

The American Fisheries Society:

What Are We Managing For?

February 28-March 2, 2002
West Coast Pocatello Hotel
Pocatello, Idaho

JOINT MEETING: Idaho and Bonneville Chapters

ASFS *AMERICAN FISHERIES SOCIETY* ORGANIZED 1870
IDAHO CHAPTER



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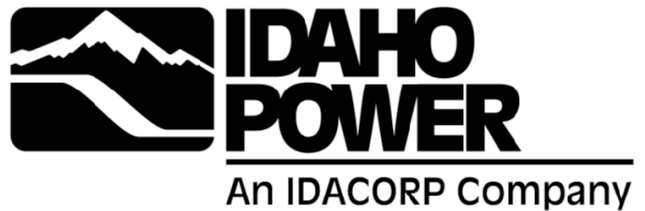
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Poster Session:

Posters are available for viewing from Thursday February 28 to Friday, March 1. Authors are to be present for discussion Friday afternoon.

Thursday, February 28, 2002

7:00-10:00AM	Registration	
8:30AM	Introduction and housekeeping - Steve Elle, President elect ICAFS	
8:40AM	President's Address Brett Roper, Acting President ICAFS and Scott Tolentino, President BCASF	
9:00AM	In Recognition of Ted Bjornn - Steve Elle	
Session	PLENARY American Fisheries Society: What Are We Managing For?	
Room	Bannock & Bonneville	
9:10AM	Introduction - Brett Roper	
9:15AM	Wayne Hubert, Assist. Unit Leader, Cooperative Fish & Wildlife, U of W Evolving Paradigms of Management and Consequences for Educators and Managers	
9:40AM	Henry Maddux, Field Supervisor, USFWS, Utah Preserving a Future or Only delaying the Inevitable?	
10:05AM	Virgil Moore, Fisheries Bureau Chief, Idaho Fish & Game Fish, Fishing, Food and Feelings - Not What but Who Do We Manage For?	
10:30AM	Kevin Christopherson, Regional Supervisor, Utah Div. of Wildlife Resources Managing the Public's Resource Amid Changing Public Expectations: Can We Hit a Moving Target, Should We Try?	
10:55AM	Break	
Session	DISCUSSION	
11:15AM	Introduction - Scott Tolentino	
11:20AM	Discussion	
12:00PM	Idaho Chapter Bag Lunch Committee Breakouts	Bonneville Chapter Lunch on your own

Session	ANADROMOUS	DISEASE
Room	Bannock	Bonneville
Moderator	Dimitri Videgar	Tim Miles
1:30PM	Introduction	Introduction
1:35PM	How Many Chinook Salmon Redds Do Redd Counters Count When Redd Counters Attempt to Count Redds? R. Thurow	Effect of Sand Size on Filtration of <i>Myxobolus cerebralis</i> Triactinomyxons E. Wagner

Thursday, February 28, 2002 Cont'd

1:55PM	Variation in Spawning Ecology Among Chinook Salmon Populations Within the Middle Fork Salmon River. D. Isaak	The Effects of Habitat Features on the Distribution of <i>Myxobolus cerebralis</i> and Occurrence of Whirling Disease Among Age-0 Salmonids in the Salt River Drainage, Wyoming-Idaho. J. Burckhardt
2:15PM	An Assessment of Snake River Spring/Summer Chinook Salmon, <i>Oncorhynchus tshawytscha</i> , Spawning Habitat Suitability Using Logistic Regression Techniques. P. McHugh	Distribution of <i>Myxobolus cerebralis</i> in the Logan River, Utah: Effects on Salmonid Populations. E. de la Hoz
2:35PM	Migration Behavior and Tributary Use by Fall Chinook Salmon in the Bonneville and Dalles Reservoirs. T. Goniea	Utah's Midway Sport Fish Hatchery: A Case Report on the Detection of <i>Myxobolus cerebralis</i> . C. Wilson
2:55PM	Break	
Session	ANADROMOUS CONT'D	CULTURE
Room	Bannock	Bonneville
Moderator	Dimitri Videgar	Tim Miles
3:15PM	Introduction	Introduction
3:20PM	Searching for a Life History Approach to Pacific Salmon Population Modeling. E. Knudsen	Triploid Trout Production in Utah: Current Status and On-Going Research. R. Arndt
3:40PM	The Effects of Water Temperature on the Migration Behavior and Survival of Adult Steelhead in the Columbia River Basin. B. High	Effects of Rapidly Changing Temperatures on Short-Term Survival of Juvenile Rainbow Trout. M. Smith
4:00PM	Molecular Genetic Variation Among Rainbow Trout <i>Oncorhynchus mykiss</i> Walbaum (Salmonidae, Salmoniformes) from the Kamchatka Peninsula. M. Powell	Triploid Induction in Rainbow Trout at Hayspur Hatchery: A Transfer of Research Test Results to the Hatchery Production Level B. Esselman
4:20PM	OPEN xxx	Efficacy of AQUI-A™ as an Anesthetic on Various Life-Stages of Rainbow Trout <i>Oncorhynchus mykiss</i> . J. Bowker
6:30PM till whenever	Paloose and Bonneville Units Student mixer at The Pocatello Pizza Place , 285 E. Alameda Road, Pocatello.	

Friday, March 1, 2002

8:30AM	Housekeeping and Announcements
Session	NATIVE AQUATICS
Room	Bannock & Bonneville
Moderator	Chris Keleher

Friday, March 1, 2002 Cont'd

8:35AM	Temporal Distribution of Kootenai River White Sturgeon Spawning Events and the Effect of Flow and Temperature Post-Libby Dam. V. Paragamian	
8:55AM	Anti-predatory Defenses Used by Two Native Cyprinid Species and their Effectiveness in Avoiding Predation by Introduced Brown Trout. M. Nannini	
9:15AM	Boreal Toad Distributional Surveys and Monitoring in Northern Utah, 1999-2001. K. Sorenson	
9:35AM	Evaluating Reasons for Failure of a Reintroduction of Leatherside chub (<i>Gila copei</i>). M. Belk	
9:55AM	Observations on RAPD and mtDNA Analyses of Westslope Cutthroat Trout from Four Streams in the Salmon River Breaks. D. Mays	
10:15AM	Break	
Room	Bannock only	
10:35AM	Year-Class Strength and Feeding Ecology of Age-0 Paddlefish in Fort Peck Lake, MT. J. Kozfkay	
10:55AM	Movement Patterns in Inland Salmonids, Migrants, Residents or a continuum? A. Schrank	
11:15AM	Abundance and Age Structure of Adult Lake Sturgeon in the Manistee River. B. Gunderman	
11:35AM	The June Sucker Recovery Implementation Program: A Collaborative Approach to Endangered Fish Recovery and Water Development. C. Keleher	
11:55AM	ICAFS Lunch Annual Business Meeting, Western Division Update – Eric Knudsen	UCAFS Lunch Annual Business Meeting, Western Division Update – Eric Knudsen

Session	NATIVE AQUATICS CONT'D	HABITAT
Room	Bannock	Bonneville
Moderator	Jim Fredericks	Rick Larson
1:50PM		Introduction
1:55PM	A Long-Term Comparison of Yellowstone Cutthroat Trout Abundance and Size Structure Throughout Their Historical Range in Idaho. K. Meyer	Upper Salmon Basin Watershed Project Update. Formerly the Model Watershed Project, Lemhi, Pahsimeroi and East Fork of the Salmon River, Idaho. J. Trapani

Friday, March 1, 2002 Cont'd

2:15PM	Status of Native Yellowstone Cutthroat Trout (<i>Oncorhynchus clarki bouvieri</i>) in the State of Utah. P. Thompson	Riparian Area Management: A Landscape View. S. Feldhausen
2:35PM	Discovery and Management of Native Colorado River Cutthroat Trout in the Escalante River Drainage, Utah. D. Hepworth	Restoration of an Incised River: A Case Study of the Right Fork of the White River in Southeastern Utah. M. Slater
2:55PM	The Influence of Water-Use on the Spawning Migration and Survival of Bear Lake Bonneville Cutthroat Trout (<i>Oncorhynchus clarki utah</i>) in St. Charles Creek, ID. P. Burnett	Historical Conditions of the Lower Boise River Prior to Large-Scale Watershed Development. D. Blew
3:15PM	Abundance and Movements of the Rainbow Trout Spawning Population in the Naknek River, Southwest Alaska. C. Schwanke	Fishery Response to Stream Habitat Improvement Projects on Thistle Creek. D. Wiley
3:35PM	Break	
3:55PM	Behavioral Interactions Between Least Chub (<i>Iotichthys phlegothonis</i>) and Introduced Western Mosquitofish (<i>Gambusia affinis</i>). M. Belk	The South Fork Salmon River – A History of Change. R. Nelson
4:15PM	Use of Otoliths to Describe Variation in Life History of Freshwater Salmonids. D. Horan	Mining and Fish: The Stibnite Story. M. Faurot
4:35PM	Susceptibility of Bull Trout, <i>Salvelinus confluentus</i> , to <i>Renibacterium salmoninarum</i> , the Causative Agent of Bacterial Kidney Disease. D. Jones	Stream Channel Restoration for Westslope Cutthroat Trout, Benewah Creek, Couer d'Alene Indian Reservation. S. Bauer
4:55PM	Applications of IFIM-Related Models to Idaho Rivers and Native Fishes J. Kent	Changes In Habitat Management of Utah Rivers and Streams in the Past 35 Years K. Summers
2-6PM	Poster Session – Authors present	
6:30PM – 11:00PM	ICAFS & BCAFS Joint Raffle and Auction	

Saturday, March 2, 2002

8:20AM	Housekeeping and Announcements	
Session	MANAGEMENT ISSUES	
Room	Bannock & Bonneville	
Moderator	Jeff Dillon	
8:25AM	Introduction	

Saturday, March 2, 2002 Cont'd

8:30AM	Where Have All the Perch Gone in Cascade Reservoir??? Will They be Back???	P. Janssen
8:50AM	Fish Lake: The Management of a Trophy Lake Trout Fishery.	C. Chamberlain
9:10AM	Using a Historical Perspective to Analyze Human Aspects of Fisheries Management: Examples from the Henry's Fork.	R. Van Kirk
9:30AM	Relative Survival and Growth of Triploid and Diploid Rainbow Trout in Two Idaho Reservoirs.	D. Teuscher
9:50AM	Fishery Investigations at Willard Bay, a Warm Water Reservoir in Northern Utah, from 1994-2001.	C. Schaugard
10:10AM	Break	
10:30AM	Growth and Survival of Stocked Rainbow Trout in Flaming Gorge Reservoir, Utah-Wyoming.	T. Haddix
10:50AM	Rainbow Trout Recruitment and Fishing Mortality in the Kootenai River, Idaho.	J. Walters
11:10AM	How Salmonid Consumption Relates to Fish Size.	R. Rader
11:30AM	An Evaluation of Physical Stream Habitat Attributes Commonly Used to Monitor Reach-Scale Stream Conditions.	B. Roper
11:50AM	Presentation of best paper awards, closing remarks.	
	Adjourn	

POSTERS

Age and growth of least chub (*Iotichthys phlegethontis*) in natural populations.

Joshua Brown* and Mark C. Belk,

Fish distributions and temperature: a tale of two trout

Jason Dunham*, Bruce Rieman, and Gwynne Chandler

Measuring stream temperatures with digital thermographs: a user's guide

Gwynne Chandler, Jason Dunham*, and Bruce Rieman

Different Life History of Brook Trout Populations Invading Mid-Elevation and High-Elevation Cutthroat Trout Streams in Colorado

Benjamin M. Kennedy*, Douglas P. Peterson, Kurt D. Fausch

Experimental studies on the temperature tolerance of two gastropods endemic to the middle Snake River, Idaho, USA

Steven J. Lysne* and Peter Koetsier Ph.D

Range-Wide Genetic Structure of the Mountain Whitefish (*Prosopium williamsoni*)

Andrew Whitely*

ABSTRACTS BY SESSION

Plenary Session: American Fisheries Society: What Are We Managing For?

**Wayne Hubert, Assistant Head, Wyoming Cooperative Fish & Wildlife Research Unit,
University of Wyoming**

Evolving Paradigms of Management and Consequences for Educators and Managers

Henry Maddux, Field Supervisor, US Fish & Wildlife Service, Utah

Preserving a Future or Only Delaying the Inevitable

Virgil Moore, Fisheries Bureau Chief, Idaho Fish & Game, Boise, Idaho

Fish, Fishing, Food and Feelings - Not What but Who Do We Manage For?

Kevin Christopherson, Regional Supervisor, Utah Div. of Wildlife Resources, Utah

Managing the Public's Resource Amid Changing Public Expectations: Can We Hit a Moving Target, Should We Try?

ANADROMOUS

How Many Chinook Salmon Redds Do Redd Counters Count When Redd Counters Attempt to Count Redds?

Russ Thurow*, (rthurow@fs.fed.us) and Dan Isaak (disaak@fs.fed.us) U.S. Forest Service, Rocky Mountain Research Station, 316 E. Myrtle, Boise, ID 83702, Phone: 208-373-4340;

Despite widespread use of redd counts to monitor trends in fish populations, the accuracy of counts are largely unknown and factors that introduce bias are poorly understood. We assessed the quality of chinook salmon redd counts by using repeated surveys to accurately estimate the true number of redds in 14 study reaches. Using these counts as baselines, we compared the accuracy and precision of single pass aerial (helicopter) and ground redd counts, quantified interobserver errors, and evaluated the influence of environmental characteristics on redd sightability. Aerial counts were within 10% of the baseline count in half of the study reaches and within 30% of the baseline in 80% of the study reaches. Valley morphology influenced counting errors and aerial counts were more likely to omit redds in confined channels and to overestimate redds in unconfined channels. Independent single pass ground counts by six observers averaged 90% of the baseline count at one study reach, but errors of omission and commission varied considerably among observers. Error rates were larger at redd clusters than at single redds.

Variation in Spawning Ecology Among Chinook Salmon Populations Within the Middle Fork Salmon River

Dan Isaak*, (disaak@fs.fed.us) and Russ Thurow (rthurow@fs.fed.us) U.S. Forest Service, Rocky Mountain Research Station, 316 E. Myrtle, Boise, ID 83702, Phone: 208-373-4340;

We monitored the progression of chinook salmon spawning at 10 reaches within the Middle Fork Salmon River in 2001. Timing of redd construction agreed with a broad latitudinal trend across the range of the species, although considerable variation was observed among study reaches. Median redd construction

dates ranged from August 11 to September 2, but most variation in spawn timing could be explained by mean stream temperature ($R^2 = 0.71$). Other patterns observed included decreased duration of redd building activities late in the spawning period, differences in adult movements into spawning areas, and strongly clustered redd distributions at the reach and subreach scales.

An assessment of Snake River spring/summer chinook salmon, *Oncorhynchus tshawytscha*, spawning habitat suitability using logistic regression techniques

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Howard Schaller, U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, 9317 NE Highway 99, Suite 1, Vancouver, WA 98665, (360)696-7605, Howard_Schaller@r1.fws.gov;

Current recovery efforts for threatened Snake River spring/summer chinook salmon populations rely heavily on freshwater spawning and rearing habitat improvements. An effective habitat restoration strategy requires a thorough understanding of which physical features are required for suitable habitat for a given life stage. We used logistic regression methods to evaluate spawning habitat suitability for chinook salmon in an Idaho stream. Depth, velocity, and substrate measurements were made at 43 potential spawning sites (pool tails) within a traditional spawning ground survey reach during the summer of 2001. The presence/absence of a chinook redd at the terminus of the spawning season was determined using a GIS approach, where redd locations were overlaid on habitat survey sample locations. Nearly one third of the sites sampled for habitat variables were used for spawning by chinook. Univariate analyses indicated that sites used by spawning chinook were characterized by larger substrate, higher water velocity, and slightly shallower depth. Additionally, D50 (median gravel diameter) was the only significant variable in the logistic regression model, though velocity was nearly significant. Both cross-validation and resubstitution error rates for this model were moderate to low, indicating that it has reasonable predictive utility. Based on the variables we analyzed, the primary determinant for site suitability for this stream is gravel size, though velocity is of secondary importance. This analysis demonstrates the utility of logistic models in understanding and predicting spawning habitat preference based on physical habitat measurements and may provide a template for prioritizing restoration activities where they are needed.

Migration Behavior and Tributary Use by Fall Chinook Salmon in the Bonneville and Dalles Reservoirs

Thomas M. Goniea* goni1520@uidaho.edu, Dr. David H. Bennett, Dr. Theodore C. Bjornn, Dr. Chris A. Peery

University of Idaho, Cooperative Fish and Wildlife Research Unit, P.O. Box 441141 Moscow, ID 83844-1141, (208) 885-7614;

We evaluated tributary use by fall chinook salmon (*Oncorhynchus tshawytscha*) migrating in the Columbia River during 1998 and 2000 when average water temperatures in the lower Columbia River differed by nearly 2°C in August and September. Fall chinook salmon radio tagged at Bonneville Dam were tracked through the system to their spawning grounds. Final locations of tags were recorded to distinguish upriver brights (URB) from lower river stocks spawning below Bonneville Dam and in the tributaries to the

Bonneville pool. Eight tributaries were monitored as possible thermal refuges for migrating salmon including: Wind, Little White Salmon, White Salmon, Klickitat, Hood, and Deschutes rivers as well as Herman and Eagle Creeks. In 2000, the cooler of the 2 years, 690 or 61.7% of all tagged fall chinook salmon were last recorded above The Dalles Dam and classified as URBs. A total of 391 URBs were tracked in the vicinity of one or more tributaries, however, no upstream migrants were found in the vicinity of Hood River, Herman Creek, or the Wind River. Of these, 74.2% delayed migration less than 12 hours, 10.0% delayed from 12 to 36 hours, and 15.8% stayed longer than 36 hours before continuing migration. Information will be presented on tributary use by URBs tagged in 1998 allowing for comparison with 2000. Preliminary data for 1998 indicate salmon used the same tributaries as in 2000.

Searching for a Life History Approach to Pacific Salmon Population Modeling

E. Eric Knudsen*, USGS, Alaska Science Center, 1011 Tudor Rd., Anchorage, Alaska 99503, 907-786-3842, eric_nudsen@usgs.gov; Eric W. Symmes, USGS, Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska, Fairbanks 99775-7020, 907-474-6197, fsews@uaf.edu; F. Joseph Margraf, USGS, Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska, Fairbanks 99775-7020, 907-474-6044, ffjfm1@uaf.edu

The interactions between Pacific salmon harvest and reductions of carcass-supplied nutrients delivered to the freshwater portion of the salmon ecosystem may have contributed to the notable declines of some populations. Previous spawner-recruit methods for assessing the effects of harvest have in many cases been inadequate. We therefore developed a heuristic, life-history based, spreadsheet survival model to analyze the effects of various harvest scenarios on a hypothetical coho salmon population. The model employs survival rates from the literature and individual, stochastically varied, terms for spawner to egg, egg to fry, fry to smolt, and smolt to adult survival and incorporates carcass-driven nutrient feedback from the marine to the freshwater ecosystems. The effects of climate variation and nutrient feedback on survival were simulated, as were density-dependent effects of the numbers of spawners and fry on freshwater survival of eggs and juveniles. We subjected the unexploited equilibrium population to 100 years of 20, 40, and 60% harvest and found each of these harvest rates gradually reduced the population to a steady state of respective reduction, regardless of generous compensatory survival at low population sizes. This or a similar approach should be pursued for helping to establish escapement goals and evaluating escapement decisions.

The Effects of Water Temperature on the Migration Behavior and Survival of Adult Steelhead in the Columbia River Basin

Brett S. High*, David H. Bennett, and Chris Peery, Idaho Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, University of Idaho, Moscow, ID 83844-1141, Phone: (208) 885-7614 e-mail: high4809@uidaho.edu

Historic dam counts from 1957 to 2000 for lower Columbia River dams including Bonneville, The Dalles, and John Day indicate that temperatures >19 °C cause a delay in the upstream progression of steelhead runs. Radio telemetry data obtained from individual steelhead tagged at Bonneville Dam in 1997 and 2000 suggest that this delay is associated with the use of cool-water tributary areas. In 2000, 76% of the 888 tagged steelhead observed migrating upstream of the Bonneville Reservoir were found utilizing tributary areas. In 1997, approximately 68% of the upstream migran temporarily delaying migration in these thermal refugia areas, steelhead maintain cooler body temperatures. In 2000, 181 steelhead were outfitted with radio data storage tags (RDST) which recorded body temperatures of steelhead. Mean body temperatures of steelhead observed in thermal refuge areas while migrating between Bonneville and The Dalles dams were significantly lower (15.6 °C) than that of

steelhead not inhabiting refuge areas (19.0 °C). Analysis of the general migration patterns of steelhead migrating upstream of The Dalles Dam indicated that the rate of survival to spawning areas and hatcheries was higher for steelhead which were previously found utilizing thermal refugia in the lower Columbia River. The predicted probability of survival for A-run steelhead in 2000 was 74% for steelhead which were not observed in thermal refugia compared to 86% for steelhead that used cool-water tributary areas. The results of this study indicate the importance of thermal refuge areas in the lower Columbia River on the migration behavior and survival of steelhead.

Molecular Genetic Variation among rainbow trout *Oncorhynchus mykiss* Walbaum (Salmonidae, Salmoniformes) from the Kamchatka Peninsula

Richard N. Williams^{1,2}, Madison S. Powell^{1*}, Serge D. Pavlov³, and Don S. Proebstel⁴, ¹ Center for Salmonid and Freshwater Species at Risk, HFCES / University of Idaho, 3059 F National Fish Hatchery Rd., Hagerman, ID 83332, USA, ² Flathead Lake Biological Station, The University of Montana, Polson, MT 59860, USA

³ Department of Ichthyology, Moscow State University, Vorob'evy gory, Moscow, 119889, Russia, ⁴ World Salmonid Research Institute, 205 Hazelwood Drive, Nederland, Colorado 80466, USA

Rainbow and steelhead trout *Oncorhynchus mykiss* from the Kamchatka Peninsula of Russia exhibited low levels of genetic variation in mitochondrial and nuclear DNA, as compared to North American rainbow trout, sharing a common mtDNA haplotype and common nDNA alleles. However, analysis of six microsatellite loci revealed significant differences among populations from different river system, but non-significant differences between anadromous and resident life histories either within or among rivers. Genetic distance among Kamchatkan rainbow trout populations generally increased with increasing geographic separation, supporting a stepping-stone model of population isolation and differentiation following a probable series of Pleistocene founding events by rainbow trout from northwestern North America during the most recent glacial epoch.

DISEASE

Effect of Sand Size on Filtration of *Myxobolus cerebralis* Triactinomyxons

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Triactinomyxons (tams) are the infective stage of *Myxobolus cerebralis*, the cause of whirling disease. A test was conducted to determine what sized particles of sand would be best for removal of tams from water supplies by filtration. A series of sieves was used to separate masonry grade sand into 12 different sizes (180-211, 212-249, 250-299, 300-354, 355-424, 425-499, 500-599, 600-709, 710-849, 850-999, 1000-1999, and >2000 μ m). Sand recovered on each of the sieves was added (either 2 or 4 cm) to a Gelman filter funnel. Prior to testing, the sand in each filter was rinsed with hatchery well water until there was no turbidity in the filtrate. Tams harvested fresh from worm cultures (10,226 to 66,400 per treatment) were diluted in 200 mL of hatchery well water. An additional 200 mL of well water with no tams was added as a rinse. The filtrate was filtered through a 20 μ m mesh to concentrate the tams. Controls consisted of tams filtered through the funnel without sand present and recovered on the 20 μ m mesh. The filtration process was repeated twice for each sand depth (2 or 4 cm) and sand size. Additional tests were conducted in which all sizes of sand combined (no sorting) were compared to filtration using sand for which particles less than 180 μ m had been removed. Control recovery averaged

74 ± 28.5% and 87.1 ± 24.8% for the 2 and 4 cm depth tests, respectively. Clearly recovery on the 20 µm mesh was not 100% efficient and highly variable, but sufficient to run the test. The critical size at which no tams were found in the filtrate was 300 µm at 2 cm depth and 425 µm for 4 cm of sand depth. For sand of 500-599 µm diameter, 4 cm of sand was sufficient to reduce tam numbers by 99%. Sand depth effects were significant: 4 cm of sand reduced tam numbers more than a sand depth of 2 cm when sizes of 500, 600, or 710 µm were used. At 4 cm sand depth, no tams were recovered from filtrate when sand of up to 425 µm was used, whereas a few tams made it through the 2 cm depth for sand 355-425 and 425-500 µm. Greater depths would likely be more efficient in trapping tams, but at a cost to hydraulic head. Tests with all sand sizes combined indicated that 2 cm depth was not enough to remove all the tams (0.60 ± 1.27% recovery), but a sand depth of 4 cm resulted in 0.0 ± 0.0% recovery of tams in the filtrate. Using sand with particles >180 µm gave similar results: 0.18 ± 0.53% and 0.0 ± 0.0% recovery at 2 and 4 cm sand depth, respectively. Removing particles <180 µm significantly increased gravity flow rates: 32.5 ± 1.0 sec vs. 155.0 ± 35.6 sec ($n = 6$) for 200 mL of water to pass through 2 cm of sand of all sizes. With 4 cm of sand depth, sand of >180 µm also improved flow (39.0 ± 7.7 sec) compared to sand of all sizes combined (160.5 ± 18.7 sec, $n = 6$). The results from these tests were used to guide further testing. Still unknown are the effects of water volume (i.e., does more flow push the tams through the media?), backflushing (are tams given a opportunity to slip through at this time?), and bacterial biofilms that develop on the sand grains over time (greater trapping efficiency? reduced flows?). At the Midway State Fish Hatchery, Midway, Utah, a filter using sand >180 µm has been established to filter contaminated spring water. Sentinel fish have been exposed to the filtered water since hatching November 5th, 2001. Control fish are being exposed to the spring water without filtration. These will be sampled after 4 months of exposure. Additional tests are being conducted at the Fisheries Experiment Station using rainbow fry in aquaria exposed to water filtered by sand of either >180 µm or >300 µm. These tests are ongoing.

The Effects of Habitat Features on the Distribution of *Myxobolus cerebralis* and Occurrence of Whirling Disease among Age-0 Salmonids in the Salt River Drainage, Wyoming-Idaho

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The Salt River is a fifth-order watershed that flows into the Snake River near the Wyoming-Idaho border. *Myxobolus cerebralis* was first detected in wild salmonids in the Salt River and its tributaries in 1995. We assessed the distribution of *M. cerebralis* and occurrence of whirling disease among age-0 trout and mountain whitefish relative to habitat features during 2000. Age-0 salmonids and associated habitat features were sampled at 108 sites on nine montane tributaries and the headwater to Salt River, 11 spring creeks originating on the valley floor, and the mainstem river. Habitat features that were sampled included the extent of fine sediment deposition, the abundance of aquatic macrophytes, length of eroding banks, channel slope, variation in stream flow, and riparian condition. Nested polymerase chain reaction

(PCR) analysis indicated that *M. cerebralis* occurs in age-0 salmonids throughout the watershed with the exception of two mountain tributaries isolated by irrigation diversion dams. A higher proportion of age-0 salmonids in spring creeks and the Salt River were infected with the parasite than in mountain tributaries. Infection rate was most highly correlated with the amount of fine sediments within a reach. Histological analysis indicated severe infections of *M. cerebralis* in trout at some spring stream and mainstem river sites. Histological grades of infection were most highly correlated with fine sediment deposition and the abundance of aquatic macrophytes at sites.

Distribution of *Myxobolus cerebralis* in the Logan River, Utah: Effects on salmonid populations

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In 2001, we sampled 100 to 200 meter reaches on 8 sites along the Logan River, Utah, using depletion electroshocking techniques to assess the current status of salmonid populations and the distribution of the parasite *Myxobolus cerebralis* (*Mc*). We also measured a number of environmental variables including temperature and flow to assess potential habitat effects on the distribution of the parasite. Our cutthroat trout population estimates ranged from absent at the lower sections of the Logan River to 1768 fish/km at the headwaters. Brown trout abundance was inversely related to Cutthroat trout, with highs of 2126 fish/km at lower elevations and only 40 fish/km upstream. Small numbers of Brook trout were also present (45 fish/km), and whitefish were present at 5 of the 8 sites sampled. PCR testing for *Mc* indicates it is present in all sites except in one of the tributaries. Although the infection appears to be widespread in the Logan River, the severity of infection varies greatly. The prevalence of *Mc* on cutthroat trout ranged from 5 % at the headwaters to 100% at a lower elevation. Brown trout samples from the tributaries tested negative for *Mc*, whereas 60% tested positive at the lower section of the river. All Brook trout and whitefish tested negative. Preliminary analyses indicate that measured environmental variables do not show a pattern related to the distribution of the parasite. Our results indicate that there have not been population declines since 1967 associated with the extent of *Mc* infections; however population sampling was sporadic before 2001. The significant increase in the number of infected sites since 1999 indicates that the disease is spreading and could have an impact on the populations in the future.

Utah's Midway Sport Fish Hatchery: A Case Report on the Detection of *Myxobolus Cerebralis*

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Midway State Hatchery is a closed spring facility located near the Provo River in central Utah. It utilized both concrete raceways at the upper end and dirt raceways at the lower end and provided approximately 21% of Utah's catchable rainbow trout. *Myxobolus cerebralis* was detected in the Provo River as early as 1997, presumably introduced by canal water from the contaminated Weber River. The hatchery was considered to be relatively susceptible to the introduction of *M. cerebralis* due to the presence of dirt raceways, proximity to contaminated water, the presence of avian and mammalian predators, human trespass and the possible introduction of free-ranging fish. In 1998, testing for the parasite was increased to a semi-annual basis, utilizing rainbow trout from the dirt systems with the longest exposure to the water. Confirmed findings of *M. cerebralis* in Jordanelle and Deer Creek reservoirs in February 2000, and in the effluent stream below the hatchery further increased the risk of parasite transfer to the hatchery. Pepsin-trypsin digest (PTD) testing at the hatchery in March 3, 2000 failed to show any evidence of the parasite from 60 fish. Although 30 samples from the concrete raceways tested negative by polymerase chain reaction (PCR) testing, 30 samples from the dirt systems showed 1/30 positive. Repeat testing on March 23, 2000 showed PCR positive results from 5/160 fish from the dirt system. These results

suggested the parasite had only contaminated the lower hatchery at that time, presumably from spore transfer by birds, mammals or fish. Concerns about return irrigation flows from the Provo River communicating to the springs prompted hydro-geologic studies using fluorescent dyes and bio-tracer bacteria. Results showed rapid contamination of the springs with the dyes and bacteria from some of the surface water introductions. Sentinel fish studies on the Blue Spring at 2 months exposure showed 1/10 fish with PCR positive results, and 2/10 positive at 4 months. In Main Spring, 0/10 were PCR positive at 2 months, but 4/10 were positive at 4 months. Myxospores consistent with *M. cerebralis* were not detected by PTD testing until 11 months post-exposure. These results suggest a second route for parasite introduction, through "secured" ground water sources contaminated by irrigation water recharge from the Provo River. In response to this, a number of test wells have been dug to secure new sources of ground water in geologically isolated subterranean layers. Based on encouraging results, a large-scale production well is currently being drilled. In addition, research trials are ongoing to determine the efficacy of sand-filtration in removing the parasite from the water of the existing springs.

CULTURE

Triploid Trout Production in Utah: Current Status and Ongoing Research

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The production of triploid rainbow trout has gained popularity recently with some states and provinces instituting production of only sterile rainbows. From a management perspective stocking sterile rainbows should prevent hybridization with cutthroat, thereby maintaining the genetic purity of the remaining cutthroat stocks. Recent requests for triploid lake and brook trout have also been made by fisheries managers. Previous research in Utah with heat shocking rainbow trout eggs has indicated that a treatment regiment of 26-27⁰C at 20 minutes post fertilization for a duration of 20 minutes resulted in fish that were 97-100% triploid with a 71-80% eye-up. Based on these results for the fall 2001 spawning season, all rainbow trout eggs of the Sand Creek strain (Sept-Nov) were heat shocked to induce triploidy. Triploid inductions among the various lots were generally 100% triploid, however concern arose over a reduction in eye-up and hatch percentages as well as a perceived increase in size differential among fish. During this past spawning season lake and brook trout eggs from the Egan hatchery (UT) and lake trout eggs from the USFWS brood hatchery at Saratoga (WY) were heat shocked for various times post fertilization and for several durations at temperatures of 27-29.4⁰C. For lake and brook trout, egg survival was negatively affected by and increase in treatment temperature. However triploid induction among the lake trout was 100% at the higher temperatures. Overall the large scale production of triploid rainbows was demonstrated to be feasible, accepting an increase in man hours required and a slight decrease in egg survival. We were successful in producing triploid lake trout, however more research may be required to improve egg survival.

Effects of Rapidly Changing Temperatures on Short-Term Survival of Juvenile Rainbow Trout

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Two experiments were conducted to evaluate the effects of rapid temperature changes on the post-stocking survival of fingerling rainbow trout. We examined the survival of fingerling rainbow trout exposed to 24°C water at different tempering rates and from initial temperatures of both 0.3 and 8°C. In our first experiment, fish acclimated to 8°C were exposed to four treatments: (1) constant 8°C, (2) an immediate transfer to 24°C, (3) 4°C/h change to 24°C, and (4) 8°C/h change to 24°C. In the second experiment, fish were acclimated to 8°C and exposed to three treatments: (1) constant 8°C, (2) iced to water temperature of 0.3°C for 2 hours then transferred to 8°C with no tempering, and (3) iced to water temperature of 0.3°C for 2 hours then transferred to 24°C with no tempering. Survival was recorded during and for 2 weeks following the experiments. We found that fingerling rainbow trout can withstand very rapid, large-scale changes in temperature with no measurable mortality. No differences in mortality were observed among the treatments in either the first or second experiment. Very few fish died during either experiment, and no mortalities occurred during the 2 weeks following the experiments. These experiments suggest that rapid temperature changes experienced by fingerling rainbow trout stocked into Wyoming waters may not be a significant cause of mortality if the receiving water is less than 24°C, approximately the upper lethal limit for the species.

Triploidy Induction in Rainbow Trout at Hayspur Hatchery: A Transfer of Research Test Results to the Hatchery Production Level

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This presentation will discuss how a fishery management request was investigated by research and implemented by hatcheries. A need to address the genetic introgression by hatchery rainbow trout on indigenous cutthroat trout drove this project. Researchers worked with hatcheries to develop methodology to induce triploidy and produce sterile trout. Hatcheries worked to develop tools to take the methodologies to production mode. Monitoring of induction rates demonstrated a 96.2% triploid average for 10 million eyed eggs produced.

Efficacy of AQUI-S™ as an Anesthetic on Various Life-Stages of Rainbow Trout *Oncorhynchus mykiss*

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The use of anesthetics is an important tool with broad application to fisheries management programs. Most often, anesthetics are used to reduce stress associated with the handling or transportation of fish. Anesthetics are widely used both in the culture of captive populations, and in field situations that involve the management of wildstock fish populations. Although a number of compounds have been used in the past, currently, the only approved anesthetic for use on fish is tricaine methanesulfonate (i.e., FINQUEL and Tricaine-S). While FINQUEL and Tricaine-S have been found to be effective anesthetics for use in aquaculture, both products require a 21 day withdrawal period after treatment before harvestable fish can be released. This requirement greatly restricts approved use in many cultured and wildstock populations. AQUI-S is a new anesthetic that is approved for use in New Zealand and several other countries as a zero-

withdrawal time product. Efforts are currently underway in the United States to gain U.S. Food and Drug Administration approval for the use of AQUI-S as an anesthetic with no withdrawal period. The active ingredient in AQUI-S is approved for human consumption in the U.S. when used as a food flavoring (21-CFR 172.515). A recent study conducted at the USFWS (Bozeman Fish Technology Center) National INAD Office evaluated various life-stages of rainbow trout treated with AQUI-S at concentrations ranging from 5 - 80 mg/L to induce handleable and anesthetized fish. Results indicate exposure to AQUI-S at concentrations less than 20 mg/L will be suitable for light sedation, and exposure to AQUI-S at concentrations ranging from 20 to 80 mg/L will anesthetize rainbow trout to the handle-able stage in less than 5 min, and to the anesthetized stage in less than 10 min. Furthermore, results indicate that if approved by FDA, AQUI-S may be a useful tool for aquaculturists and field biologists.

NATIVE AQUATICS

Temporal Distribution of Kootenai River White Sturgeon Spawning Events and the Effect of Flow and Temperature Post-Libby Dam

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We examined the temporal distribution of endangered Kootenai River white sturgeon *Acipenser transmontanus* spawning and how it related to flow and temperature, and both natural and man made variations thereof. White sturgeon spawning from 1994 through 2000 was monitored by the collection of eggs in the spawning reach with sampling mats and subsequent microscopic examination of eggs to estimate age and timing of spawning. Chi-square analysis indicated no two years of flow during May and June were alike ($p < 0.0001$). We estimated there was a range of white sturgeon spawning events of nine in 1999 to 20 events in 1998 and they spawned during a range of 17 d in 1997 to 31 d in 1998. Average daily water temperature during spawning ranged from 7.5 to 14°C, with the highest probability of spawning (48%) at the 9.5-9.9°C range. Average daily flow for spawning events ranged from 141 to 1,265 m³/s but most (63%) spawning took place above 630 m³/s. Initial spawning during spring by Kootenai River white sturgeon may be synchronized with the arrival of females from downstream staging reaches. After the onset of white sturgeon spawning, the temporal distribution of spawning events appears to be dependent on the shape and stability of flow and temperature. We recorded 10 circumstances when white sturgeon spawning ceased for three or more d between the first and last events, four circumstances were apparently due to a drop in temperature, two a drop in flow, two both temperature and flow, and two circumstances could not be explained. Our analysis suggests flows for optimum white sturgeon spawning in the Kootenai River should be held above 630 m³/s and ideally 1,200 m³/s with a temperature range of 9.5 to 12.5°C.

Antipredatory Defenses Used by Two Native Cyprinid Species and their Effectiveness in Avoiding Predation by Introduced Brown Trout

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Leatherside chub (*Gila copei*) and reidside shiner (*Richardsonius balteatus*) are two species of cyprinids that have historically not been exposed to a strong predatory influence in the Bonneville Basin. In the early 1900's brown trout (*Salmo trutta*) were introduced into the Bonneville basin as a sport fish and have since come to occupy most flowing waters in the Bonneville Basin. During the same period both leatherside chub and reidside shiner have experienced declining population sizes and distributions. Prey species that have coevolved with strong predators develop antipredatory behaviors and morphologies as a

result of the negative impacts of predation. However, since leatherside chub and redbside shiner within the Bonneville Basin evolved in an environment without strong predation, they may lack appropriate antipredatory responses to this introduced predator.

I compared behavioral antipredatory responses of both leatherside chub and redbside shiner in order to better understand how these two species may respond to this introduced predator. Both prey species respond to the presence of a predator or simulated attack, however, the response strategies differ between leatherside chub and redbside shiner. Redside shiner increase activity level, respond to a simulated attack earlier and quicker, and also change directions frequently. Leatherside chub, on the other hand, decrease activity level, respond to the simulated attack later and more slowly, and make fewer changes in direction, opting instead to move a further distance away.

I also tested the effectiveness of these two different strategies by exposing both species to predation by brown trout in a field experiment. Survivorship data indicates that brown trout appear to have a more negative impact on leatherside chub than on redbside shiner. Thus it would appear that the effectiveness of a native species antipredatory response is an important factor to consider when making management decisions.

Boreal toad distributional surveys and monitoring in Northern Utah 1999-2001

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Boreal toad (*Bufo boreas boreas*) is considered a sensitive species by the Utah Division of Wildlife Resources (UDWR) due to declining populations. Intensive surveys were conducted from 1999-2001 to locate boreal toad populations in Northern Utah. The number of known boreal toad populations increased from 15 to 30 as a result of these surveys. Efforts to monitor populations in Northwestern Utah began in 1999 at six sites. Time constraints on UDWR aquatics biologists preclude time intensive monitoring activities, consequently, monitoring was limited to once-a-week visits during the breeding season. During these visits, the number of egg strands was documented and adult (>50 mm snout-vent length) boreal toad were PIT-tagged to determine population sizes at individual ponds. Populations were calculated with a running Schnabel mark-recapture method. Population estimates and tight 95% confidence intervals were obtained at all six sites during at least one year. Population estimates indicated that boreal toad populations were 1.5-5.7 times larger than the maximum number of toads observed on any given visit. Even though statistically sound population estimates can be obtained with PIT-tagging, boreal toad will be monitored in Northern Utah by counting the number of egg strands. Nine boreal toad moved 1.6 km between breeding ponds during the three year span.

Evaluating reasons for failure of a reintroduction of leatherside chub (*Gila copei*)

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Leatherside chub (*Gila copei*) is a species of concern in Utah because of documented declines in the species range. In the Provo river drainage, leatherside chub have disappeared from most of their formerly occupied range. As part of the ongoing Provo river restoration project we reintroduced leatherside chub into a newly restored side channel of the Provo river. Two hundred individuals were transferred from Main Creek in the Wahlsburg area to the new location in November of 1999. Snorkel surveys were used periodically throughout the next two years to assess population abundance and distribution. During the first summer after reintroduction leatherside chub were observed in several locations mainly downstream

from the reintroduction site. One young-of-year was observed late in the first summer. Total numbers observed declined throughout the first summer. The second summer numbers were lower yet, and by the end of the second summer no leatherside chub were observed. What may account for apparent failure of the reintroduction? Side channels may not provide sufficient refuge for a small population. Cutoff pools or other more isolated habitats may be required for this vulnerable species to survive. I suggest that more research is needed to determine factors affecting success of reintroductions.

Observations on RAPD and mtDNA Analyses of Westslope Cutthroat Trout from Four Streams in the Salmon River Breaks

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The subspecific identity of two populations of cutthroat trout, *Oncorhynchus clarki ssp*, in the lower Salmon River drainage of Idaho were analyzed using RAPD and mtDNA techniques. Despite uncertain findings of earlier work on the Trail Creek population, specimens analyzed in this research were determined to be westslope cutthroat trout, *O. c. lewisi*. The second population studied, John Day Creek, received numerous introductions of Yellowstone cutthroat trout, *O. c. bouvieri*, and rainbow trout, *O. mykiss*, from the 1930s through the 1970s. However, samples analyzed from this stream identified the present population as westslope cutthroat trout, with the exception of one individual identified as an *O. c. lewisi* x *O. m. gairdneri* specimen. Chi-square analyses utilizing a Monte Carlo bootstrapping technique with mitochondrial DNA RFLP data from five additional trout populations revealed a significant difference ($X^2 = 669$, 24 df, $p = < 0.0001$) in heterogeneity of the samples studied. Several RAPD and mitochondrial DNA markers were developed that separate westslope, Yellowstone, and two types of rainbow trout. Other findings suggest that despite relatively widespread stocking of hatchery trout in the middle to latter 20th century, populations of native, non-introgressed westslope cutthroat trout may still be fairly numerous in relatively isolated 1st and 2nd order streams of the lower and middle Salmon River basin.

Year-Class Strength and Feeding Ecology of Age-0 Paddlefish in Fort Peck Lake, MT

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The paddlefish *Polyodon spathula* stock inhabiting Fort Peck Lake, MT is among the few remaining naturally-reproducing stocks. For effective management, information is needed on reproductive success and year-class strength, which entails an understanding of the distribution, abundance, and food habits of age-0 and age-1 fish. Sampling was conducted during the late-summer and fall of 1998 and 1999 in a 39.4 km portion of the upper reservoir from rkm 3,042.5 to 3,003.1. Counts of age-0 and age-1 paddlefish indicated that abundance was low in 1998 and even lower in 1999. During 1998, higher numbers of age-0 paddlefish were more often observed near rkm 3,024 during late July and early August. By late August, higher counts of age-0 paddlefish shifted to down-reservoir areas where zooplankton abundance had increased ten-fold from up-reservoir areas. Significant correlations were found between age-0 fish abundance and two of the six habitat measurements; age-0 fish abundance was positively correlated with wave height and negatively correlated with current velocity. Food habits of wild, age-0 and age-1 paddlefish were investigated in July-September, 1998 and 1999. The stomach contents of age-0 and age-1 paddlefish indicated that these age-classes fed selectively, and the diet was composed of some of the larger organisms available. In up-reservoir areas, paddlefish fed heavily on chironomid larvae, whereas those paddlefish collected from down-reservoir areas selected for *Leptodora kindtii*.

Movement patterns in inland salmonids, migrants, residents or a continuum?

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In the past, researchers have attempted to characterize inland salmonid life histories as migratory or resident, often concluding that populations are composed of a small proportion of migratory fish and a larger proportion of resident fish. The purpose of this study was to test several hypotheses about movement patterns in Bonneville cutthroat trout, *Oncorhynchus clarki utah*, by radio tagging fish on the spawning grounds. Our first hypothesis was that the spawning population would consist largely of resident rather than migratory fish. This hypothesis was not supported, 82% of radio-tagged fish migrated downstream out of the tributary in which they spawned and 18% remained in their spawning tributary. Our second hypothesis was that larger fish would move longer distances than smaller fish. This hypothesis was supported by a significant positive linear relationship between the natural logarithm of post-spawning distance moved (km) and fish length (mm). Our third hypothesis was that females would move longer post-spawning distances than males. This hypothesis was not supported because there was no significant difference in the relationship between post-spawning movement distance (km) and fish length (mm) between males and females. After post-spawning movements were complete, fish remained in the same locations throughout the summer. Our results suggest that the division of the population into migratory and resident segments may not be useful, especially because fish that moved long distances during spring were relatively sedentary during the summer. Rather, examining the overall pattern of movement within or across seasons may be a more realistic way to determine how populations use an entire drainage and how human fragmentation will affect inland salmonid populations.

Abundance and Age Structure of Adult Lake Sturgeon in the Manistee River

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Lake sturgeon (*Acipenser fulvescens*) populations in the Great Lakes region were drastically reduced in the late 1800s due to commercial overfishing and habitat degradation. A lack of current information regarding key population parameters for remaining populations has hindered recent rehabilitation efforts. The Manistee River (Manistee County, Michigan) was believed to support one of the largest remaining lake sturgeon populations in Michigan. The main objectives of this study were (1) to obtain annual spawning population estimates for lake sturgeon in the Manistee River in 1999 and 2000, and (2) to determine the age structure of sturgeon returning to spawn. Sturgeon were captured using gill nets (20.3 cm and 25.4 cm stretch mesh) fished overnight during April-June of both years. Population estimates were obtained using the Schnabel method, and age was determined from cross-sections of pectoral fin ray samples. Population estimates for both years were less than 110 individuals. Approximately one-third of the fish captured were juveniles, indicating that the actual number of spawning adults was probably much less than 100. This represents a dangerously low number of spawners, but the presence of juveniles suggests that some natural reproduction is still occurring.

The June Sucker Recovery Implementation Program: a collaborative approach to endangered fish recovery and water development

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The June sucker (*Chasmistes liorus*) is endemic to Utah Lake and its tributaries and was federally listed as an endangered species with critical habitat in 1986. Reasons the June sucker was listed include its localized distribution, failure of individuals to survive to the adult life stage, and multiple threats to its continued survival. The U.S. Fish and Wildlife Service designated June sucker as a species with a high risk of extinction, a low recovery potential, and one where recovery would be complicated because of the presence of conflict. The primary conflicts with recovering June sucker are water development and operations, nonnative fish and sport fish management, and urbanization. With the listing of June sucker as an endangered species, federal agencies managing and developing water resources were required to consider impacts to June sucker from proposed and on-going water projects through consultation with the U.S. Fish and Wildlife Service. There grew a general recognition, however, that many of the threats to June sucker recovery, such as impacts from nonnative fish and habitat degradation, could not be addressed solely through water management. In order to make significant progress towards recovery and address the threats to June sucker recovery in a balanced manner, a cooperative multi-agency program was believed to be essential. A collection of state, federal and private entities are collaborating to implement actions to recovery June sucker while balancing the water needs of a growing human population. This collaborative effort, known as the June Sucker Recovery Implementation Program, has two main goals: (1) to recover June sucker so that it no longer requires protection under the Endangered Species Act, and (2) all for the continued operation of existing water facilities and future development of water resources for human use along the Wasatch Front. The presentation will focus on the current status of June sucker and approach being taken by the June Sucker Recovery Implementation Program.

A Long-Term Comparison of Yellowstone Cutthroat Trout Abundance and Size Structure Throughout Their Historical Range in Idaho

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We compared estimates of population abundance and size structure for Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* derived by electrofishing 77 stream segments across southeastern Idaho in the 1980s and again in 1999-2000 to test whether populations of Yellowstone cutthroat trout had changed. Sites sampled in the 1980s were relocated in 1999-2000 using maps, photographs, or by finding original site-boundary stakes, so that the same reach of stream was sampled during both periods. Abundance of Yellowstone cutthroat trout greater than 10 cm did not change, averaging 40.8 fish/100 m of stream during the 1980s and 41.1 during 1999-2000. The proportion of the total catch of trout comprised of Yellowstone cutthroat trout also did not change, averaging 82.3% in the 1980s and 78.1% in 1999-2000. At the 48 sites where size structure could be estimated for both periods, there was a slight decline in the proportion of Yellowstone cutthroat trout 10-20 cm (74.0% vs. 66.2%), but the change was due entirely to the dramatic shift in size structure at the Teton River sites. Yellowstone cutthroat trout > 10 cm were not captured in 1999-2000 at 5 of the 77 sites that originally contained them in the 1980s, but four of the sites contained few cutthroat trout in the 1980s, and one site contained numerous cutthroat trout fry as well as cutthroat trout > 10 cm above and below the study site in 1999-2000. The number of sites that contained rainbow trout *O. mykiss* or cutthroat trout x rainbow trout hybrids rose from 23 to 37, but the average proportion of the catch comprised of rainbow trout and hybrids did not increase (6.5% in 1980s and 7.1% in 1999-2000). Although the distribution and abundance of Yellowstone cutthroat trout has been substantially reduced in Idaho over the last century, our results suggest that Yellowstone cutthroat trout abundance and size structure in Idaho has remained relatively stable for the last 10-20 years. The expanding distribution of rainbow trout and hybrids throughout much of the upper Snake River basin, however, calls for additional monitoring and active management actions.

Status of native Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) in the State of Utah

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Yellowstone cutthroat trout (YCT) historically occurred in the northwest corner of Utah in two drainages, the Raft River and Goose Creek. While Utah Division of Wildlife Resources data indicates that YCT occurred in many of the streams in these drainages, most data was over twenty-five years old. In addition, non-native trout (e.g., brook, brown, and rainbow) had been historically stocked in most of these streams. Extensive surveys were completed in 2001 in most of these streams within the Utah portion of these drainages. The two main objectives of these surveys were: 1) to determine if YCT still persist in Utah and 2) to determine the purity of any remaining YCT populations. A total of 46 localities on 26 streams were examined in 2001. Trout were present in 63 stream miles of which YCT were present in 37 of those stream miles (59%). YCT were the only trout present in 22 of the 63 stream miles. Genetic samples were collected from six localities and results should be available in 2002-2003. Cutthroat trout that phenotypically resembled YCT were present in seven streams, however, hybrids dominated all but the headwater reaches of two streams.

Discovery and Management of Native Colorado River Cutthroat Trout in the Escalante River Drainage, Utah

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A putative population of highly colorful Colorado River cutthroat trout (CRCT) was first discovered in East Boulder Creek, a tributary to the Escalante River in the mid-1980s. Prior to this, CRCT were not historically known in Utah south of the Fremont River drainage. This discovery was unexpected and conservation management of this subspecies in this area represented an added work load to the existing aquatic management program. Conservation efforts seemed initially slow in development and largely consisted of 5-10 years to confirm population genetics, conduct disease inspections to allow transplants/potential development of a brood stock, and identify potential areas to conduct expanded conservation efforts. Nevertheless, by 2002, 6 remnant populations of CRCT had been identified inhabiting 13% of the historic stream habitat. Restoration projects completed to date increased this value to 22%. Projects in progress as of 2001 (scheduled to be completed in 2002) within the Escalante River drainage will increase these amount further to 33% of historic stream habitat, 29% of which will be exclusively native fishes. Also, CRCT were used to restore populations in the adjacent Fremont River drainage where native trout had been completely extirpated. In addition, a wild brood stock of Escalante River CRCT was established with eggs taken and successfully cultured at the Fisheries Experiment Station, in Logan, Utah, during 1999, 2000, and 2001. Plans are underway to incorporate native trout into local sport fish management programs including popular Boulder Mountain lakes.

The influence of water-use on the spawning migration and survival of Bear Lake Bonneville cutthroat trout (*Oncorhynchus clarki utah*) in St. Charles Creek, ID

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Like most other cutthroat trout subspecies the Bonneville cutthroat trout has suffered severe declines in population sizes and numbers. This pattern holds true in Bear Lake where hatcheries have been the main source of cutthroat production since the 1960's. St. Charles Creek is the only tributary to Bear Lake that supports a significant naturally reproducing population of Bear Lake Bonneville Cutthroat (BLBCT), however this population is generally small (<500 individuals). Since St. Charles Creek splits near the

mouth and enters the lake in two different locations, studying both arms is necessary to identify important spawning areas and sources of loss. The summer of 2001 was the second year of a three-year study of the wild population of BLBCT in St. Charles Creek. Our overall goal is to identify anthropogenic sources that limit the population and design a management plan to limit their effects and improve the wild population numbers. Our objectives in 2001 were to describe the cutthroat trout spawning movements with radio telemetry and redd counts and identify areas of concern that may be limiting natural reproduction in both the Little Arm and Big Arm. Spawning and rearing habitat appears to be plentiful in the Little Arm and main fork, however most spawners failed to reach quality spawning grounds. Most cutthroat that migrated into the Little Arm spawned near the mouth, which was dewatered for most of the summer. Population estimates from electrofishing suggest little to no egg-to-fry survival near the mouth. Most fish moving up the Big Arm were lost to the system when they entered the Bear Lake Outlet Canal and moved into the Bear River however a small number did successfully spawn. The summer of 2002 will involve artificially transporting fish to quality spawning grounds upstream and determining movement and spawning success.

Abundance and Movements of the Rainbow Trout Spawning Population in the Naknek River, Southwest Alaska

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Rainbow trout in the Naknek River of southwest Alaska attain large sizes and support a popular recreational fishery. Spawning fish are protected by a complete closure of sport fishing from 10 April to 7 June each year. As a result of increased sport fishing, the Alaska Department of Fish and Game initiated a study during 2000 and 2001 to better understand the dynamics of the spawning stock. Mark-recapture abundance estimates were conducted each year during the spring and population features, such as length distributions and the proportions of sexually mature fish, were estimated each year. Rainbow trout in the Naknek River are known to migrate between the river and Naknek Lake. A telemetry study was initiated in the spring of 2001 to determine the post-spawning movements of sexually mature fish in the river. The proportion of spawning fish that migrated from the river to the lake after spawning and the proportion of these fish that return to the river in the fall were estimated. The spawning stock was estimated to be 2,784 (SE=248) fish with a mean fork length of 655 mm (range 424 – 860 mm). Males became sexually mature at 424 mm and females at 425 mm. Eighty percent of the radio-tagged fish moved from the river into the lake during the summer, and 70% of the fish that could be located with functioning tags in the fall moved back into the river. It appears that most of the spawning stock migrates upstream to Naknek Lake after spawning and most of these fish return to the Naknek River in the fall to spend the winter in the river. The management implications of these findings are that most of the large mature fish in the Naknek River spawning stock are not available for exploitation by anglers during the peak angling period in the summer.

Behavioral interactions between least chub (*Iotichthyes phlegothonis*) and introduced western mosquitofish (*Gambusia affinis*)

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Least chub are a rare fish endemic to the Bonneville Basin. One of the major threats to their continued existence is the introduced western mosquitofish. However, little is known about the interaction between these two species that may account for the negative impact on least chub. To determine the nature of the interaction between these species we experimentally quantified activity, feeding behavior, and

aggressive interactions of least chub in the presence and absence of western mosquitofish. Two size classes of each species were used in the experiments. Least chub decreased activity rates and time spent feeding, but position in the water column (upper or lower) and habitat occupied (open or closed) did not show a clear trend. Both size classes of mosquitofish were more aggressive than least chub. Dominance, determined by the number of interactions initiated and the number won or lost, was large mosquitofish > large least chub = small mosquitofish > small least chub. These data suggest that mosquitofish may negatively impact least chub by interference competition and direct aggression.

Use of otoliths to describe variation in life history of freshwater salmonids

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Variation in life history patterns of salmonids represent an important component of biological diversity in streams and rivers of the western United States. Although scales and otoliths can provide useful information about life history, inferences based on the interpretation of growth patterns are often imprecise. We explored otolith microchemistry as an alternative that may offer better resolution of life history patterns and even the origin of individual fish when significant differences in chemistry exist among the environments fish may use. We collected 47 otoliths from carcasses of adfluvial adult bull trout (*Salvelinus confluentus*) to determine total age, and age and season of first migration from Trestle Creek to Lake Pend Oreille, Idaho. Otoliths were sanded to thin sections before we aged and measured chemical composition (Sr/Ca). The age of migration was determined by measuring the distance from the primordia to the point where we observed a sharp drop in Sr/Ca, and then locating the annulus where the change occurred. The season of migration was located by studying the point of movement relative to the annulus. Bull trout age ranged from 6-11 yr. Migration to the lake occurred between 1-5 yr and 51% of the fish moved at 3 yr. About 40% of the fish migrated to the lake in spring, 13% in summer, and 43% in fall, 4% were undetermined. Because the annuli were well-defined during stream growth, we had a high level of confidence when determining age of migration. We had less confidence when determining total age and season of migration. Otoliths from westslope cutthroat trout (*Oncorhynchus clarki lewisii*) in the Coeur d'Alene River basin were sampled to determine life history patterns that occur among and within tributaries. The chemical composition of the otolith nucleus can be used in many streams to discriminate fish of resident and migratory parental origin. Otolith chemistry appears to be a viable tool for the study of life history patterns in heterogeneous environments.

Susceptibility of bull trout, *Salvelinus confluentus*, to *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease

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Little is known about the susceptibility of bull trout (*Salvelinus confluentus*) to *Renibacterium salmoninarum*, causative agent of bacterial kidney disease, and how low grade bacterial infections affect overall survival and swimming performance of fish. We estimated a median lethal dose (LD₅₀) of *R. salmoninarum* for fish held at two water temperatures (9°C and 15°C). To provide a challenge, fish were administered 0.1 mL of a bacterial suspension between 3×10^5 and 1×10^{11} cells/mL via intraperitoneal injection. Fish sham challenged with 0.1 mL PBS served as controls. At 45 d post challenge, the estimated LD₅₀ for fish held at 9°C was 5.61×10^8 cells/g while at 15°C the estimate was 5.60×10^7 cells/g. Survival and susceptibility of bull trout challenged with 3×10^8 cells of *R. salmoninarum* was tested relative to similarly challenged lake trout (*Salvelinus namaycush*), arctic char (*S. alpinus*), rainbow trout (*Oncorhynchus mykiss*), and chinook salmon (*O. tshawytscha*) in trials at 9°C and 15°C. At 9°C,

86% of the bull trout, 84% of the lake trout, 67% of the rainbow trout, 69% of the arctic char, and 10% of the chinook salmon were alive 90 d post challenge. At 15°C, 97% of the bull trout, 95% of the lake trout, 70% of the rainbow trout, and 50% of the arctic char were alive 90 d after challenge. Small groups of each species of fish were tested for their ability to swim in a constant velocity swim chamber before and after bacterial challenge to determine how chronic infection with the bacterium affected swimming performance. Clinically infected fish had poor swimming performance yet challenged fish that appeared healthy were able to swim at a velocity of 6 body lengths per second for extended periods.

Instream Flow Incremental Methodology

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The Instream Flow Incremental Methodology (IFIM) is a process through which informed management decisions can be made for regulated rivers for the benefit of fish. There are several computer models that may be utilized within the IFIM framework for different purposes: PHABSIM predicts fish habitat as a function of flow, SNTMP predicts stream temperatures, and SALMOD predicts young-of-year recruitment based on several biologic and hydrologic parameters. In a pure IFIM study, all three of these models may be used. However, each of these models stands alone admirably on its own merits.

This presentation will submit examples of several projects and studies that are very different in scope and content, but are related through the use of one or more of the IFIM suite of models. First, an aquatic habitat study of native Snake River fishes will be presented. Next, a temperature model of the Lochsa River will be described. One of the newer and lesser-known models, SALMOD, will be introduced in two, first-of-its-kind applications. Finally, the applicability of these models to current situations regarding Idaho's rivers and native fishes will be examined.

HABITAT

Upper Salmon Basin Watershed Project Update. Formerly the Model Watershed Project Lemhi, Pahsimeroi and East Fork of the Salmon River, Idaho

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The Model Watershed Project has gone through many phases and changes in the ten years of anadromous fish habitat restoration with a community approach. We have expanded our boundaries, project complexities, budgeting, personnel, contacts, participants and even our name. The new Upper Salmon Basin Watershed Project continues to be a leader in the Columbia River Basin for cooperative habitat restoration that directly involves agencies and the public. **We wish to present an update on these changes and the many projects that have been implemented.**

This project was initiated in the fall of 1992 with "The Vision" of "Providing a basis of coordination and cooperation between local, private, state, tribal and federal fish and land managers, land users, land owners and other affected entities to manage the biological, social and economic resources to protect, restore and enhance anadromous and resident fish habitat."

The Project and local Soil and Water Conservation Districts receive funding from Bonneville Power Administration and other agencies for administrative support and project implementation. It is also guided by a community Advisory Committee and Technical Committee and works off the 1995 Model Watershed Plan which outlines restoration priorities for anadromous and resident fish habitat.

Our main Issue is a decline in chinook salmon, steelhead trout and bull trout in the Salmon River and tributaries. Salmon spawning surveys or redd counts are used indication of the numbers of fish returning to each drainage. In 1992 only 15 redds were counted in the Lemhi River as compared to an average of 1,300 from 1960-65. This decline has occurred proportionately in all drainages of the Salmon River.

The many successes and implemented projects include over 66 projects in the last six years including:

- 1) Twenty-nine fencing projects installed affecting 38 miles of stream for a total of 51 miles of actual fence.
- 2) Eleven bank stabilization projects installed for sediment reduction to enhance spawning habitat and water quality.
- 3) Six migration barriers moved to enable fish passage.
- 4) Water conservation of over 42 cfs on the Lemhi River and 12 cfs on the Pahsimeroi through irrigation diversion modifications and changes in irrigation practices.
- 5) Twenty irrigation diversion consolidations and modifications, including fish screens.
- 6) Stream habitat inventory conducted.
- 7) Experimental "Fish Flush" tested in 1994. Most ranchers voluntarily gave up irrigation water for a 12 hour period and increased Lemhi River flows by 50-100 cfs to allow stranded fish to move upstream to spawning areas.

Landscape Scale Riparian Improvement - An Example of Teamwork in Action

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Since the early 1990's, the Bureau of Land Management, Salmon Field Office has been actively engaged in restoring riparian areas on public land in the upper Salmon River basin, and particularly in the Lemhi River subbasin. The rugged topography, hot summers and historic overuse by livestock had heavily impacted the channel integrity and riparian vegetation of most streams in the subbasin. Through a combination of partnerships, teamwork, knowledge of the land and strong vision of what the land should look like, the Salmon Field Office staff has improved miles of perennial, fish-bearing streams throughout the subbasin. In 1994, and again in 1999, the Salmon Field Office (aka Lemhi Resource Area) was presented the American Fisheries Society Western Division Award for Recognition for Riparian Management, "awarded for special recognition in behalf of your efforts, interdisciplinary skills and leadership so capably applied toward protection, enhancement and overall management of riparian zones". Through this presentation we hope to showcase the results of the past decade's efforts and presents the management philosophy used to achieve these results.

Restoration of an Incised River; A Case Study of The Right Fork of the White River in Southeastern Utah

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Approximately 3,000 feet of the Right Fork of the White River was restored in 2001. The course of the river was threatening access to much of the White River drainage due to severe erosion of a portion of USFS road 081. The severe erosion over the past several years resulted in a 15-20 foot deep incised river, creating poor fish habitat and water quality. The recent discovery of a population of native Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in this drainage increased the need to restore the

degraded portion of the river. Details and lessons learned during the planning, design, construction, cost, re-vegetation, and monitoring stages of the restoration project will be explained and illustrated.

Historical Conditions of the Lower Boise River Prior to Large-Scale Watershed Development

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Society's view of streams and rivers is shaped by the current condition of the resource. This view may vary greatly from the system's "natural" state or potential. We have little memory of the early historical conditions of many native ecosystems including rivers and their associated floodplains. Also lacking is an appreciation of the degree to which these systems can change through time and space and the importance of this change to aquatic habitat. Restoration efforts must begin with an understanding of natural processes and historical context of ecological condition. The Boise River has undergone many changes since the mid 1800's and little is left of its natural state. In order to better understand these changes, this study was conducted to investigate the condition of the Boise River before large-scale development had taken place in the watershed. Written accounts of the Boise River during the 1800's provided anecdotal evidence of a river with constantly changing and shifting channels. Soil surveys were used to provide evidence of the boundary of the Holocene floodplain and the potential extent of the hyporheic zone. The cadastral survey of 1867 was used to graphically reconstruct the Boise River and its numerous sloughs and backwater areas during this time period. Vegetation maps, tree size and densities were determined based using data and descriptions in the cadastral survey notes. In addition, maps of cultural development were produced to place the river and floodplain conditions of 1867 into its appropriate historical context.

Fishery Response to Stream Habitat Improvement Projects on Thistle Creek

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Long-term commitments to protect and/or enhance Utah's fish and wildlife habitat were made in 1995 by establishing the Wildlife Habitat Program. Until January 2001, most people who fish, hunt, or trap in Utah were required to purchase a \$6 Wildlife Habitat Authorization. Money generated from the program is used to enhance, preserve, manage, acquire, and protect fish and wildlife habitat. Effective 1 January 2001, the requirement to purchase a Wildlife Habitat Authorization was eliminated, however funding of the program continues. To ensure that money will continue to be available, a portion of the revenue received from the sale of licenses will be placed in the Wildlife Habitat Account. The fee schedule for licenses was adjusted by legislation to maintain annual account revenues at about \$2,150,000.

Since 1997, the Central Region of the Utah Division of Wildlife Resource has been actively involved in stream restoration/habitat improvement projects. Objective of stream restoration projects on Thistle Creek, Utah County included: reduce sediment load from stream bank erosion, restore proper dimension, pattern and profile that mimics a natural stream, enhance riparian vegetation quality and quantity, enhance fish cover, enhance spawning habitat, enhance macroinvertebrate production, secure angler access and gain additional support from landowners in the Spanish Fork River Watershed to initiate additional restoration projects to enhance above-mentioned objectives.

A critical component of stream restoration/habitat enhancement projects that is often overlooked is post project evaluation. Without conducting such evaluations lessons will not be learned from past success and

failures. To evaluate the fishery response to the stream restoration fish population estimates were conducted prior to and following treatments.

Fishery response to habitat improvements has been very positive. On reaches where stream banks were sloped to allow vegetative cover to reestablish and placing rock and log structures to protect stream banks the mean trout abundance was about 295% greater than pretreatment and mean trout biomass was about 119% greater. In treatments that consisted of complete channel realignment the fishery response has not been as pronounced. Two years following treatment, the mean trout abundance was about 51% greater than pretreatment and mean trout biomass was about the same. However, it is anticipated that the trout population is still expanding.

The South Fork Salmon River A History of Change

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The South Fork Salmon River's history in the last century has been interesting and turbulent. The importance of the river to anadromous fishes has long been appreciated, but the watershed is important for other resources, including timber and recreation, as well. Natural disturbances, particularly flooding and fire, have been common in the watershed, and, until recently, substantial flood events seemed to occur on an approximately 10-year cycle. This was somewhat forgotten during the drought years of the mid-1980s to mid-1990s, but we were abruptly reminded with severe flooding in 1997. In this discussion, we are considering the drainage of the river itself and two major tributaries, the East Fork South Fork and the Secesh River; the drainage of the river itself is further divided into an upper and a lower portion, based on their relationship to the mouth of the Secesh River. The development of the South Fork has been diverse, including timber harvest, mining, recreation, community development, and so forth. In the upper South Fork, development led to concerns with anadromous fish habitat conditions as early as the late 1940s, with observer accounts of degraded habitat; some early photos show sand in the river, but its origin, whether natural or anthropogenic, is unclear. However, problems became obvious during December of 1964 and on into 1965 when rain fell on a well-developed snowpack and saturated soils. Mass failures, always common in the watershed, were abundant and many of our logging roads were washed into the river. Spawning and rearing areas for anadromous fish were inundated with sand, leading to aggressive restoration efforts that have included mechanical removal of fine sediment, road obliterations, road improvements, a harvest moratorium, culvert upgrades, campground relocations and improvements, and so forth. Similar actions have been taken in the tributary watersheds, where mining reclamation has also been important. Today, it appears that conditions have improved in the upper South Fork since the late 1960s: core sampling in several spawning areas indicates either stable or slightly coarsening trends in substrate size, and time series photographs show considerably less sand today. On a slightly ambivalent note, streambars over much of the upper South Fork show extensive stabilization, but the agent is an aggressive grass that may be an exotic species. However, it is our feeling that, considering all the evidence, that the river, though possibly not "back to normal," has recovered much of its natural resilience and that the watershed, as a whole, is in better shape today than in at least the last 50 years.

Mining and Fish: The Stibnite Story

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The Stibnite Mining Area, located near Yellow Pine, Idaho in the headwaters of the East Fork of the South Fork of the Salmon River, has been mined intermittently for various minerals since the early 1900's. Our story relates Stibnite mining and recent reclamation to aquatic habitat and associated biota changes. Historical and recent mining effects include toxic tailings within the streams and riparian areas, miles of exploration and mining roads, barriers to fish migration, impoundment failure, unstable channels, severely altered hydrology, and poor water quality. In 1997, mining ceased at Stibnite. A Superfund removal was initiated, and restoration and reclamation actions were begun. Stream channels have been reconstructed to avoid toxic tailings, diversions have been filled, tailings have been covered, bridges and dams have been removed, roads have been obliterated, culverts have been pulled, large areas have been revegetated, waste has been relocated, buildings have been burned, and pits, ponds, and heaps have been reshaped. Continued reclamation and removal actions are planned for the next several years.

The East Fork South Fork Salmon River watershed still contains an intact complement of native aquatic species (wild chinook salmon and steelhead, multiple life history forms of bull trout, native westslope cutthroat trout, Pacific lamprey, and others). Data show improving water quality, increased bioassessment scores from macroinvertebrate sampling, a stable if not improving sediment trend, increased potential for upstream anadromous fish passage, and successful spawning and rearing of outplanted chinook salmon.

Stream Channel Restoration For Westslope Cutthroat Trout, Benewah Creek, Coeur d'Alene Indian Reservation

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The C d' A Tribe has a long-term goal of restoring self-sustaining populations of cutthroat trout (*Oncorhynchus clarki lewisii*) to C d' A Lake. The C d' A Tribe was asked by a landowner to improve the stream channel that was historically straightened and adjoining floodplains cleared to develop cropland and pastures. The objective of the project, located on the mainstem of Benewah Creek, is to improve migration corridors and rearing habitat. Watershed Professionals Network provided stream channel design and construction supervision; and the Tribe implemented channel construction, riparian planting, fence construction, and long-term monitoring and maintenance.

The channel design goal was to restore the channel configuration, a Rosgen C4 channel type, based on meander pattern evident in the 1930's aerial photography and reference reaches. Design steps included hydrologic analysis to develop design flows, a topographic survey, soil and sediment survey, dominant discharge determination, hydraulic modeling (HEC-RAS), evaluation of landowner constraints, and development of alternative alignments.

Stream channel construction was initiated in the fall of 2000. Much of the old, entrenched channel was filled and the historic floodplain was reactivated through construction of 0.5 miles of new stream channel and nine meanders. Four J-hooks were built to establish lateral control points. Ten riffles were constructed with imported gravel to provide horizontal control. Large wood was used in conjunction with transplanted vegetation to provide additional bank stability and add structural complexity. Native tree, shrub, and graminoid communities were established onsite using a combination of mature transplants, live cuttings, containerized stock, and hydroseeding.

The stream channel has experienced two flow seasons. Low flows occurred in 2001, and an estimated bankfull flow occurred in January 2002. In general the stream channel is functioning as anticipated; the high flows scour out deposited fine sediments, deposit coarse sediments providing aquatic habitat, and are beginning to shape banks to the desired undercut configurations. One meander, compromised by

landowner constraints, shows some undesired streambank erosion and may require structural repairs in the future. Monitoring on the site will track changes in channel profile and streambank stability, summer utilization by westslope cutthroat trout, and colonization by aquatic macroinvertebrates.

Changes In Habitat Management of Utah Rivers and Streams in the Past 35 Years

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Past history shows that essentially all streams and rivers in the west, in the vicinity of humans have been altered at the whimsical desire of the landowner. In the past 35 years laws have been passed to correct this abuse of our water ways. Alterations made to water ways are now regulated to protect all entities effected by the alteration under review. Since the implementation of the clean water act and other such laws, the changes to our environment have been rewarding. Comments and photographs, showing the past practices, and comments and photographs showing changes in selected rivers and streams are presented. Also comments are made about what was done to speed up the corrections needed for these Utah water ways.

MANAGEMENT

Where have all the perch gone in Cascade Reservoir??? Will they be back???

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Cascade Reservoir was once considered a world-class yellow perch *Perca flavescens* fishery. It supported 300,000 to 400,000 angler hours of pressure annually. As recently as 1992 yellow perch made up 69% of the harvest and harvest rates for all game fish averaged 0.91 fish/h. Large catches of 250 to 300 mm perch were common if not expected. Angler catch rates declined through the mid 1990's and by 1997 there were virtually no yellow perch caught. Yellow perch population investigations in 1998 revealed that age-0 and age-1 fish made up over 95% of the yellow perch present. Many of the fish collected were in very poor condition and many had moderate to heavy loads of metacercariae of the digenetic trematode *Neascus elipticus*. Older age classes of yellow perch had all but vanished from the reservoir.

Investigations into causes of the decline were conducted from 1998 through 2000 by IDFG with funding from UBOR and Idaho Paser Co. We examined both historic and present water quality conditions and reservoir water management patterns. We conducted studies examining entrainment, food abundance and disease. None of the parameters examined revealed a cause for the decline. Northern pikeminnow *Ptychocheilus oregonensis* predation on yellow perch was also investigated using historical population data, present population data, bioenergetics modeling and predator exclosure pens. Historical data revealed that the yellow perch population increased dramatically only after the chemical removal of northern pikeminnow in the 1960's and 1970's. Modeling results indicated that northern pikeminnow could easily consume all yellow perch produced in a given year. Survival rates of yellow perch in the exclosure pens far exceeded that found in the reservoir. Population estimates in 1999 and 2000 revealed that there were only three yellow perch present for every one northern pikeminnow. Northern pikeminnow removal efforts were begun in 2001.

Fish Lake: The Management of a Trophy Lake Trout Fishery

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Fish Lake is one of the most popular fisheries in the state, supporting three resort marinas and drawing thousands of anglers annually. Lake trout (*Salvelinus namaycush*) were first stocked in Fish Lake, Utah in 1906 and while other species are more abundant, the possibility of catching a trophy fish draws many anglers to the lake each year. Concern about the status and future of the lake trout population arose when a decline in the abundance of forage fish became apparent in the mid-1980's. Utah chubs, the traditional forage of lake trout, and rainbow trout, an alternate forage fish, declined to low levels. A study was initiated to determine the cause of these declines and document the current status of the lake trout population. Estimates of lake trout relative abundance, exploitation, growth rates, and food habits were generated. Lake trout in Fish Lake are abundant, while primary forage species (Utah chub and rainbow trout) are limited. Smaller lake trout (<20 inches) consume primarily aquatic insects, while larger individuals (>25 inches) convert to a total fish diet (primarily rainbow trout). However, it is clear that some lake trout do not convert to a fish diet and experience lower growth rates than their piscivorous counterparts. In fact, by their ninth year in the lake, stocked lake trout ranged from 15 to 33 inches in length. In addition, smaller lake trout exhibited poor condition, while larger fish displayed high condition. The relatively large number of lake trout and limited numbers of forage fish in Fish Lake have created a bottleneck for lake trout between 20 and 25 inches. To continue growth these fish must convert to a piscivorous diet. Individual lake trout that squeeze through this bottleneck will reach trophy size and lake trout that do not may not survive.

Using a Historical Perspective to Analyze Human Aspects of Fisheries Management: Examples From The Henry's Fork

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The recreational fishing opportunities offered by a given fishery are strongly influenced by societal values and attitudes regarding outdoor recreation and natural resource management. These influences can occur directly via fisheries management agency actions and indirectly through the effects of natural resource management use throughout the watershed on fish habitat conditions. Thus, as societal attitudes change over time, fishing opportunities also change. However, the response time of fishing opportunity variables to societal change varies substantially, often resulting in discrepancies between what the angling public desires and what is physically and biologically possible. For example, responses of fish habitat to changes in land and water use practices may occur over a time scale of decades to centuries, whereas changes in fishing regulations in response to changing societal attitudes may occur in only a few years. Because all anthropogenic influences on a fishery are cumulative, a historical perspective is needed to effectively analyze the factors that determine the fishing opportunities and fisheries management options available today. On the Henry's Fork of the Snake River, fisheries scientists and managers have used multidisciplinary analysis of 130 years worth of information from government documents, popular and scholarly histories, historical archives, and quantitative databases to help address management issues that have included loss of native species, declines in population sizes and catch rates in popular recreational fisheries, and increasing demand for "wild trout" fishing opportunities.

Relative Survival and Growth of Triploid and Diploid Rainbow Trout in Two Idaho Reservoirs

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Increased growth rates, improved survival, and genetic protection of wild stocks have been suggested as possible benefits of stocking triploid fish. This study monitored the long-term growth and relative survival of triploid and diploid rainbow trout stocked in two Southeast Idaho reservoirs. In October 1996, triploid and diploid rainbow trout were differentially marked and stocked in equal proportions. Relative survival and growth were monitored using gillnet and electrofishing samples collected through October 2000. In both reservoirs, relative survival (total catch) was significantly higher for triploid fish. The final catch ratios (triploid:diploid) were 1.4:1 in Treasureton ($\chi^2 = 6.08, P < 0.03$) and 1.9:1 in Daniels reservoirs ($\chi^2 = 10.91, P < 0.01$). We also observed ontogenetic difference in growth. At age-1, mean length and weight values were similar for the triploid and diploid fish in each reservoir. During the second year, however, diploids grew significantly faster than triploids. The trend reversed as the diploid fish reach sexual maturity. Age-3 and older triploids matched or exceeded diploid fish in length but not weight. Our findings suggest that managers considering the use of triploid rainbow trout for trophy management should not expect a consistent growth advantage but may extend the period that a specific plant of fish is susceptible to anglers. Moreover, the all-female triploids fish provide an enticing management option when considering their ability to maintain hatchery-supported fisheries while protecting the genetic integrity of wild populations.

Fishery Investigations at Willard Bay, a Warm Water Reservoir in Northern Utah from 1994-2001

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Willard Bay is a large open water reservoir constructed in 1964 to provide irrigation water for Weber County. Shortly after it was constructed the Division of Wildlife Resources began stocking it with numerous species of warm water sport and forage fish. Prior to 1990, walleye and channel catfish were the dominant sport fish in the reservoir. Black crappie were also important, but numbers declined in the early 1980's probably due to predation and a lack of rearing habitat. In 1990, 1800 gizzard shad were introduced into the reservoir to occupy the vast open water habitat in the reservoir and provide additional forage for predators. In 1994, after the gizzard shad had become well established, an open water predator was needed to help control the shad numbers and provide additional fishing opportunities. A hybrid striped bass X white bass cross (wipers) were stocked into the reservoir to fill this niche. Since 1994, intensive sampling has occurred in the reservoir to monitor the fish community and investigate any impacts the newly introduced species are having on the other fish species.

Since their introduction, wipers have become a very popular sport fish at Willard Bay obtaining weights of 6-7 pounds and anglers have caught over 100 wipers in a day. Gizzard shad have become the most dominant food item for most piscivorous fish species in the reservoir, often comprising the majority of the yearly diet. Walleye have obtained better growth rates since the introduction of gizzard shad and the walleye fishery has become more consistent. Gizzard shad also have taken the pressure off other prey species and in response, those species have started to increase. However, since 1994, channel catfish numbers and growth rates have declined.

Growth and Survival of stocked rainbow trout in Flaming Gorge Reservoir, Utah-Wyoming

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Over the past forty years Flaming Gorge Reservoir has shifted from a trophy rainbow trout (*Oncorhynchus mykiss*) fishery to a trophy lake trout (*Salvelinus namaycush*) and kokanee salmon (*O. nerka*) fishery. Although this shift has occurred, rainbow trout are still highly sought after by recreational fisherman. Utah Division of Wildlife Resources annually stocks Flaming Gorge Reservoir with 400,000 sub-adult rainbow trout (~20cm), while Wyoming Game and Fish stock an equal biomass of fingerling rainbow trout. We are investigating factors that may limit rainbow trout growth and survival in Flaming Gorge Reservoir. For our research, we have divided the reservoir into three research units based on productivity and physical habitat types. Comparisons of growth of rainbow trout in these three regions along with productivity data, food availability, and lake trout predation may help to understand which factors are limiting rainbow trout survival and entry into the creel. Our results suggest that macrozooplankton sizes and abundance should not limit growth of rainbow trout in Flaming Gorge Reservoir. However preliminary analysis of size and age distributions suggest that few age classes of rainbow trout are found in Flaming Gorge Reservoir. Further, bioenergetics modeling indicates that lake trout can potentially consume over 300,000 stocked rainbow trout annually, a significant portion of rainbow trout stocked in the reservoir each year. Understanding the combination of these different factors may provide valuable insight, which may be used to assist in the management of Flaming Gorge Reservoir fisheries.

Rainbow Trout Recruitment and Fishing Mortality in the Kootenai River, Idaho

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The Kootenai River drainage is the only system in the Idaho panhandle with native inland (redband) rainbow trout. Fishing pressure appears to have increased in the past ten years due to increased access, but fishing mortality is unknown for this population. The system also appears to be recruitment limited. Our objectives were to determine sources of rainbow trout recruitment, and to measure fishing mortality to help guide management decisions. To address recruitment, we radio-tagged rainbow trout to determine spawning locations, and we estimated the numbers of juvenile outmigrants from tributaries from 1997-2001. We also conducted population estimates to determine rainbow trout densities in the Kootenai River in 1998 and 1999. To address fishing mortality (exploitation), we tagged rainbow trout ≥ 225 mm total length with \$10 angler reward tags in 1999 and 2000. A total of 44 rainbow trout were radio-tagged in the Kootenai River upstream of Bonners Ferry. Radio-tagged fish were located in four Idaho and three Montana tributaries during the spawning season. A total of 4,594 and 6,850 age-0 rainbow trout outmigrated to the Kootenai River from Idaho tributaries upstream of Bonners Ferry in 2000 and 2001, respectively. Kootenai River rainbow trout population estimates upstream of Bonners Ferry for 1998 and 1999 were 204 (68/km) and 190 (63/km) fish \geq age 2. Exploitation rates were 58 and 46 % for 1999 and 2000, respectively. The fluvial rainbow trout population in Idaho is recruitment limited, but also partly dependent on recruitment from Montana. Any spawning habitat enhancement in tributaries would benefit this population. Options to increase spawning habitat are being investigated. The population is also limited by fishing mortality. To address high exploitation, more restrictive fishing regulations have been implemented in 2002, including a bag limit of 2 fish ≥ 16 " (406 mm).

How Salmonid Consumption Relates to Fish Size

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In the study of ecological communities researchers have often tried to identify which organisms or individuals are dominant. The identification of such an organism or individual can provide valuable insights pertaining to the behavior of certain species. Often these studies result in the development of a hierarchy where one organism or individual is able to control a particular resource. In the case of fish inhabiting a stream, it is a common belief that larger fish are able to exclude other individuals from certain locations, thereby restricting their access of smaller fish to certain resources. In the case of foraging salmonids a valid question is whether or not larger individuals are able to exclude smaller individuals from optimal feeding sites and thus obtain a greater quantity of food. In order to answer this question we sampled the stomach contents of several hundred trout from the Arkansas River (Colorado) and recorded the length and weight of each fish. The stomach contents were identified to the family level and a dry weight for each family was recorded. The analysis of this data set allowed us to identify which size classes did indeed consume the largest amount of food and also allowed the creation of a regression equation that may prove valuable in identifying the amount of food a fish of a certain size class will consume in the presence of other fish.

An evaluation of physical stream habitat attributes commonly used to monitor reach-scale stream conditions

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The last couple of decades have seen an increased reliance on stream attributes for monitoring stream conditions. The use of these attributes have been criticized because of variation in how observers evaluate habitat, inconsistent application of protocols, lack of consistent training, and the difficulty in using stream attributes to detect change due to management activity. We evaluated the effect of environmental heterogeneity and observer variation on the use of stream attributes as monitoring tools. For most stream attributes we evaluated difference among streams (environmental heterogeneity) accounted for greater than 80% of the total measured variation. To minimize variation among stream it may be necessary to design survey protocols that include stratification, permanent sites, or analysis of covariance. Although variation was primarily explained by differences among streams, observers also differed in their evaluation of stream attributes. This study was able to minimize variation among observers through extensive training. Our study suggests if objectively defined stream attributes are evaluated by trained observers as part of study designed to account for environmental heterogeneity, then results of such survey should prove valuable in monitoring reach-scale stream condition. The failure to pay attention to any of these factors will likely lead to the failure of stream attributes to be an effective monitoring tool.

POSTERS

Age and growth of least chub (*Iotichthys phlegethontis*) in natural populations.

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The least chub (*Iotichthys phlegethontis*) is endemic to the Bonneville basin, formerly occupying slow moving rivers, creeks, ponds, swamps and springs. However, its range has been severely reduced due to habitat destruction and impacts of introduced species. As a result least chub is listed as a conservation species in the State of Utah. The least chub is generally thought to be slow growing and short-lived. However, no information is available on growth and longevity from individuals in the wild. We report age and annual growth patterns from four natural populations using otolith-derived estimates. Least chub appear to live longer than previously thought in natural populations. Growth rates are variable, but similar to estimates from laboratory studies. Understanding patterns of age and growth is important for future management of this rare species.

Fish distributions and temperature: a tale of two trout

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Temperature is a widely recognized limiting factor for coldwater biota. Salmonid fishes are among the most thermally sensitive species in this category, and there is great interest in their thermal requirements. This information can guide development of water quality criteria and provide a better understanding of the relationship between temperature and the productivity and persistence of populations. We modeled the distribution of two threatened trout, bull trout *Salvelinus confluentus*, and Lahontan cutthroat trout *Oncorhynchus clarki henshawi*, in relation to maximum water temperatures. The distribution of both species was strongly related to temperature. Results of this work demonstrate the utility of alternative approaches to studying and analyzing associations between temperature and fish distributions, and the value of multiple lines of evidence from independent field and laboratory studies.

Measuring stream temperatures with digital thermographs: a user's guide

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Digital data loggers (thermographs) are among the most widespread instruments in use for monitoring physical conditions in aquatic ecosystems. Temperature is a variable of widespread interest in aquatic ecosystems because it is an important component of water quality and it is affected by many different natural and human-related influences. Due in part to the dramatic increase in the use of temperature data loggers, the quantity of data on water temperature data has increased dramatically. The rapid accumulation of new data has perhaps surpassed our data processing ability, and it is not always clear that information from temperature data loggers is reliable, accurate, or useful. The intent of this protocol is to provide a comprehensive synthesis and analysis of the issues that must be addressed to ensure that data from temperature data loggers serve the objectives for which they were collect. We focus on issues

concerning measurement interval, data screening, correlation among various metrics, and development of a relational database for distribution.

Different Life History of Brook Trout Populations Invading Mid-Elevation and High-Elevation Cutthroat Trout Streams in Colorado

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Brook trout (*Salvelinus fontinalis*), native to eastern North America, have invaded many montane coldwater systems of western North America. These invasions are implicated in the decline of native cutthroat trout, but there is little information on the mechanisms involved. We tested whether brook trout populations invading streams at two different elevations varied in life history characteristics that influence population dynamics and potential invasion success. In the mid-elevation stream (2683 m), water temperatures were warmer and brook trout apparently grew faster (i.e., had longer lengths-at-age), became sexually mature earlier, and had shorter life spans compared to those in the high-elevation stream (3195 m). This suggests that flexibility in brook trout life history allows brook trout to maximize their chance of establishment and invasion success among elevations. We propose that in mid-elevation streams, fast growth and early maturity maximizes fitness and can lead to rapid establishment and high population growth rates. In high-elevation streams, slow growth, later maturity, and a long reproductive life span may allow brook trout to successfully establish populations in marginal habitats where recruitment is often poor. Landscape-scale models predicting brook trout invasion rates, distribution, and population growth rates should incorporate data from multiple elevations to account for differences in life history.

Experimental studies on the temperature tolerance of two gastropods endemic to the middle Snake River, Idaho, USA

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We studied the theoretical tolerance to extreme temperatures of two federally endangered gastropods endemic to the Snake River in south-central Idaho, USA. The Utah valvata (*Valvata utahensis*) and the Idaho springsnail (*Pyrgulopsis idahoensis*) were protected by federal law in 1992 in response to declining population numbers due to habitat alteration and degradation. Our objective was to begin investigating the theoretical niche that these snails exploit by conducting laboratory experiments designed to define the limits of the snails' physiological tolerances to temperature. In tightly controlled laboratory tests, we subjected experimental animals to incremental increases and decreases in water temperature until the thermal maxima and minima temperatures respectively, were realized. The average maximum temperature tolerable for *V. utahensis* was 31.77 ° C, the average minimum 7.39 ° C. The average maximum temperature tolerable for *P. idahoensis* was 33.70 ° C, the average minimum 9.34 ° C. Results of this work are intended to provide basic life history information, which is currently unavailable for either species of Snake River gastropod, and to stimulate further research into the biology and ecology of these unique organisms.

Range-Wide Genetic Structure of the Mountain Whitefish (*Prosopium williamsoni*)

POSTERS cont'd

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The genetic population structure of the mountain whitefish (*Prosopium willimasoni*) was investigated at 32 allozyme and four microsatellite nuclear loci. The amount of genetic variation within populations and the degree of genetic differentiation between populations have never been quantified for this species. Our results suggest that there is a large amount of intraspecific variation across the range of the mountain whitefish. Large among population and among region genetic differences were found with both microsatellites and allozymes. Three major genetic assemblages have been identified at this point: one in the upper Missouri and Yellowstone Rivers, one in the upper Snake River above Shoshone Falls, and one in the Columbia River Basin (including the Snake River below Shoshone Falls). These initial results provide a first step in understanding the basic biology of this understudied species. In addition, these data will be helpful to define populations and therefore to provide additional information upon which to base management decisions. Future analysis of additional samples from throughout the range of this species will allow us to determine if additional genetic assemblages exist and will allow us to determine the genetic structure of the mountain whitefish across its entire range.