cooperative Fish & Wildlife Research Unit, University of Idaho, Moscow, ID)
8:25 AM – 8:45 AM	**Through the Looking Glass: Chasing the Rabbit Tracks of NMFS' 2000 Biological Opinion**. C.E. Petrosky (Idaho Dept. of Fish & Game. Boise, ID)
8:45 AM – 9:05 AM	**Is Headwater Habitat the Issue? A Very Curious Look at the NMFS Biological Opinion.** Russell F. Thurow (U.S. Forest Service, Rocky Mountain Research Station, Boise, ID)
9:05 AM – 9:25 AM	**Death from Above: The Federal Approach to Salmon Recovery?** Gregg Mauser (Idaho Dept. of Fish & Game, Boise, ID

Saturday, February 24, 2001 cont'd

9:25 AM – 9:50 AM	**Impacts of Electrofishing Injury on Idaho Stream Salmonids at the Populations Scale.** Steve Elle (ID Dept. of Fish & Game, Fisheries Research, Nampa, ID)
9:50 AM – 10:05 AM	Break
10:05 AM – 10:25 AM	**Snake River Sockeye Captive Broodstock Program: Where are we now?** J. Lance Hebdon and Paul Kline, (Idaho Dept. of Fish & Game, Nampa, ID)
10:25 AM – 10:45 AM	**Estimating the Ocean Age Proportions of Snake River Wild Spring/Summer Chinook Salmon Adults**. Russell B. Kiefer and June Johnson, (Idaho Dept. of Fish & Game, Fisheries Research, Nampa, ID)
10:45 AM – 11:05 AM	**Application of a Conservation Approach for Use of Artificial Propagation in Salmon Recovery**. J.L. Vogel, (Nez Perce Tribe Dept. of Fisheries Resources Management, McCall, ID), J.A. Hesse, (Nez Perce Tribe Dept. of Fisheries Resources Management, Lapwai, ID), and C. Beasley, (Columbia Inter-Tribal Fish Commission, Portland, OR)
11:05 AM – 11:25 AM	**Hatchery Reform Begins with a Review of Current Hatchery Practices**. John Whiteaker, André Talbot, Doug Hatch, and Chris Beasley (Columbia River Inter-Tribal Fish Commission, Portland, OR Whiteaker
11:25 AM – 11:45 AM	open slot
11:45 AM - 12:00 PM	Presentation of best paper awards, closing remarks

Adjourn

1:00 PM Executive Committee Meeting

Plenary Speakers

Let's Do the Genetics: An Ecologist's Perspective on Selected Issues and Opportunities to Use Genetics in Fisheries Management
Jason Dunham (Fisheries Scientist-USFS Rocky Mountain Research Station, Boise)

Genetics and Ecomorphology in Fish Management: Does it matter if Reproductive Isolation Precedes or Follows Divergence between Lineages?
Jennifer Nielsen (Geneticist-USGS Anchorage, AK)

Fisheries Management Utilizing Genetics: The Value and Limitations of this Interdisciplinary Approach
Matt Powell (Research Geneticist-University of Idaho, Hagerman, ID

The Problems with Hybrids: Setting Conservation Guidelines
Paul Spruell (Geneticist-University of Montana, Missoula, MT

Contributed Papers

Population Structure and Mitochondrial DNA (mtDNA) Diversity of North American White Sturgeon (Acipenser transmontanus)

P. J. Anders, **C. R. Gelok** *(Center for Salmonid and Freshwater Species at Risk, University of Idaho, Moscow, Idaho, panders@uidaho.edu)* and **M. S. Powell** *(Center for Salmonid and Freshwater Species at Risk, University of Idaho, Hagerman Fish Culture Experiment Station, Hagerman, ID).*

Abstract: Variation in the nucleotide sequence of the mitochondrial control region (453 bp) was examined in white sturgeon (*Acipenser transmontanus*) from 13 localities in western North America. Twenty-six unique mtDNA haplotypes (sequences) were observed among the 260 white sturgeon analyzed. Thirty-four informative sites were identified, exhibiting 90 transitions, 13 insertions, and 2 transversions. Pairwise comparisons revealed 0.2-4.2 % sequence difference (1-19 nucleotide substitutions) among the 26 haplotypes. Two to eleven haplotypes were observed at individual study sites. The two most common haplotypes were represented by 165 (63.5%) of the 260 fish sequenced, 110 (42.3%) and 55 (21.2%) fish respectively. The most common haplotype was observed in 4 to 19 of the 20 fish from every study site. Of the remaining 24 haplotypes, 15 were represented by 2 to 13 fish, and 9 were represented by a single fish. Negative correlations were observed between haplotype diversity and geographic distance from the Pacific Ocean (r2= 0.82, n=260), and between maximum percent sequence difference among individuals within study sites and geographic distance from the Pacific Ocean (r2 =.77, n=260). White sturgeon population structure was evaluated using the nested analysis of molecular variance program (AMOVA) which hierarchically partitioned white sturgeon genetic variability into three distinct strata: 1) variability among geographic regions; 2) variability among study sites within geographic regions; and 3) variability among individuals within study sites. Approximately 87% of white sturgeon genetic variability was observed within study sites, suggesting considerable gene flow among large areas of western North America, including the Columbia, Fraser, and Sacramento river systems. Conversely, two unique haplotypes observed in the Nechako River (BC) were represented by 4 and 5 fish respectively. Post-glacially recolonized

Kootenay Lake (BC) and Kootenai River (ID) study sites were represented by only 2 haplotypes. Such reduced haplotype diversity may be the result of founder effects during recolonization, and/or subsequent loss of genetic variation through demographic or genetic bottleneck events.

Quality Assurance Testing as part of a Long-term Monitoring Program for Streams and Riparian areas

Eric Archer, Chad Mellison, Rick Henderson, and **Jeff Kershner** *(U.S Forest Service/Fish Ecology Unit, Forestry Sciences Lab, Logan, UT, earcher@fs.fed.us).*

Abstract: The Effectiveness Monitoring Program for streams and riparian areas is a long- term study to assess trends in conditions of federal lands within the boundaries of the Interior Columbia Basin. The study attempts to answer the question of whether key biological and physical attributes, processes, and functions of upland, riparian, and aquatic systems are being degraded, maintained, or restored. As part of our sampling during the 2000 field season, we designed a Quality Assurance program to assess variability in our sampling methods. We conducted three separate studies (measurement, repeat, temporal) to assess the different sources of variation in our methods. We assessed the variability between observers by having each crew take measurements at the same point to examine which parameters were too subjective to measure precisely. In addition, we assessed error associated with the sampling methods by using repeated sampling of six reaches by seven field crews (sampling error). To assess temporal variability, we used repeated samples throughout the sampling season at eight fixed sites to estimate temporal error. The ultimate objective of this component of the project was to determine which parameters are technically sound and legally defensible, thus useful over the long-term life of this project.

Cryopreservation of Chinook Salmon and Steelhead Gametes in the Snake River Basin

Robyn Armstrong *(Nez Perce Tribe Department of Fisheries Resources Management, McCall, ID, robyna@nezperce.org)* and **Paul Kucera**, *(Nez Perce Tribe Department of Fisheries Resources Management, Lapwai, ID)*

Abstract: Chinook salmon *(Oncorhynchus tshawytscha)* and steelhead *(Oncorhynchus mykiss)* populations in the Northwest are decreasing and are listed as threatened under the Endangered Species Act. Genetic diversity is being lost at an alarming rate. This project strives to ensure availability of a representative genetic sample of male salmonid populations by establishing and maintaining a germplasm repository. Our approach has been to collect and preserve salmon and steelhead genetic diversity across the geographic landscape by sampling within the major river subbasins in the Snake River basin. Gamete cryopreservation conserves the genetic diversity in a germplasm repository, but is not a recovery action for a listed species. A total of 1,867 viable chinook salmon and 536 steelhead cryopreservation samples, from as early as 1992, are in storage in the germplasm repository. Chinook salmon gametes were taken from the Lostine River, Catherine Creek, upper Grande Ronde River, Lookingglass Hatchery (Imnaha River), Rapid River Hatchery, Lake Creek, Johnson Creek, McCall Hatchery (South Fork Salmon River), Big Creek, Marsh Creek, Capehorn Creek, Pahsimeroi Hatchery, and Sawtooth Hatchery (upper Salmon River). Steelhead gamete have been cryopreserved from upper Grande Ronde River, Imnaha River, Irrigon Hatchery (Little Sheep Creek), Dworshak Hatchery (North Fork Clearwater River), Selway River, Fish Creek, Johnson Creek, Pahsimeroi Hatchery, and Oxbow Hatchery (Snake River). Cryopreserved sperm samples from the Snake River basin are in storage, in duplicate, at the University of Idaho and Washington State University.

Evaluating Uncertainty in Genetic Data

Chris Beasley, André Talbot, Douglas R. Hatch, John Whiteaker,
(Columbia River Inter-Tribal Fish Commission, Portland, OR, beac@critfc.org)

Abstract: Fisheries management in the Columbia Basin has been shaped in large part in recent years by the collection and analysis of genetic data. Absent from many of these analyses is a measure of uncertainty in the results. Statistical methods to address this issue are widely available, but remain underutilized in decision-making processes across the region. Given that the identification of reproductively isolated stocks is a critical first step in management under the Endangered Species Act, we argue that quantifying uncertainty is crucial. We present data from the Salmon River analyzed with a commonly used statistical technique, and then apply a statistical measure of uncertainty. We suggest that incorporation of uncertainty in reported results is a key step in identifying the suite of management alternatives that might be used to address declines among salmonids in the Northwest.

Hybridization and Introgression in a Managed, Native Yellowstone Cutthroat *Oncorhynchus clarki bouvieri* Population, Henrys Lake, Idaho: Genetic Detection and Management Implications

Matt Campbell, *(University of Idaho, Moscow, ID, mattcamp@uidaho.edu).*

Abstract: Since the mid-1920s, the Idaho Department of Fish and Game has cultured Yellowstone cutthroat trout at Henrys Lake to offset declines in natural production, and for use in stocking programs throughout the state of Idaho. Since the mid-1970s, they have also produced Yellowstone cutthroat X rainbow trout hybrids to create a trophy fishery in the lake. Yellowstone cutthroat trout eggs are fertilized with either rainbow trout milt to produce F1 hybrids, or with cutthroat milt to produce putatively pure, Yellowstone cutthroat. The ability of fishery managers to visually distinguish returning cutthroat from F1 hybrids is, therefore, crucial to avoid accidental introduction of rainbow trout genes into the hatchery supplemented cutthroat population. To evaluate this ability, fish identified by staff as cutthroat or hybrids, using an array of phenotypic characters employed at the station, were sampled during two spawning seasons. Phenotypically identified fish were genetically tested using species specific restriction fragment length polymorphisms (RFLPs) of nuclear and mitochondrial DNA gene loci, and diagnostic allozyme loci. Current levels of rainbow trout introgression in the cutthroat population at Henrys Lake were also investigated through samples collected from the lake and several tributaries. Results indicated that staff phenotype-based identifications were highly accurate in distinguishing cutthroat from F1 hybrids when selecting broodstock (no F1 hybrids detected among 80 samples identified as “pure”). Present low levels of rainbow trout introgression identified in this study are most likely the product of past rainbow trout introductions and limited, intermittent tributary spawning of hatchery produced F1 hybrids with wild Yellowstone cutthroat, rather than the accidental crossing of F1 hybrids with cutthroat at the hatchery. Current levels of introgression are maintained by the inability of managers to phenotypically identify and exclude individuals with low levels of rainbow trout introgression as broodstock, and by the limited, intermittent reproductive success of straying, hatchery produced F1 hybrids.

Impacts of Electrofishing Injury on Idaho Stream Salmonids at the Population Scale

Steve Elle and **Dan Schill** *(Idaho Dept. of Fish & Game, Fisheries Research, Nampa, ID, selle@idfg.state.id.us, dschill@micron.net).*

Abstract: This study assesses the mortality impacts of electrofishing at the population scale based on levels of sampling by Idaho Department Fish and Game (IDFG) and non-IDFG projects during the 1995 and 1996 field seasons. We estimated electrofishing induced population mortality by considering the proportion of stream reach shocked during sampling, the probability of fish exposure to an electric field based on sampling method used, and a hypothesized worst-case (25%) mortality rate for all electroshocked fish. For IDFG removal sampling (n = 137), we estimate the mean population mortality equals 0.38% with a range of 0.02-2.91%. For mark-recapture estimates (n = 25) the mean mortality impact was 1.05% with a range of 0.13-4.02%. For non-IDFG sampling (n = 305) mean population mortality was 1.11% with a range of 0.05-7.71%. Fifty-one percent of all the 1995 and 1996 sample streams had estimated mortality at the population scale of 0.50% or less. These low estimates are likely worst-case electrofishing effects because the high assumed mortality value used is not supported by the literature values. We conclude the impacts due to sampling using electrofishing methods does not constitute a meaningful impact to Idaho stream trout at the population level, especially when compared to annual natural mortality levels for most stream salmonids which typically equal 30-60%. Biologists should take all precautions to minimize electrofishing injury whenever possible through selection of appropriate voltage and waveforms. However, electrofishing as a sampling tool should not be rejected out-of-hand due to concern over injuries during fish collections.

Snake River White Sturgeon Stock Assessment, Lower Granite Dam to Salmon River

Scott Everett, *(Nez Perce Tribe Department of Fisheries Resources Management, Lapwai, ID, scotte@nezperce.org)*; **Michael Tuell**, *(Nez Perce Tribe Department of Fisheries Resources Management, Lapwai, ID, miket@nezperce.org).*

Abstract*:* The objective of this study is to identify means to restore and rebuild the Hells Canyon white sturgeon (*Acipenser transmontanus*) population. In 1996, a Biological Risk Assessment Team (BRAT), consisting of regional fisheries managers and researchers, was formed and identified data needs to fully assess the risks associated with potential mitigative strategies. This stock assessment addresses those critical uncertainties specified by the BRAT.

From 1997 to 2000, a total of 1,463 white sturgeon has been captured by setlines, gillnets and angling. In addition, 21 select fish were fitted with Combined Acoustic and Radio Tags (CART). Fish were captured throughout the study area from Lower Granite Dam (rkm 174) to the mouth of the Salmon River (rkm 303). Movement of recaptured and tracked fish ranged from 98.5 km downstream to 92.5 km upstream from the initial point of capture, with fewer than 26% of the fish moving more than 8 km. Differences were detected in the length frequency distributions of white sturgeon in Lower Granite Reservoir and the free-flowing Snake River (Chi-Square test, $P<0.05$). In addition, the proportion of white sturgeon greater than 92 cm (total length) in the free-flowing Snake River has shown an increase of 28.7% since the 1970's. Analysis of the length-weight relationship indicate that white sturgeon in Lower Granite Reservoir have a higher relative weight (Wr) than white sturgeon in the free-flowing Snake River (T-test, $P<0.05$). Preliminary age analysis of pectoral fin rays suggests the current population has been growing faster than the records indicate for Hells Canyon white sturgeon in the 1970's and 1980's. Population abundance was estimated at 2,313 fish or 0.52 fish/ha. Artificial substrate mats were deployed in select locations throughout the study area to document white sturgeon spawning. White sturgeon eggs were recovered from these mats in both the free-flowing segment of the Snake River and the Salmon River.

Assessment and Overview of Mountain Lake Stocking in the Panhandle Region

Jim Fredericks *(Idaho Dept. of Fish & Game, Couer d'Alene, ID, jfrederi@idfg.state.id.us).*

Abstract: The Idaho Department of Fish and Game (IDFG) stocks mountain lakes in the Panhandle Region to provide diverse fishing opportunities. In recent years we have identified the need for an improved record of the number and size of all mountain lakes in the region, and for productivity-based stocking guidelines to optimize density and growth rates. Our objectives were to: 1) identify the total number of stocked and un-stocked mountain lakes in the Panhandle Region; 2) refine existing surface area estimates of mountain lakes in the stocking program; and 3) develop a model to optimize cutthroat trout growth and abundance by adjusting stocking rates based on lake productivity and size. We used 1:24,000 (7.5 minute) USGS topographical maps and a digital planimeter to enumerate all lakes with a surface area of at least 0.5 ha and elevation of at least 1,000 m. We counted 124 lakes in the Panhandle Region with a surface area of at least 0.5 ha and an elevation of at least 1,000 m. Of these, 49 are currently being stocked on a regular basis by IDFG and 75 are not stocked, or have not been stocked for many years. We then corrected the existing surface area estimates listed in the stocking records. We found that existing area estimates of many lakes were inaccurate, which had translated into erroneous estimates of stocking density. We surveyed 14 lakes in 1999 and used available data from two lakes surveyed in past years. We assessed several variables related to cutthroat trout growth, and then developed a multiple regression model using elevation and stocking rate as independent variables and cutthroat trout age-at-length as a dependent variable. We found the model was useful in predicting growth, with a multiple r-value of 0.78, an r2 value of 0.62 and an adjusted r2 value of 0.54. We then used the regression model to plot curves depicting the relationships between stocking rates, elevation, and age-at-length. We developed stocking guidelines based on elevation and surface area that will optimize both growth and densities of cutthroat trout in Panhandle Region mountain lakes.

Conserving Genetic Integrity of the Henrys Lake Yellowstone Cutthroat Trout Population: How pure is pure enough?

Mark Gamblin and **Jeff Dillon***, (Idaho Dept. of Fish & Game, Idaho Falls, ID*, mgamblin@idfg.state.id.us, jdillon@idfg.state.id.us).

Abstract: The Henry's Lake watershed supports one of the five most important Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) populations in the upper Snake River Basin, making it a high priority in Idaho's plans to conserve and restore genetically viable Yellowstone cutthroat populations.

As early as 1891, rainbow trout (Oncorhynchus mykiss) were introduced into the Henry's Lake native trout population, which consisted solely of Yellowstone cutthroat trout and mountain whitefish (*Prosopium willliamsoni*). Recent genetic analysis of Henry's Lake trout determined that a high percentage of Henry's Lake cutthroat trout are introgressed with rainbow genes, but at varying intensities. A 1998 protein electrophoresis analysis (7 loci) of Henry's Lake trout (n=60) detected rainbow trout introgression in 93% of the sampled fish. In 1999, nuclear DNA analysis (2 primers) of cutthroat trout from 6 Henry's Lake tributaries (n=201) detected rainbow trout introgression in 23% of the sampled fish, but the same analysis of cutthroat trout spawners (n=60) from the hatchery ladder detected no rainbow trout introgression.

We describe a long-term conservation and recovery program for the Henry's Lake Yellowstone cutthroat trout population that capitalizes on the Henry's Lake Hatchery facility and our ability to control tributary fish migration. By emphasizing management with sterile hybrid trout, developing and expanding a permanently marked "genetically pure" stock of the Henry's Lake cutthroat trout and strictly managing tributary spawning escapement for known, genetically "pure" cutthroat trout, we intend to effectively reverse the process of genetic introgression in favor of Yellowstone

cutthroat trout. We also discuss the implications of population genetics theory as it applies to the implementation of species conservation programs.

The Relationship Between Summer Stream Temperature and Bull Trout Abundance in the Little Lost River, Idaho Drainage

Bart L. Gamett, **Jeffrey L. Kershner** *(Department of Fisheries and Wildlife, Utah State University, Logan, Utah, bgammet@fs.fed.us).*

Abstract: Water temperature is thought to be one of the most important factors influencing bull trout abundance. However, our understanding of the relationship is limited and critical thresholds are not well defined. The objective of this study was to assess the relationship between eighteen water temperature metrics (max, mean, min, etc.) and bull trout presence, bull trout density, and the percentage of salmonids that are bull trout. Data were collected from 39 sites and the temperature metrics covered the period from July 1 to September 30. Bull trout were present in 69% of the study sites and were the only salmonid present in 26% of the sites. Bull trout densities (fish>70mm) ranged between 0.0 and 39.6 bull trout/100 m2. Several temperature metrics were closely related to bull trout abundance. However, mean water temperature appeared to be the most effective overall at describing bull trout abundance. In this paper we report detailed results for mean and maximum water temperatures. Mean water temperatures in the study sites ranged between 5.2 and 14.6oC. Bull trout were present at all sites where mean temperature was less than 10.0oC. Bull trout were present at 40% of the sites where mean temperature was between 10.0 and 12.0oC and were not present at any sites where mean temperature was greater than 12.0 oC. Bull trout were the only salmonid present at sites where the mean temperature was less than 7.0oC. The percentage of salmonids that were bull trout was variable at sites where mean temperature was between 7.0 and 12.0oC. Bull trout densities were highest at sites where mean temperature was less than 9.0oC and densities dropped sharply when mean temperature was above this point. Maximum water temperatures in the study sites ranged between 8.1 and 25.9oC. Bull trout were present at all sites where maximum temperature was less than 17.0oC. Bull trout were present in 38% of the sites where maximum temperature was between 17.0 and 21.0oC and bull trout were not present at any sites where maximum temperature was greater than 21.0 oC. The percentage of salmonids that were bull trout averaged 81% at sites (n=5) where maximum temperature was less than 10.0oC, 74% at sites where maximum temperature was between 10.0 and 15.0oC, 16% at sites where maximum temperature was between 15.0 and 21oC, and 0% at sites where maximum temperature was above 21.0oC. Bull trout densities were highest at sites where maximum temperature was between 10.0 and 15.0 oC. The results of this study suggest that minor changes in water temperature resulting from anthropogenic and natural events could have a strong impact on bull trout populations.

Winter Habitat Utilization and Movement by Cutthroat Trout in The Snake River near Jackson, Wyoming

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Abstract: The availability of winter habitat can be the limiting factor in determining salmonid populations in high elevation streams. Habitat use and movement by cutthroat trout (*Oncorhynchus clarki* spp.) was monitored by radio telemetry from November – March 1998/99 and 1999/2000, in the Snake River near Jackson, Wyoming. Microhabitat measurements were recorded at over 400 fish locations and included data from 48 different fish. Deep runs,

backwater areas with groundwater discharge, stream margin areas with shelf ice, and lateral scour pools with woody cover were important overwintering habitat. Backwater pool areas with groundwater influence were uncommon in the study area, but were used frequently by radiotagged cutthroat and appear to be important overwintering habitat. Depth, shelf ice, and boulders were the most frequently selected cover. Winter movement was generally in a downstream direction, however there was variability in the distance and direction of individual fish movement. The average movement was 6 km downstream. Several fish displayed a strong fidelity to specific locations and frequently returned to the same habitat structures. Long downstream migration (>30 km) was not observed.

In-Season homing of Pacific lamprey (*Lampetra tridentata*) in the Columbia River Basin

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Abstract: A field study to investigate in-season homing in Pacific lamprey using radio telemetry was conducted in the lower Columbia River in 1998 through 1999. A total of fifty Pacific lamprey were captured (25 at Willamette Falls and 25 at Bonneville Dam) fitted with radio transmitters and released in the Columbia River approximately 26 km downstream of the confluence of the Willamette River. Radio tagged Pacific lamprey exhibited non-significant homing fidelity (p=0.622) based on the null expectation that one half of the total recoveries would home and the other half would stray. Final location classifications were 17 homed, 20 strayed, and 13 were undetermined. The undetermined classification labeled individuals that were not detected upstream of the confluence of the Willamette River, or were not heard in tributaries. Final location classifications were not influenced by fish length (p = 0.594). A previous study in Clear Creek a tributary to the John Day River estimated migration time as 4.5 km/day for Pacific lamprey. Our telemetry observations illustrate that although considered weak swimmers, Pacific lamprey are capable of traveling at velocities near 2.5 km/hour and sustaining that activity for at least 24 hours.

Snake River Sockeye Captive Broodstock Program: Where are we now?

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Abstract: The Snake River sockeye captive broodstock program was started in spring 1991 prior to the listing of Snake River sockeye salmon *Oncorhynchus nerka* as endangered on November 20, 1991. Since the inception of the program through 1998 all returning anadromous adult sockeye salmon, several residual adult sockeye salmon and several hundred wild smolts from Redfish Lake have been captured and used to establish captive broodstocks at IDFG's Eagle Fish Hatchery and at two NMFS facilities in Washington state. The program follows a "Spread the Risk" policy while evaluating multiple release strategies including, smolt, presmolt, in-lake net pens, eyed-egg plants and mature adults released for volitional spawning. The program is a cooperative effort between IDFG, NMFS, Shoshone-Bannock Tribes and University of Idaho. Bonneville Power Administration provides funding.
Six sockeye "jacks" and a single "jill" which returned to the Sawtooth Basin in 1999 represented the first anadromous returns of juvenile sockeye produced in the captive broodstock program. The year 2000 brought the largest run of sockeye to the Sawtooth Basin since the early 1970's, with 257 adults. Fin clips identified 96% of the run originating from captive broodstock progeny.

Adult Sockeye Tagging at Lower Granite Dam and Tracking to Redfish Lake

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Abstract: Adult Sockeye were outfitted with radio transmitters at Lower Granite Dam from 25 June to 25 July 2000. The fish were randomly selected for tagging and outfitted with a 22mm X 9.5mm, 3-volt Lotek radio transmitter. Thirty-one adult sockeye were tagged, released back into the ladder, and their migrations recorded by fixed site receivers and boat and truck tracking. At Lower Granite Dam, 282 sockeye salmon were counted during 2000, and 243 (86%) of those fish were recaptured at the two weirs in the Stanley Basin. All radio-tagged fish, identified by a CWT, were destined for the upper end of the Salmon River in the Stanley Basin, ID. Seven of the 31 (23%) tagged adults were recaptured at either the Redfish Lake Creek weir or Sawtooth Fish Hatchery weir, and two tags were found downstream from the Redfish Lake Creek weir; 29% of the tagged fish were known to have made it back to where they were released or migrated from as smolts. Migration rates from Lower Granite Dam to first observation at one of the weirs, averaged 18km\day. Two mortalities were confirmed, one in the recovery area at Lower Granite Dam and the second at Chief Timothy State Park on the Snake River, approximately 37 miles upstream from Lower Granite Dam. The remainder of the fish were last recorded between Lower Granite Dam and the Stanley Basin. A secondary tag was not put into the fish, so we are unable to determine if the remaining fish regurgitated their transmitters then completed their migration or if they died near the location of last record.

Seasonal and Diel Patterns of Habitat Use by Spotted Bass in Otter Creek, Kansas

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Abstract: The management of spotted bass populations in Kansas streams is a priority of the Kansas Department of Wildlife and Parks; however, little is known about spotted bass habitat requirements. Thus, the objectives of this study were to determine seasonal and diel habitat use by spotted bass *Micropterus punctulatus* using radiotelemetry in Otter Creek, Kansas. Spotted bass were tracked biweekly from May 1998 through April 2000. Macro-habitat use by spotted bass was non-random (*P*=0.0006, Wilk's lambda (v)=0.51, df=2), and use of pools ranked significantly higher (*P*#0.1) than runs and riffles. Cover-habitat use by spotted bass was non-random (*P*=0.0001, v=0.06, df=4), and woody debris (i.e., log complex and rootwad) and undercut-bank ranked highest. Cover-habitat compositional analysis by season showed similar patterns. Woody debris use did not differ significantly (*P*$0.1) among diel periods for summer and fall, but did differ significantly (*P*#0.1) during winter and spring. Spotted bass use of clay and bedrock substrate was similar to availability, and spotted bass used large substrates less than available. Spotted bass used fine substrates more than available; however, use of fine substrates was positively correlated (*P*=0.004, *r*=0.57, df=23) with use of log complexes. The use of depth by spotted bass in pools was similar to availability. Use of velocity by spotted bass in pools varied from 0 to 0.46 m/s (mean=0.03 m/s, SE=0.0014), was similar to availability, and represented the low-velocity environment of pools in Otter Creek. These results indicate that woody debris and undercut-bank habitat are important for spotted bass populations in Kansas streams.

Landscape Views of Trout Populations in Small Mountain Streams

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Abstract: Advances in geographic information systems, increased availability of spatial data, and ongoing declines in lotic salmonid populations have led to broadscale modeling efforts for these fishes. As a result, models that link population attributes directly to watershed features have become common means for attempting to understand how anthropogenic landscape modifications will affect trout populations. We developed watershed-trout models that predicted population density, biomass, and species composition and compared these models to multitiered, hierarchical models that incorporated geomorphic, land surface, stream, and trout variables. Data to construct models were collected from 90 reaches on 24 second- to fourth-order streams across a fifth-order, Rocky Mountain watershed. Both model types accounted for similar amounts of variation in population attributes, but the watershed-trout models provided predictive power with a minimum of effort. The multitiered models required additional resources, but provided better understanding by depicting the complexity of interactions that occur to propagate effects from the terrestrial realm to the aquatic realm. Both views of how trout may be linked to the surrounding landscape are complimentary and can be valuable management tools if used within the limits of the knowledge that each provides.

Fires and Fish: What is the real Concern?

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Abstract: The summer of 2000 was a remarkable wildfire season across the western United States. On the Payette National Forest, three major fires burned for most of the late summer period, covering some 450,000 acres when finally settled down by a heavy, late summer snowfall. This hectic summer marked the third time in 12 years that very large acreages burned on the Forest; of the three, this was the most extensive. The Burgdorf Junction Fire was the smallest, at about 66,000 acres, of the three largest fires on the Forest (Burgdorf Junction, Diamond Point, and Flossie) this past year, but was best known because it was the first and closest to McCall; the others, in fact, were predominantly wilderness fires with little suppression activity.

Summer 2000 started dry on the Forest with an early melt to an approximately normal snow pack. On about July 9, a lightning strike above Burgdorf started a “sleeper” fire that was not detected until the lookout at War Eagle spotted it on 14 July; within hours of detection, high winds had whipped the flames into a 1,500 acre conflagration. By 13 September when the fire was declared contained, it had covered a broad area of primarily roadless and wilderness forest, burning mostly to the northeast from Burgdorf in the Secesh River watershed all the way, and at one time spotting across, the Salmon River downstream of Mackay Bar. The early days of the fire were the most active, with a distinct decline in intensity as the fire moved out of the Secesh River watershed and toward the Salmon River. The high winds that fueled the fire during its early runs left the Grouse Creek watershed, a tributary of the Secesh River that supports steelhead, chinook salmon, and bull trout, was left with virtually no tree canopy.

We take fire suppression seriously on the Payette, but we also take protection of resources that might be damaged by suppression activities just as seriously. With respect to fisheries, we believe that fire management tactics may have a direct impact on threatened and endangered fish species that is of greater concern than the ecological impacts of the fire itself. Suppression actions such as retardant drops from aircraft, bucket dipping from lakes and rivers, pumping water from streams, bulldozer use, etc. clearly have the capacity to affect aquatic resources. On the other hand, several years of fire effects research by Idaho State University have shown little long-term effect on aquatic resources. Wildfire is a natural and common occurrence in our area, and it stands to reason that fish are adapted to withstand it.

This year, we saw many examples of how aquatic resources, being systems integrated with the ecological template in which they occur, can withstand fire. Thermographs in streams in the fire's path showed little temperature effect as the fire passed through despite burning through the riparian vegetation. Understory vegetation burned by the fire had already started to recover substantially by late fall, and, in the case of Burgdorf Junction, much of the downed wood in place before the fire remained intact. Field observations within the Grouse Creek watershed following the fire and into late fall and early winter did not identify any water quality problems that were a result of the fire itself. Indeed, we have been able to use the occurrence of the fire as an opportunity to obtain burned area emergency rehabilitation funds to try and correct some chronic erosion problems in the Grouse Creek watershed whose likelihood of seriously damaging the fisheries resource was increased by such complete loss of tree canopy.

The Warmwater Fish Community in the Pend Oreille River, Idaho: Response to Higher Winter Water Levels

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Abstract: We evaluated changes in relative abundance, size structure, and year class strength following 3-years of higher winter water levels for selected warmwater fishes in the Pend Oreille River Idaho upstream of Albeni Falls Dam. From 1966 to 1995, an annual winter drawdown of 3.5 m occurred in the Pend Oreille River from mid-November through May, primarily for spring flood control. From 1996 through 1999, an experimental winter drawdown of 2.1 m occurred to increase the quantity of potential spawning substrate for shoreline-spawning kokanee *Oncorhyrnchus nerka* in Lake Pend Oreille. In addition, higher winter water levels increase the amount of over-wintering habitat for warmwater fishes in the Pend Oreille River above Albeni Falls Dam. Previous findings suggest warmwater fish populations were likely being limited by the lack of suitable winter habitat that resulted in high winter mortality. We sampled the Pend Oreille River in 1999 and 2000 following the experimental drawdown, and compared these data with data collected prior to the establishment of higher winter water levels in 1991 and 1992. Comparisons of mean catch rates indicated that relative abundance of largemouth bass *Micropterus salmonides*, pumpkinseed *Lepomis gibbosous*, and black crappie *Pomoxis nigromaculatus* were significantly higher during 1999 and 2000 than in 1991, but not 1992. Relative abundance of yellow perch *Perca flavescens* did not significantly differ among years. Size structures of largemouth bass demonstrated a shift to more abundant larger individuals. Although year class strength was highly variable among years, higher recent year class strength suggests that over winter survival is enhanced by higher winter lake levels.

Ecotypic Variation in Rainbow Trout Morphology

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Abstract: Rainbow trout populations in British Columbia differ dramatically in life-history characteristics that may vary according to the habitat occupied by a population. We studied native populations of rainbow trout, distributed over a wide geographic area, to determine if morphology of rainbow trout varies according to habitat or ecotype. Our study indicates that a significant proportion of the morphological variation present between rainbow trout populations is related to ecotypic conditions. We found that populations appear to vary most dramatically in morphology depending on whether the population occupies a stream or lake environment. However, the presence of competitor fish species and the trophic level occupied by rainbow trout also seem to influence morphological variation.

Estimating the Ocean Age Proportions of Snake River Wild Spring/Summer Chinook Salmon Adults

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Abstract: Accurate age information is important for the successful management of wild Snake River spring/summer chinook salmon. Pacific salmon are usually aged by examining the circuli of scales. However, as Pacific salmon leave the ocean for their spawning migration they cease feeding and scale material is resorbed. This resorption results in the loss of circuli and annuli on the periphery of scales making accurate age determination difficult if not impossible for salmon with long spawning migrations such as Snake River spring/summer chinook. This report covers efforts to select the preferred structure for aging, set up a database to track all samples collected, develop procedures and order equipment for structure preparation and reading, and results form sampled that were collected in 1999. A cooperative effort was used to sample chinook salmon carcasses from representative spawning areas throughout the Snake River Basin. Ocean age proportions were determined for each five centimeter fork length group of Snake River wild adult spring/summer chinook salmon carcasses sampled. These ocean age proportions were applied to the number and estimated length frequency distribution of wild/natural chinook salmon adults passing Lower Granite Dam to estimate the number of adult returns for each ocean age group in 1999.

Death from Above: The Federal Approach to Salmon Recovery?

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Abstract: Nesting sites and smolt concentrations provided by the federal Columbia River power and navigation system have led to dramatic increases in colonial seabirds. Avian predation can amount to 30 percent of the spring smolt migration and may exceed other man-caused mortality rates, except those resulting from direct and delayed effects of the hydrosystem. In the absence of more specific information, managers assume bird predation impacts all anadromous stocks in the Columbia Basin. The Corps of Engineers and Bonneville Power Administration have spent $2 million documenting seabird predation, however the federal agencies (COE, USFWS & NMFS) have been unwilling to proceed beyond a decrease in smolt losses achieved in the Columbia River estuary in the 2000-nesting season. Strong language concerning avian predation was

removed from the NMFS' 2000 Biological Opinion. The federal agencies have inexplicably traded the required removal of seabirds from the Columbia for continued increases in smolt losses. The rationale for this under ESA protection is not clear. The federal proposal for 2001-2002 virtually assures the birds will take more than 22 percent of the spring smolt migration. A preponderance of hatchery fish in the upriver run may contribute to a classic predator trap for ESA listed stocks. Management alternatives are available to reduce avian predation to conservation levels. Dispersing the birds to a number of nesting sites outside the lower Columbia could increase the anadromous run by 170,000 adult fish in 2-3 years, and improve long-term viability of bird populations.

Length Variation in Young-Of-The-Year Westslope Cutthroat Trout across Spatial Scales and Environmental Gradients

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Abstract: Phenotypic diversity, or the morphological, behavioral, or life history variation between individuals, is an important component of ecological diversity in fishes. This variation can lead to speciation via local adaptation, and can provide a stabilizing mechanism for populations in variable environments. The importance of body size in salmonids for survival, migratory success, competitive ability, and predator avoidance is well documented. Variation in body size may lead to variation in life history and habitat use, as well. We examined mean body size and coefficient of variation of mean size (COV; size diversity) in young-of-the-year westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in the Coeur d' Alene basin, Idaho, across multiple spatial scales. Four scales, stream network, stream, site within stream, and reach within site were examined. Relationships of size and variation in size with temperature, elevation, valley width, and productivity (measured as conductivity) were used to explore spatial patterns of size variation. In nested analyses of variance, mean length varied most across stream and site scales, but was still significant across network and reach scales. COV was most significant at the site scale. In regression analyses, mean length varied with productivity and temperature, and COV varied with elevation. Our findings have important implications for westslope cutthroat trout. Differences in life history characteristics such as migratory behavior, egg size, fecundity, or age at maturity between fish in productive and unproductive environments might be predicted based on life history theory. We might also predict that populations in high elevation streams are more sensitive and less resilient to disturbance. Conservation of the full range of variation in this subspecies may therefore require high quality habitats across these gradients. Identification of spatial scales at which diversity is generated and environmental gradients generating that diversity are important steps towards understanding diversifying mechanisms and conservation needs of westslope cutthroat trout.

A bioenergetics assessment of adult salmonid consumption and post-stocking predation on cutthroat trout *Oncorhynchus clarki utah* in Bear Lake (Utah-Idaho)

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Abstract: Intensive sampling within a stocking and a non-stocking site, coupled with bioenergetics simulations for age four and greater cutthroat trout *Oncorhynchus clarki utah* and lake trout *Salvelinus namaycush* were performed to estimate annual consumption of prey fish and estimate predation losses of stocked cutthroat trout from April 1998 through April 1999 in Bear Lake (Utah-Idaho). Distribution and diets of adult cutthroat (> 350 mm total length (TL)) and lake

trout (> 425 mm TL) were similar between the stocking and non-stocking sites suggesting that predation on stocked fish was not localized to stocking sites; this was the result of both rapid dispersal of stocked fish and high mobility of predators. Stocked cutthroat trout were a dominant diet item for both predator species during 3-4 weeks after stocking. Stocked cutthroat trout were completely absent from diets with the occurrence of strong thermal stratification. Juvenile cutthroat trout re-appeared in the diets of lake trout during late winter and early spring 1999. Terrestrial invertebrates were the dominant diet item for cutthroat trout 350-550 mm TL during the spring and summer with endemic coregonids (Bonneville cisco *Prosopium gemmifer*, Bonneville whitefish *P. spilonotus*, and Bear Lake white fish *P. abyssicola*) becoming dominant in the fall and winter. Endemic coregonids were the dominant diet item for both large (>550 mm TL) cutthroat trout and adult lake trout. Bioenergetics simulations suggest that from April 1998 to April 1999, 121 kg or 2,464 individual stocked cutthroat trout was consumed for every 1,000 cutthroat trout >350 mm TL in Bear Lake. Consumption of stocked cutthroat trout was estimated at 870 kg or 17,765 individuals for every 1,000 lake trout > 425 mm TL. Annual consumption of endemic coregonids was estimated at 20,000 individuals for every 1,000 cutthroat trout and nearly 90,000 individuals for every 1,000 lake trout. Population level consumption during 1998-99, based on a 1993-94 population estimate of sport fish by Ruzycki and Wurtsbaugh (in press) translated into a estimated predation loss of 143,500 cutthroat trout representing 44% of stocked fish.

Have We Found the Pre-Libby Dam Spawning Location of Kootenai River White Sturgeon Or Has High Powered Science Led Us Astray?

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Abstract:. Kootenai River white sturgeon *Acipenser transmontanus* spawn within a 10-km reach in Idaho, river kilometer (rkm) 228.0-238.0. Previous studies indicated the reach is comprised primarily of sand and they were spawning over a substrate very unusual for white sturgeon. Furthermore survival of eggs and larvae is very poor. In this investigation we studied white sturgeon focal spawning locations, location of spawner groups, and factors that may affect movement of spawners. Late vitellogenic females and males were tagged with radio and sonic transmitters to monitor movement from 1994 through 1999. Egg mats were deployed to determine approximate spawning locations and timing. White sturgeon demonstrated a peculiar pattern of shifting focal spawning locations. Analysis indicated spawning and the location of spawners, as documented by egg collections and telemetry across date/periods for the years 1994-1999, was independent of rkm location. A distinct pattern emerged in our analysis of sturgeon spawning location and the elevation of Kootenay Lake, British Columbia. Concomitant to Libby Dam construction, the elevation of Kootenay Lake was lowered 2 m. Although Kootenay Lake is 108 km downstream of the spawning reach, higher lake elevations have a backwater affect on the sturgeon spawning reach. We found that as lake elevation rose during any given spawning season, sturgeon spawned progressively further upstream. A linear regression model indicated higher lake elevations might promote spawning further upstream at about rkm 241.9, if Kootenay Lake was at it's pre-Libby Dam elevation, 537 m. Gravel substrates begin at about rkm 244.5. To further our knowledge of spawning habitat and to investigate the hypothesis that sturgeon were not spawning in the historic reach we employed seismic technology and sampled the substrate with a coring device. Seismic and coring samples indicated a sand substrate in the present spawning reach but samples also documented cobble and gravel substrates at rkm 242.5, 40 cm below what is thought to be a post-Libby Dam layer of silt and sand. We believe white sturgeon are reacting to new environmental conditions and are seeking areas of suitable current velocities for spawning. Because Kootenay Lake has a back-water affect and the lake is now lower sturgeon are finding the proper velocities over inferior spawning habitat.. This hypothesis must be tested, but it presents an enormous political issue. Encroachment of the lake shoreline by landowners has occurred since 1972 and higher lake elevations may cause serious

property losses and hydropower concerns. If higher lake elevations are part of the solution and the social issue cannot be addressed, modification of the present less suitable spawning location may be necessary to improve survival of white sturgeon eggs and larvae.

Through the Looking Glass: Chasing the Rabbit Tracks of NMFS' 2000 Biological Opinion

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ABSTRACT: The NMFS' 2000 Biological Opinion (BiOp) found that operation of the federal hydrosystem from 1995 to 1999 jeopardized Snake River salmon and steelhead. A reasonable and prudent alternative (RPA) was developed for hydrosystem actions, which was also judged insufficient without additional survival improvements from off-site actions in habitat, hatcheries and harvest. Numerous concerns, raised by salmon management agencies and Western Division American Fisheries Society about the draft BiOp, remain applicable to the final BiOp and RPA. These include: abandonment of formal risk analysis; overly optimistic assessments of recent population growth rate and necessary survival improvements to avoid extinction and achieve recovery; overly optimistic assumptions about effectiveness of non-breach actions; and an overemphasis on uncertainties associated with natural river conditions, while ignoring the uncertainties for actions to offset effects of the federal dams.

Formal risk assessments, and the BiOp analyses, have identified management options that include removal of Snake River dams as being the most likely to recover populations with the least risk. The key remaining uncertainty hinges on how much of the mortality that occurs in the estuary and early ocean is related to earlier hydrosystem experience. Numerous mechanisms and observations could explain this delayed mortality in relation to a fish's experience through the hydrosystem. Direct evidence exists from tagging studies of delayed mortality by route of passage through the hydrosystem, including transportation and in-river routes. Indirect evidence, from temporal and spatial patterns of population response, suggests that delayed mortality is substantial. Analytical results indicate the RPA would rival the natural river option only when delayed hydrosystem mortality is negligible. The different types of evidence in combination suggest that it is implausible that delayed mortality of Snake River fish is completely unrelated to the hydrosystem, yet the BiOp avoids evaluating this weight of evidence. Instead the RPA focuses on undefined habitat actions. The BiOp delays decisions on dam breaching until 2005-2008, pending a future performance of population growth rate and abundance in response to the RPA actions. Even Lewis Carroll would be perplexed.

Anadromous Salmonid Recovery in the Umatilla River Basin, Oregon: A Case Study

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Abstract: The Umatilla River Basin Fisheries Restoration Plan was initiated in the early 1980s to mitigate salmonid losses caused by hydroelectric development and habitat degradation. The objectives are to enhance the abundance of endemic steelhead and reintroduce extirpated chinook and coho salmon. The project prompted collaborative effort among federal, state and tribal agencies, and local water users. It has incorporated habitat restoration, flow enhancement, fish passage improvements and population supplementation through artificial production. Water exchanges have successfully increased minimum flows during spring and fall migration. While flows remain depressed compared to historic conditions, there is potential for improved habitat, passage, and homing. The mean adult-to-adult return rate of hatchery-reared steelhead exceeded replacement and that of the naturally-spawning population. Although the smolt-to-adult

survival rates of hatchery-reared fish fluctuate, salmonid escapement has increased in recent years, permitting steelhead and spring chinook harvest. Enumeration of potential spawners and observed redds reveals an increase in natural production of all supplemented species. Comparison of hatchery-reared and naturally-spawning steelhead populations revealed differences in life history characteristics (age composition and sex ratios) though run timing and genetic stock compositions of the two components of the populations have not differed. Sustained monitoring is needed to determine benefits of integrating habitat restoration and artificial production in restoring salmonid populations.

Implications to the Management of Disease in Salmonids: Using Quantitative PCR for the Detection of IHNV and BKD.

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Abstract: Methods for the direct detection of etiological agents, such as *Renibacterium salmoninarum*, have developed through the use of enzyme-linked immunosorbent assays (ELISAs), fluorescent antibody tests (FATs) and culture methods. These methods are widely used but can be slow, labor intensive and can vary in their efficacy at detecting low levels of infection. The polymerase chain reaction (PCR) has been shown to be an effective means to qualitatively identify levels of infectious disease agents within tissues. However, nested PCR analyses are unable to quantify bacterial or viral pathogens with precision. Until recently, quantitative PCR has been problematic relying on multiple sets of serial dilutions for each sample which is also time consuming and labor intensive for large numbers of fish. The recent development of automated, quantitative PCR instruments has allowed for the advancement of new quantitative methods for the detection of disease. We have developed quantitative PCR assays for two commercially important diseases in salmonids, infectious hematopoetic necrosis virus (IHNV) and bacterial kidney disease (BKD). These assays allow for the direct enumeration of viral or bacterial RNA or DNA copy number within tissue, body fluid or other media. Both assays are rapid, extremely sensitive, easy to perform, and can accommodate large numbers of samples. These methods can also be applied non-lethally and in the case of BKD, can be used to determine whether the *R. salmoninarum* present are transcriptionally active and thus producing RNA.

Trout In The Classroom Projects in Idaho

Rick Prange, **Tom Frew** *(Idaho Department of Fish & Game, Boise, ID, tfrew@idfg.state.id.us)*, **Kris Stone**, and **Ted Koch** *(ted_koch@R1.fws.gov)*

Abstract: The Idaho Chapter of the American Fisheries Society, Idaho State Council of Trout Unlimited and the Idaho Department of Fish and Game have developed a partnership with about 15 schools in Idaho to implement a salmonid education program that Trout Unlimited calls “Trout In The Classroom.” Similar programs have been implemented in other states. The goal of the program is to educate 4th grade through high school age students about salmonid biology by implementing a curriculum developed by ICAFS members and IDFG employees, in conjunction with raising trout from eggs hatched in the classroom using equipment provided by TU and eggs provided by IDFG. Since its beginning some three years ago, the program has reached hundreds of students in Idaho. Future growth potential of the program in Idaho is significant but is limited in part by the number of fish biologists available to mentor in classrooms. For more information, contact Rick Prange in Boise at 208-378-5031.

Arrowrock Dam Outlet Works Rehabilitation: Assessment of Potential Impacts of an Adfluvial Bull Trout Population

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Abstract: Arrowrock Dam, completed in 1915, was constructed by the Bureau of Reclamation as part of the Boise Project in southwest Idaho. The dam is located on the main stem Boise River about 17 river miles upstream from the city of Boise.

The purpose of the proposed valve rehabilitation is to enable Reclamation to continue to operate Arrowrock Dam and Reservoir to meet the project purposes of irrigation and flood control.

The current condition of the Arrowrock Dam outlet works presents an increasingly difficult maintenance problem. The Ensign valves, which control water releases from the dam, have been in use since 1915 and have exceeded their design life. Based on the results of the last inspection, major repairs and rehabilitation of the existing valves and sluice gates are needed to assure continued use over the long term.

There are environmental concerns associated with drawdown of Arrowrock Reservoir to repair or replace the existing valves. Of most importance is the adfluvial population of bull trout that utilize Arrowrock Reservoir and the potential impacts (entrainment, stranding, mortality) to bull trout associated with the valve rehabilitation project. The preferred alternative would require Arrowrock Reservoir (full capacity of 286,000 acre-feet) to be drawn down to a residual pool of 1,500 acre-feet from September 15 to March 1. This construction period coincides with the time that bull trout overwinter in Arrowrock Reservoir.

This presentation will also discuss preliminary results and continued study plans to investigate the Arrowrock adfluvial bull trout population demographics, migration patterns, and environmental correlates.

Competitive interactions between an exotic planktivore (bighead carp Hypophthalmichthys nobilis) and a native planktivore (paddlefish Polyodon spathula)

S. J. Schrank *(Idaho Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID, sschrank@uidaho.edu)* and **C. S. Guy** *(Kansas Cooperative Fish and Wildlife Research Unit, Division of Biology, Kansas State University, Manhattan, KS, chrisgy@ksu.edu).*

Abstract: Bighead carp *Hypophthalmichthys nobilis* were introduced into the US in the 1970's for aquaculture purposes. Currently bighead carp are located throughout the Mississippi and Missouri River drainage. Previous research on bighead carp indicates that life history characteristics in the Missouri River are similar to populations in Europe and Asia. These basic biological data on bighead carp in the Missouri River provide a foundation to predict potential ecological problems and to perform manipulative studies. The objective of this study was to test for competitive interactions between bighead carp and paddlefish *Polyodon spatula,* a native planktivore, through a manipulative experiment. Age-0 paddlefish exhibited a decrease in relative growth in enclosures with bighead carp, while bighead carp exhibited a decrease in relative growth in enclosures without paddlefish. Bighead carp negatively affected growth of paddlefish through competition for food, and an increase in intraspecific competition negatively affected growth of bighead carp. Results from previous studies and our study suggest that bighead carp have become well established in the Missouri River, and may negatively impact paddlefish. It is likely that dispersal and increased population density of this exotic species will negatively impact

native planktivores in the lower Missouri River. Future studies need to directly assess interspecific competition between bighead carp and paddlefish in the Missouri River.

Population Genetics using Highly Heritable Non-fitness Quantitative Traits

André Talbot, *(Columbia River Inter-Tribal Fish Commission, Portland, OR)*

Abstract: One of the more fundamental issues with genetics of conservation is the determination of appropriate broodstock for recovery of depressed populations, and the metapopulation structure. The stock structure based on allele frequencies has been useful in many regards, but does not provide sufficient evidence for management among several spawning aggregates. Concerns over the possibility that groups of fish may be genetically incompatible should be addressed prior to implementation of a supportive breeding program. For example, resolution of the phylogenetic scale of outbreeding depression in salmon can only be reached using quantitative genetic techniques. We show empirical evidence for stock structure in Columbia River Chinook based on these highly heritable meristic characters. The data is consistent with stock structure based on allozyme frequencies, but may be useful as a bridge to more quantitative genetic method. Examples are given.

Is Headwater Habitat the Issue? A Very Curious Look at the NMFS Biological Opinion

Russell F. Thurow *(U.S. Forest Service, Rocky Mountain Research Station, Boise, ID, rthurow@fs.fed.us)*

Abstract: Since the mid 1970's, all stocks of anadromous fish in the Snake River basin have declined precipitously. Despite more than 25 years of efforts to rebuild stocks, they have continued to decline and Snake River sockeye salmon have been federally listed under the Endangered Species Act (ESA) since 1991, spring, summer, and fall chinook salmon since 1992, and summer steelhead since 1997. Although opinions on the most effective means of recovery vary, it is clear that substantial (2-3 fold) improvements in survival are necessary if Snake River stocks are to be restored. Recently, the National Marine Fisheries Service released a Biological Opinion and Recovery Strategy (BIOP) which suggests some of the best opportunities to improve survival and restore Snake River anadromous fish stocks lie in freshwater spawning and rearing areas, specifically in improving egg to smolt survival. In this paper I examine the BIOP's focus on spawning and rearing habitat. Using wild Snake River chinook salmon stocks as an example, I examine the condition of spawning and rearing habitat, evaluate estimated salmon mortality at various life stages, assess whether that mortality is natural or discretionary, and evaluate the feasibility of rebuilding stocks through headwater habitat improvements. Much of the spawning and rearing habitat in the basin is in good condition with about 70% of the priority watersheds with listed anadromous fish in designated wilderness or roadless areas. Similar stock declines in both wilderness and degraded habitats suggest that changes in spawning and rearing habitat quality have not been responsible for declines. Collaborative evidence indicates mortality in the egg to smolt life stage has not changed substantially since the 1960's. The life stage where the largest increases in mortality have occurred and the life stage with the largest discretionary mortality is the smolt to adult stage. The preponderance of scientific evidence illustrates the BIOP's approach to recover Snake River anadromous fish stocks through restoration of freshwater spawning and rearing habitat is infeasible and will fail to meet recovery goals under ESA. The BIOP's emphasis on undefined habitat actions is very curious, given the existing habitat condition, the relative stability in egg-to-smolt survival, the observed decrease in the smolt-to-adult life stage, and the lack of habitat feasibility studies.

Application of a Conservation Approach for Use of Artificial Propagation in Salmon Recovery

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Abstract: The continued decline of anadromous and resident salmonids throughout the Northwest is increasing utilization of artificial propagation as a means to reduce demographic risk and conserve genetic and life history traits of imperiled stocks. It is widely recognized that recovery will require a multifaceted approach. In many cases, the preferred management option is alteration of the current system through improved spawning and rearing habitat, mainstem survival, and ocean conditions, followed by natural repopulation. Unfortunately, these improvements may not be possible in the time frame necessary to recovery stocks, at high demographic risk of extirpation, and to prevent the irretrievable loss of genetic and life history variability. We suggest that supplementation, utilizing modern aquaculture techniques such as NATURES rearing, in combination with clear goals, objectives, and monitoring and evaluation offers the highest probability of successful conservation and recovery.

In the Johnson Creek drainage of central Idaho, we have designed and established a supplementation program with the goal to reduce the demographic risk of extirpation to the ESA listed Johnson Creek summer chinook salmon stock. Our efforts to design a program capable of achieving this goal have produced an approach that fishery managers may find useful. We present a method for defining the number of adults necessary to reduce demographic risk and maintain rare genetic variation, even in the absence of baseline genetic data. We then present a means of using this rough estimate to define broodstock and escapement goals and allocation of adult returns to broodstock or escapement under a variety of adult return scenarios (a "sliding scale"). Utilization of these concepts may yield the highest probability of successful conservation and recovery.

Response of an Aquatic Macrophyte Community to Fluctuating Water Levels in an Oligotrophic Lake

Tyler Wagner and **C. Michael Falter**. (Dept. of Fish and Wildlife Resources, College of Natural Resources, University of Idaho, Moscow, ID, *wagn0969@uidaho.edu*, *cmfalter@uidaho.edu*).

Abstract: This study compares the species composition, biomass, and the influence of substrate composition on an aquatic macrophyte community in the meso-oligotrophic Lake Pend Oreille, Idaho under two winter drawdown regimes. Mean dry aquatic macrophyte biomass significantly increased in the drawdown zone (1.4 – 3.5 m) from 39.9 g·m-2 under a 3.5 m drawdown in 1990 to 99.2 g·m-2 and 103.7 g·m-2, respectively under 2.1 m drawdowns in 1998 and 1999. Mean aquatic macrophyte biomass deeper than 3.5 m did not significantly increase; suggesting the increased biomass in the drawdown zone can at least partially be attributed to decreased winter mortality. *Myriophyllum sibiricum*, *Chara* spp., and *Potamogeton richardsonii* dominated the aquatic macrophyte community under the 3.5 m winter drawdown, while *Chara* spp., *P berchtoldii*, and *P. crispus* dominated under higher winter water levels. Logistic regression indicated a higher probability of finding clay and cobble substrates in the drawdown zone. On these clay substrates, there were significantly lower densities of aquatic vegetation (17.9 g·m-2) than on sand (86.6 g·m-2) or silt (129.0 g·m-2) substrata and few plants were observed on cobble substrata. During this investigation, the exotic Eurasian watermilfoil (EWM) was discovered in the outlet arm of Lake Pend Oreille. EWM was most prevalent in depths between 3.9 – 5.1 m and attained mean *maximum* densities in excess of 900 g·m-2 by August, 1999 (one year after it was first observed). An integrated approach to fish-plant management will also be discussed.

Designing a Monitoring Plan for Tiny Endangered snails in the Snake River

Dana Weigel, (USBR, Burley, ID, dweigel@pn.usbr.gov)

Abstract: In 1992, the USFWS listed 5 species of snails under the Endangered Species Act. Under the subsequent Aquatic Species Recovery Plan, the USBR was required to determine the abundance, distribution, population trend, life history, and habitat use of the snails in order to determine the effects of operations. Between 1995 and 1998 the USBR surveyed 50 miles of the Snake River upstream of Milner Dam. These surveys determined the distribution of the snails in this river reach. We used this distribution data to design a monitoring plan to meet the diverse objectives in the recovery plan. We will present a study design focused on monitoring Utah valvata (*Valvata utahensis*) between Milner Pool (approx. RM 669) and American Falls Dam (RM 714).

Hatchery Reform Begins with a Review of Current Hatchery Practices.

John Whiteaker, André Talbot, **Doug Hatch**, and **Chris Beasley** (Columbia River Inter-Tribal Fish Commission, Portland, OR, whij@critfc.org)

Abstract: Hatchery reform has been the subject of planning for many years in the Pacific Northwest. Reform of hatchery programs has ranged widely in its recommendations, from the transfer of production to local stocks, with no alteration of the goals of the program, to reform of the goals to assist in recovery. Yet, little has been done to compile current uses of hatchery fish, and to determine the potential for reform. Towards these objectives, we have compiled the use of anadromous fish returns from all hatchery programs in Oregon, Washington and Idaho. We conclude that there is a substantial “surplus” production of fish beyond the needs of hatchery broodstock and terminal fisheries, and suggest that these surplus fish could be used to repopulate suitable habitat and increase natural production.

Yellowstone Cutthroat Trout in the Upper Snake River Basin: Defining Management Units and the Extent of Introgression with Non-native Salmonids.

Richard N. Williams, Matthew R. Campbell, and Matt Powell. (Center for Salmonid and Freshwater Species at Risk, University of Idaho, Hagerman, ID, Williams@micron.net, mattcamp@uidaho.edu, fishdna@micron.net)

Abstract: Genetic introgression with non-native trout, particularly hatchery-reared rainbow trout, has occurred widely among endemic cutthroat trout subspecies in the intermountain west and has been a factor in their decline. In August 1998, several conservation groups petitioned the U.S. Fish and Wildlife Service to list the Yellowstone cutthroat trout as a threatened species under the Endangered Species Act (ESA). Research on Yellowstone cutthroat trout native to the Henry's Fork and South Fork of the Snake River indicate that rainbow trout hybridization and introgression have occurred coincident with declines in these populations as well. However, because most Yellowstone cutthroat trout populations in the upper Snake River basin have not been screened for genetic purity, the actual extent of rainbow trout introgression is unknown. In this study, we examined genetic variation among Yellowstone cutthroat trout specimens from 38 populations in the upper Snake River basin in Idaho. Specifically, we examined variation in the ND-2 mitochondrial DNA region and three nuclear gene regions (Ikaros, RAG 3’, and p53) that have previously yielded banding patterns diagnostic for separating cutthroat and rainbow trout. Results show that 24 populations (63.2%) exhibited no detectable introgression with rainbow trout, while 4 populations (10.5%) had introgression levels less than 1%. Six populations (15.8%) had introgression levels less than 10%, while 4 populations (10.5%) contained greater than 10%

introgression with rainbow trout genes. Three of four populations sampled in the Henry's Lake area showed introgression. Four of six populations sampled in the South Fork of the Snake River below Palisades Dam were introgressed with rainbow trout.

Posters

Using Fish Nutrition to Minimize Aquaculture Effluent Nitrogenous Waste: The Optimum Dietary Amino Acid Pattern for Rainbow Trout (*Oncorhynchus mykiss*)

Joel A. Green, Ronald W. Hardy and **Ernest L. Brannon** (University of Idaho Hagerman Fish Culture Experiment Station, Hagerman, ID, gree9524@uidaho.edu)

Abstract: The optimum dietary amino acid pattern for rainbow trout, which results in maximum protein retention relative to protein intake and consequently low nitrogenous excretion relative to growth, was determined in a series of experiments. Although some amino acid requirements of rainbow trout have been investigated previously, no previous study has estimated the optimum dietary amino acid pattern for rainbow trout. This topic is highly relevant to development of commercial diets which will maximize protein growth while minimizing nitrogenous waste in aquaculture effluent. The optimum dietary amino acid pattern includes two components: (1) the optimum essential amino acid pattern or optimum ratios of individual essential amino acids to total essential amino acids, and (2) the optimum ratio of total essential amino acids to total nonessential amino acids.

With respect to the first component, an experimental design based upon the amino acid deletion method was used to arrive at an estimate of the optimum essential amino acid pattern for rainbow trout. In this experiment, we formulated the control diet to have the amino acid pattern of rainbow trout whole body protein. In each of 10 other experimental diets, 40% of each of the 10 essential amino acids was deleted in turn from the control amino acid formulation. In an 8-week feed trial with rainbow trout, the relative effects of amino acid deletions on fish weight gain, feed efficiency ratio and protein retention were measured. Based on these results, an estimate of the optimum dietary essential amino acid pattern for rainbow trout was determined. Stated as % total essential amino acids, the estimated optimum dietary essential amino acid pattern for growing rainbow trout is: Arg = 12.9, His = 4.9, Ile = 7.7, Leu = 13.4, Lys = 14.9, Met = 6.2, Cys = 1.7, Phe = 10.5, Tyr = 8.1, Thr = 9.4, Trp = 1.7, Val = 8.6.

In another experiment, this dietary essential amino acid pattern were compared to the dietary essential amino acid pattern of amino acid requirements published by the National Research Council, and to the dietary essential amino acid pattern of rainbow trout whole body protein, with respect to growth, protein retention and nitrogen excretion. Further research in our laboratory will determine the optimum ratio of essential amino acids to non-essential amino acids for maximum nitrogen retention and growth of rainbow trout.

Conservation Aquaculture: An Adaptive Approach to Prevent Extinction of an Endangered White Sturgeon Population (*Acipenser transmontanus*)

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Abstract: The white sturgeon (*Acipenser transmontanus*) population in the Kootenai River was listed as endangered by the U.S. Fish and Wildlife Service on September 6, 1994, due to a virtual lack of recruitment during the last two decades. Conservation aquaculture was chosen as an approach to preserve genetic variability, begin rebuilding natural age class structure, and prevent extinction of the population while measures are identified and implemented to restore natural recruitment. A breeding plan, including culture methods to minimize potential detrimental effects of conventional stocking programs, has been implemented to guide management in the systematic collection and spawning of wild adults before they are lost from the breeding population. The objectives of the program are to produce 4-9 families per year and use preservation stocking criteria to produce 4 to 10 adults per family that survive to breeding age. Monitoring and evaluation will assess survival, growth, movement, and habitat use of released juveniles. Success of the project will be determined by: 1) an increase in the number of juvenile sturgeon; 2) survival of hatchery fish to sexual maturity; 3) retention of wild sturgeon life history characteristics; and 4) an understanding of the life history characteristics and factors limiting natural recruitment. Because the Kootenai River drainage lies within Montana, Idaho, and British Columbia, success of recovery efforts for the white sturgeon will also depend upon cooperation and coordination among all entities and agencies within the geographical area.