AMERICAN FISHERIES SOCIETY
ORGANIZED 1870
IDAHO CHAPTER

Abstracts and Agenda

for the

1998 Annual Meeting
February 26 - 28

at

Cavanaughs on the Falls
Idaho Falls, Idaho

1998 Idaho Chapter AFS Annual Meeting
Agenda Overview

Wednesday, February 25

0830-1700	Training/Workshop: "Landscape Scale Disturbance: Effects on Aquatic Ecosystems" - Targhee/Bonneville Room
1700-2200	Annual Meeting Registration - Hallway
1800-??	Executive Committee Meeting - Sawtooth Room
1900-2200	Fish ID Workshop - Teton Room

Thursday, February 26

Ongoing	Poster Session - Lobby
0700-0800	Annual Meeting Registration - Hallway
0800-1200	Plenary Session and Keynote Addresses: "Managing Natural Resources in a Dynamic Environment" - Targhee/Bonneville Room
1200-1400	Committee Meetings - Box Lunch Water Quality/WaterQuantity Committee - Teton Room Anadromous Fishes Committee - Yellowstone Room Native Fishes Committee - Patio Room Riparian Committee - Room 143 Public Education Committee - Room 144 Stream Hydraulics Committee - Room 145
1400-1720	Technical Session I: Native Fishes - Targhee/Bonneville Room
1830-??	Palouse Unit Social and Student Mixer

Friday, February 27

Ongoing	Poster Session - Lobby
0700-0800	Annual Meeting Registration - Hallway
0800-1200	Technical Session II: Watershed Councils - Targhee/Bonneville Room
1200-1400	Business Luncheon - Teton/Yellowstone/Patio Room
1400-1700	Technical Session III: Dams and Diversions - Targhee/Bonneville Room
1830-??	Slide Show and Evening Social - Teton/Yellowstone/Patio Room

Saturday, February 28

Ongoing	Poster Session - Lobby
0800-1150	Technical Session IV: Fisheries Management - Targhee/Bonneville Room
1150-1200	Presentation of Best Paper Awards - Targhee/Bonneville Room
1200-1300	Executive Committee Meeting - Sawtooth Room

1998 Idaho Chapter AFS Annual Meeting
February 25-28, 1998
Detailed Agenda

Wednesday, February 25

0830-1700	**Training/Workshop**—"*Landscape Scale Disturbance: Effects on Aquatic Ecosystems*." Moderator - Kerry Overton. Targhee/Bonneville Room.
1700-2200	**Annual Meeting Registration** - Hallway.
1800-2000	**Executive Committee Meeting** - Sawtooth Room.
1900-2200	**Fish Identification Workshop** - Teton Room.

Thursday, February 26

Ongoing	**Poster Session** - Lobby.
0700-0800	**Annual Meeting Registration** - Hallway.
0800-1200	**Plenary Session and Keynote Addresses**: "*Managing Natural Resources in a Dynamic Environment: dealing with vibrant ecological, economic, social and policy realities*." Targhee/Bonneville Room.
0800-0830	Opening Remarks: Tim Cochnauer, IDAFS President
0830-0915	Keynote Panelist: Robert Ziemer, USDA Forest Service, Redwood Sciences Laboratory, Arcata, California--Ecological Dynamics
0915-1000	Keynote Panelist: Ernie Niemi, ECO Northwest, Eugene, Oregon--Economic Dynamics
1000-1030	Break
1030-1115	Keynote Panelist: Tom Kovalicky--Social and Policy Dynamics
1115-1200	Keynote Panel Discussion
1200-1400	Committee Meetings--Box Lunches Water Quality/WaterQuantity Committee - Teton Room Anadromous Fishes Committee - Yellowstone Room Native Fishes Committee - Patio Room Riparian Committee - Room 143 Public Education Committee - Room 144 Stream Hydraulics Committee - Room 145

1400-1720 **Session I: Native Fishes**. Moderator - Ed Lider. Targhee/Bonneville Room.

1400-1420 Life history and population status of migratory bull trout (*Salvelinus confluentus*) in Arrowrock Reservoir, Idaho. Brian J. Flatter (IDFG)

1420-1440 Development of a regional database of temperature records for bull trout. Donald Martin (EPA) and Bruce Rieman (USFS-INT).

1440-1500 Distribution and population trends of redband trout (*Oncorhynchus mykiss gairdneri*) in Owyhee County, Idaho. Dale Allen (IDFG).

1500-1520 Age determination using scales and otoliths for headwater populations of westslope cutthroat trout, *Oncorhynchus clarki lewisi*. C.C. Downs (IDFG), B.B. Shepard (MFWP) and R.G. White (MSU).

1520-1540 Interactions between cutthroat trout and coho salmon juveniles in an artificial stream. Pam Porter (U of I).

1540-1600 Break

1600-1620 Conservation versus recovery of chinook salmon, selecting the right tool for the job. Peter F. Hassemer (IDFG).

1620-1640 A hierarchical examination of the distribution and abundance of tailed frog larvae in north Idaho. Blake Hossack and Kirk Lohman (U of I).

1640-1700 Predation on juvenile arctic grayling in Upper Red Rock Lake, Montana. Laura Katzman (MSU).

1700-1720 Metapopulations and interior salmonids. Bruce Rieman (USFS-INT) and Jason Dunham (UNR).

1830-?? Palouse Unit Social and Student Mixer

Friday, February 27

Ongoing **Poster Session** - Lobby

0700-0800 **Annual Meeting Registration** - Hallway.

0800-0810 **Announcements** - Targhee/Bonneville Room.

0810-1200	**Session II. Watershed Councils Panel**. Moderator - Mike Larkin. Panel Members: Carloyn Hubble (Thompson Creek Mining Co), Dave McFarland (Lemhi County Riparian Habitat Conservation Agreement), Erasmo Paolo (United Stanley), Don Dixon/Mike Crapo (Congressman), Charlotte Reid (Blackfoot Watershed Council), Mel Wagner (Yakima River Watershed Council), Louise Solliday (Oregon Governor's Office), Linda Hestag (Idaho Roundtables), Dale Swenson (Henry's Fork Watershed Council), Jack Williams (BLM).
0810-1000	Perspectives on how we manage the environment (Each panel member will have up to 10 minutes, with questions, on how they perceive governmental approaches to environmental management.)
1000-1015	Break
1015-1200	Collaborative Groups/Community Based Conservation/Watershed Councils. Open panel discussion. (How they got started. How they keep it going. Benefits and costs.)
1200-1400	**Business Luncheon -** Teton/Yellowstone/Patio Room.
1400-1700	**Tech Session III: Mostly Dams and Diversions**. Moderator - Brett Roper. Targhee/Bonneville Room.
1400-1420	Dissolved oxygen and feeding effects on growth, feed conversion, hemotology and physiology of rainbow trout, *Oncorhynchus mykiss*. Steve Todd (U of I).
1420-1440	Spawning behavior and movement of Kootenai River white sturgeon as determined by telemetry. Vaughn Paragamian and Gretchen Kruse (IDFG).
1440-1500	Passage of adult chinook salmon at dams and migration into tributaries, an update. Ted Bjornn (U of I).
1500-1520	Fishway entrance use and passage by adult chinook salmon in 1996 at Bonneville, McNary, Ice Harbor and Lower Granite dams. Matt Keefer (U of I).
1520-1540	Salmon and steelhead migration routes in the forebays of Ice Harbor, Lower Granite, and Bonneville dams. Tami Reischel (U of I).
1540-1600	Break
1600-1620	Evaluation of adult chinook and sockeye salmon passage at Priest Rapids and Wanapum dams with orifice gates closed and with an experimental fishway fence — 1997. Christopher A. Peery and Ted C. Bjornn (U of I).
1620-1640	Timing of migration and distribution of adult steelhead with radio transmitters in the Snake River drainage. P.J. Keniry, T.C. Bjornn, K.R. Tolotti and R.R. Ringe (U of I).

1640-1700 Loss of resident salmonids to irrigation diversions. John Der Hovanisian (IDFG).

1700-1720 Predator abundance and salmonid prey consumption in Lower Granite Reservoir and tailrace. George P. Naughton (U of I).

1830-2200 **Steve Pettit Slide Show and Evening Social -** Teton/Yellowstone/Patio Room.

Saturday, February 28

Ongoing **Poster Session** - Lobby

0800-1150 **Tech Session IV: Fisheries Management**. Moderator - Dan Schill. Targhee/Bonneville Room.

0800-0820 The role of dispersal in limiting brook trout invasions. Susan B. Adams, Christopher A. Frissell (UofM), and Bruce E. Rieman (FS-INT).

0820-0840 Conservation planning under Section 10 of the Endangered Species Act and the Plum Creek Timber Company bull trout project. Ted Koch (USFWS).

0840-0900 Evaluation of sterile triploid rainbow trout in put-and-take stream fisheries. Jeff Dillon, Chuck Alexander, David Teuscher and Dan Schill (IDFG).

0900-0920 Infections of *Myxobolus cerebralis* in trout from several Idaho drainages. Christine Moffitt, Yasunari Kiryu, Monica Hiner (U of I) and Steve Elle (IDFG).

0920-0940 Habitat use and the overwinter loss of age-0 rainbow trout in the Henry's Fork of the Snake River, Idaho. Matthew G. Mitro (MSU).

0940-1000 Distribution and diet of smallmouth bass in the Hells Canyon reach of the Snake River. R.D. Nelle (U of I)

1000-1030 Break

1030-1050 Floods along the South Fork. David C. Burns and Rodger L. Nelson (Payette NF).

1050-1110 Use of watershed analysis to define habitat parameters for rare salmonids in Herd Creek, upper Salmon River Basin, Idaho. Bob House (Shapiro).

1110-1130 Evaluation of lake trout and bull trout population status in Upper Priest Lake. Jim Fredericks (IDFG).

1130-1150 The use of angling as a management tool for controlling lake trout. Ned Horner (IDFG).

1150-1200 **Presentation of Best Paper Awards**

1200-1300 **Executive Committee Meeting** - Sawtooth Room.

POSTER SESSION

Tailed frog migration: a local response to seasonally unsuitable habitat? Susan B. Adams (FS-RM).

Karyotypic analysis of endangered Kootenai River white sturgeon (*Acipenser transmontanus*). P. Anders (U of I) and M. Powell (U of I).

Steelhead trout acclimation experiment conducted at Sawtooth Fish Hatchery, Idaho. Randall S. Osborne and Dean Rhine (IDFG).

Effects of dam operation on the distribution of northern squawfish (*Ptychocheilus oregonensis*) in the Snake River, Lower Granite Dam tailrace, Washington. Rich Piaskowski and Paul Anders (U of I).

Assessing genetic variation among Columbia Basin white sturgeon (*Acipenser transmontanus*). M. Powell (U of I), E. Brannon (U of I), D. Campton (USFWS), and P. Anders (U of I).

Developing and testing external tags for adult chinook salmon. Dean Rhine, David A. Cannamela, Peter F. Hassemer, and Randall S. Osborne (IDFG).

Steelhead trout size-at-release experiment conducted at Haggerman National Fish Hatchery, Idaho. Dean Rhine, David A. Cannamela, and Randall S. Osborne (IDFG).

ALPHABETICAL LISTING OF ABSTRACTS
Papers Presented at the 1998 IDAFS Annual Meeting

The Role of Dispersal in Limiting Brook Trout Invasions. Susan B. Adams, C. A. Frissell (University of Montana, Flathead Lake Biological Station, Polson, MT) and B. E. Rieman (U.S.D.A. Forest Service, Rocky Mountain Research Station, Boise, ID).

We revisited tributaries of the upper South Fork Salmon River (SFSR) studied 20 years previously and found that brook trout (*Salvelinus fontinalis*) had invaded relatively little habitat in the interim. One hypothesis for explaining why brook trout invasions stop is that the fish will not ascend steep channel slopes. We compared movements of brook trout into various channel gradients by experimentally manipulating populations in four small, central Idaho streams. We electrofished six sites with gradients ranging from <1 to 13%. In each site, we batch marked and returned fish from the upper and lower 200 m ("marking reaches") and killed those from the middle 200 m ("removal reaches"). We assessed brook trout recolonization via repeated night snorkeling in removal reaches from July 1996 to August 1997. Marked brook trout moved upstream through 67 m streams sections in which average channel slopes exceeded 13 %. Significantly more marked brook trout moved upstream than downstream. Substantial numbers of brook trout moved into removal reaches from beyond 200 m. Brook trout moved more rapidly and over greater distances into low than high gradient reaches. While channel slopes as high as 13 % may not prevent brook trout from swimming up small streams, steep slopes may inhibit other aspects of the invasion process. High gradients may interact with abiotic factors (e.g. temperature) or with biotic factors (e.g. the presence of other fish species) to inhibit invasion by brook trout. SFSR tributaries that contained only a few mature brook trout in the 1970's had similar population structures in 1996, indicating that continued dispersal to a stream is not sufficient to ensure colonization.

Distribution and Population Trends of Redband Trout (*Oncorhynchus mykiss gairdneri*) in Owyhee County, Idaho. Dale Allen (Idaho Department of Fish and Game, 3101 S. Powerline Road, Nampa, ID 83686).

Streams in Owyhee County, Idaho were sampled from 1993 through 1997 to identify the presence, distribution, and density levels of redband trout (*Oncorhynchus mykiss gairdneri*) by fisheries management personnel of the Southwest Region of the Idaho Department of Fish and Game (IDFG). The main objective of this contract work for the Lower Snake River District of the Bureau of Land Management (BLM) was to document declines of redband trout due to the extended drought of the late 1980's. Stream sites that had been sampled in the 1970's were revisited and trout densities compared. Significant declines in redband trout densities were documented during and after the drought. Several of these sites were again revisited in 1997 and many showed improvement (higher fish densities) from the two previous data sets. Redband trout had positively responded to increased base water flows during the past few years at some but not all sites visited. Data sets from this study and the BLM were combined and analyzed within the six Hydrologic Units (HU) occurring in Owyhee County. Redband trout densities or even their presence were different among the county's Hydrologic Units. The Owyhee County redband trout distribution is fragmented over the landscape with many trout populations becoming isolated in the upper watersheds. The data collected will update IDFG Conservation Data Center's redband trout distribution maps.

Passage of Adult Chinook Salmon at Dams and Migration into Tributaries, an Update. Ted Bjornn (Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID).

In 1997, we continued studies of adult salmon and steelhead migration in the Columbia and Snake rivers that began in 1991. Salmon and/or steelhead have been released with radio transmitters in every year except 1995. Radio telemetry studies of adult salmon and steelhead migrations in 1997 were the most extensive of any conducted to date. Radio Transmitters were placed in 991 spring and summer chinook, 55 fall chinook, and 554 sockeye salmon, and more than 900 steelhead at Bonneville Dam. At Lower Granite Dam, 72 chinook salmon with selected PIT tags were recaptured, outfitted with a transmitter, and released back into the ladder. Dams that salmon pass in the Columbia and Snake rivers and major tributaries were outfitted with antennas connected to more than 150 receivers to monitor their migrations throughout the basin in 1997 by Corps/BPA and PUD funded study teams. Portions of the basin upstream from tributary receiver sites were also mobile tracked to obtain information on success of migration.

The 49,500 adult spring and summer chinook salmon (excluding jacks) that returned to the Snake River in 1997 were 35% of the run counted at Bonneville Dam. With correction for fallbacks (0.83) at Bonneville Dam, the proportion of the run at Bonneville that returned to the Snake River becomes about 42%. In 1996, the Snake River run made up about 16% of the corrected count at Bonneville Dam. The 991 chinook salmon we tagged at Bonneville Dam in 1997 were about 0.8% of the run, and that proportion was used to estimate the number of wild and hatchery salmon returning to the various Snake River drainages based on salmon with transmitters found in the streams by mobile trackers. Each fish with a transmitter was a "black sheep" and represented about 120 fish. Composition and disposition of the salmon run into Idaho streams will be presented.

Floods Along the South Fork. David C. Burns and Rodger L. Nelson (Payette National Forest, P.O. Box 1026, McCall, ID 83638).

The consequences to the South Fork Salmon River of the "Christmas Storms" during the winter of 1964-65 are well known, but several similar, less heralded events, have occurred since. The most obvious of these was last winter, when severe flooding washed out several portions of the recently-paved South Fork road and flooding of the Little Salmon River damaged homes, roads, and other structures along Idaho's Highway 95. Prior to that, the winter of 1973-74 produced similar flooding and also destroyed parts of Highway 95, and spring discharge of the South Fork Salmon River was the highest ever recorded.

In the winter of 1964-65, weather events usually considered unusual racked the steep slopes of the South Fork Salmon River watershed. These storms were characterized by heavy rains on a deep snowpack, and the result was widespread failure of hillslopes and inundation of important salmon and steelhead spawning areas with fine material. Many of the slope failures were associated with the extensive road system that had been developed to support timber harvest in the watershed, and mitigation efforts including a logging moratorium, road rehabilitation, and slope stabilization were initiated.

Against this background, the South Fork has been slowly recovering from the inundation that occurred in 1965. Following a huge initial increase in fine sediments, particles smaller than 6.3mm in diameter, from a probable background level of 20-25% to more than 50% in 1968, the river has been gradually cleansing itself such that current levels are about 25-30%. Unlike the events of 1964-65, the more recent events do not seem to have affected the South Fork so badly, though they have surely retarded its healing. Fine sediments appear to have continued their decline in the mid-1970s despite the floods of 1973-74, but there appeared to be a gradual increase in the mid-1980s coincident with some renewed but limited activity in the watershed. Since then, fines have remained relatively stable, though it appears that very small material (less than 0.85mm) is still being flushed from the system. The two wet winters of 1995-96 and 1996-97, which immediately followed paving the South Fork road, led to apparent increases in fine sediment, and it remains to be seen whether this pattern will continue or whether fines will once again drop as the roadcuts stabilize and other mitigation efforts progress.

The most important conclusion to be drawn from this would seem to be that the mitigation efforts implemented after the floods of 1964-65 and been successful for the most part, because similar 1973-74 and 1996-97 winter discharge events seem to have had far less effect on the streambed.

Loss of Resident Salmonids to Irrigation Diversions. John Der Hovanisian (Idaho Department of Fish and Game).

Idaho fishery managers and anglers have long suspected that significant numbers of resident salmonids are lost to irrigation diversions. However, there is little quantitative data available to assess the effects of such losses on stream populations, or to determine whether a widespread problem exists. The first step in addressing this issue has involved estimating resident salmonid exploitation rates for a variety of canals. During the 1996 and 1997 irrigation seasons, I trapped 15 canals in the South Fork Snake, Lemhi, and Pahsimeroi river drainages. I estimated exploitation rates by releasing marked fish in the streams, expanding the number recaptured in the canals by trap efficiency estimates, and dividing by the number released. Exploitation rates have averaged 35% (range = 2-69%, n = 4) for young-of-year fish and 22% (range = 1-62%, n=8) for age 1 and older fish. Although exploitation rates for some canals have been low, cumulative rates can be high. For instance, the cumulative exploitation rate for age 1 and older fish by four canals sampled on the Pahsimeroi River in 1997 was 50% (mean = 17%, range = 1-43%, n = 4). In addition to estimating exploitation rates, I am collecting information on canal characteristics to determine if there is a set of factors that influence fish loss. I am also searching for cheaper alternatives to rotary drum screens for minimizing losses. These data will eventually be used to determine under what circumstances and to what degree sport fishing opportunities can be enhanced by minimizing losses of resident salmonids to irrigation canals.

Evaluation of Sterile Triploid Rainbow Trout in Put-and-Take Stream Fisheries. Jeff Dillon (Idaho Department of Fish and Game, 1515 Lincoln Rd., Idaho Falls, ID 83401), Chuck Alexander and David Teuscher (Idaho Department of Fish and Game, 868 E. Main, Jerome, ID 83338) and Dan Schill (Idaho Department of Fish and Game, 1414 E. Locust Lane, Nampa, ID 83686).

Sterile hatchery fish may have important applications in fishery management programs, particularly where hatchery fish are used to supplement angling opportunity in streams containing native salmonids. Techniques to produce sterile triploid trout are well developed, and triploid eggs and fish have recently become available from many commercial suppliers. Despite widespread availability, information on performance of triploids in recreational fisheries is lacking. We purchased mixed-sex triploid and control diploid rainbow trout eggs from a commercial supplier, and reared these fish to catchable size (250-300 mm). We jaw-tagged and planted 300 sterile and 300 control fish each into 18 streams statewide, and monitored tag returns to assess relative return to creel in each location. Results from a paired t-test indicated no significant difference in return to the angler from sterile and control fish ($p = 0.80$). Although additional field evaluations are needed, sterile rainbow trout appear a useful tool to meet the demand for put-and-take stocking programs on streams while minimizing genetic risks to native salmonids.

Age Determination Using Scales and Otoliths for Headwater Populations of Westslope Cutthroat Trout, *Oncorhynchus clarki lewisi*. C.C. Downs (Idaho Fish and Game Department, 2750 Kathleen Ave., Coeur d'Alene, ID 83814), B.B. Shepard (Montana Fish, Wildlife, and Parks, 1400 South 19th St., Bozeman, MT 59717) and R.G. White (Montana Cooperative Fishery Research Unit, Department of Biology, Montana State University, Bozeman, MT 59717).

Scales of salmonids are commonly used for age determination yet their reliability is suspect, particularly after maturity or in slow growth environments. Inaccurate age determination can result in errors when estimating mortality, recruitment, longevity, and age at sexual maturity, all of which influence management actions. We examined the validity and precision of ages estimated from scales and otoliths of westslope cutthroat trout from 29 headwater populations in Montana. Evidence for the validity of otoliths as aging structures was provided through comparison with a length-frequency histogram. We compared ages estimated using scales and saggital otoliths from 424 individual fish. Otoliths provided older age estimates for 74% of the pairs. Ages assigned by otoliths were also more precise than those assigned by scales ("Index of Average Percent Error" = 3.2% and 11%, respectively). We estimated that 65% of age-1 and age-2 individuals in the paired sample were missing a first year annulus on their scales. The presence of greater than 6 circuli to the first annulus was generally indicative of a missing first year annulus. We attempted to validate annulus formation on the scales of adults through the recapture of marked fish. Interpretable annuli formation on scales decreased with increasing age. Eighty-seven percent (n=30) of recaptured tagged fish formed an interpretable annulus between the ages of 2 and 3, 45% (n=38) from 3 to 4, and only 10% (n=10) from 4 to 5. If missing first-year annuli can be accounted for, scales will be valid aging structures in slow growth environments to the age of maturity. Where feasible, otoliths should be used to assign ages beyond maturity.

Life History and Population Status of Migratory Bull Trout (*Salvelinus confluentus*) in Arrowrock Reservoir, Idaho. Brian J. Flatter (Idaho Department of Fish and Game, 3101 South Powerline Road, Nampa, ID 83686).

Between October 1996 and May 1997 intensive sampling for bull trout (*Salvelinus confluentus*) was conducted in Arrowrock and Lucky Peak Reservoirs. A total of 410 bull trout were captured in Arrowrock Reservoir in 3,446 hours of sampling with trapnets and gillnets. Lucky Peak was sampled for 270 hours resulting in a catch of 76 bull trout. Fourteen of these bull trout had been originally tagged in Arrowrock, and had moved downstream across Arrowrock Dam. Twenty-two bull trout captured in Arrowrock between 400 and 660mm were surgically implanted with radio transmitters. Eight fish from Lucky Peak, ranging from 470 to 660mm in length, were implanted with radio transmitters and released in Arrowrock Reservoir. Telemetry data were collected from the air and ground between May and December of 1997. Seventeen fish migrated up the North Fork of the Boise River, six migrated up the Middle Fork, and one migrated up the South Fork. Fish were assumed to have spawned if tracked to known spawning areas. Radio-tagged fish generally left Arrowrock Reservoir by mid-June, entered spawning tributaries between late-July and early-August, exited tributaries by the second week in September, and returned to the reservoir between the second week in September and the third week in October. Fish transported to Arrowrock from Lucky Peak generally used the same areas to spawn as Arrowrock fish, and migrated at approximately the same time. We estimated there were 471 bull trout in Arrowrock 300mm or greater in length (95% CI =389-590) in 1997.

Evaluation of Lake Trout and Bull Trout Population Status in Upper Priest Lake. Jim Fredericks (Regional Fisheries Biologist, Idaho Department of Fish and Game).

Lake trout were introduced to Priest Lake in 1925. They were first reported in Upper Priest Lake in 1985. Catch records of some Upper Priest Lake anglers indicated that the lake trout population was expanding in the upper lake, but no quantitative surveys of Upper Priest Lake had been conducted in recent years. We used gillnets, hoopnets, and conventional angling to assess the abundance and size structure of lake trout *Salvelinus namaycush* and bull trout *Salvelinus confluentus* populations in Upper Priest Lake. We marked all lake trout and bull trout > 320 mm with spaghetti tags to develop population estimates, and surgically fitted nine lake trout with sonic tags to monitor movements. In four sampling periods from June 2 to October 15, we collected 150 lake trout, including 5 recaptures, ranging in size from 193 to 980 mm. We tagged 112 of the lake trout and estimated a total population of around 646 fish greater than 320 mm. We caught 20 bull trout, including 1 recapture, ranging in size from 190 to 738 mm. The lack of recaptures precluded a reliable estimate of the bull trout population. However, the ratio of marked to unmarked fish in the catch, the ratio of bull trout to lake trout in the gillnets, and redd surveys in Upper Priest Lake tributaries, suggest the adult bull trout population is between 50 and 100 fish. The lake trout size structure indicates a rapidly expanding population. Sonic telemetry and tag return information suggests that movement between the upper and lower lakes is not uncommon. We concluded that suppression of the lake trout population will be a long-term, ongoing project.

Conservation Versus Recovery of Chinook Salmon, Selecting the Right Tool for the Job. Peter F. Hassemer (Idaho Department of Fish and Game).

Captive propagation of threatened or endangered species may be used to satisfy two seemingly disparate objectives. One common objective is conserving the genetic resources, or the last remaining members, of a species at extremely low abundance. This approach is often used to separate the species from the factor limiting population growth. With the species removed from its natural envronment, efforts are made to remove or correct the limiting factor and then restore the species to its natural environment. A second objective is to use captive propagation to increase survival of the species during all or a portion of its life cycle, thereby increasing the total number of individuals in the population. This approach, refered to as captive brood stock, may be used to restore the species to an area where it was extirpated or to add additional members to an existing but depressed breeding population.

The overall goal of any captive propagation program should be clearly stated before the program is initiated. Preserving genetic diversity and increasing the size of a population are very different outcomes of captive propagation, and likely would require different sets of tasks to reach a desired endpoint. Regardless of the goal or desired outcome, special attention should be given to avoiding adverse genetic impacts to the captive population. Because of the low numbers of individuals typically present in a captive population, the population is at high risk of direct or inadvertant selection processes.

A captive propagation program, referred to as captive rearing, was initiated for three populations of Salmon River chinook salmon. The purpose of this program is two-fold. First, the program is designed to develop and evaluate captive propagation techniques for chinook salmon. Little scientific information is available concerning chinook salmon captive propagation and wild population conservation and rebuilding. Secondly, the populations brought into captivity were at high risk of extinction in the near future. If successful, this program could maintain the metapopulation structure of Snake River chinook salmon by preventing demographic extinctions.

The Use of Angling as a Management Tool for Controlling Lake Trout. Ned Horner (Regional Fisheries Manager, Idaho Department of Fish and Game).

Lake trout *Salvelinus namaycush* have recently become established in Upper Priest Lake, Idaho, threatening a depressed population of adfluvial bull trout *Salvelinus confluentus.* Upper Priest Lake is currently managed as a catch-and-release fishery, precluding the use of angling as a method to remove lake trout. Anglers commonly ask why they can't harvest lake trout if the intent is to remove them from the lake. An effort was made to determine if sport angling could be used as an effective management tool to remove lake trout, without unacceptable risk to bull trout from unintended by-catch. A group of expert lake trout sport fishing anglers were recruited to fish Upper Priest Lake on August 15-17, 1997 using multiple gear and bait to maximize catch rates. Twenty-five lake trout and six bull trout were caught in 100 hours of angling effort, for a catch rate of 3.2 h/fish. The catch ratio of lake trout to bull trout by anglers during the "Fish-a-Thon" was 4.2:1. The catch ratio of two anglers who frequently fish Upper Priest Lake was 4.9:1 lake trout to bull trout in 1997. In comparison, the catch ratio of gill net caught lake trout to bull trout was 10:1 in 289 h of gill netting effort. Bull trout appear to be more vulnerable to anglers than lake trout. There also appears to be complete habitat overlap of the two char species in this 30 m deep lake. Lake trout and bull trout were caught at all depths by sport anglers and in gill nets. One lake trout died as a result of the angling effort (3% angling mortality) despite the relatively high level of angler knowledge and handling care. We would expect higher angling mortality on bull trout from the general angling public. It does not appear that sport angling can be used as an effective management tool to selectively remove lake trout from Upper Priest Lake.

A Hierarchical Examination of the Distribution and Abundance of Tailed Frog Larvae in North Idaho. Blake Hossack and Kirk Lohman (Department of Fish and Wildlife, University of Idaho, Moscow, ID).

We sampled 52 reaches in 46 streams to investigate the distribution and abundance of tailed frog (Ascaphus truei) larvae relative to stream and landscape characteristics. We used field measurements and geographical information systems (GIS) data to build predictive models of presence-absence and density at three spatial and two temporal scales: 1) stream reaches; 2) forest characteristics of subwatersheds; and, 3) geomorphology. Ascaphus was detected in 40 of the 52 reaches sampled. Ascaphus larvae were most likely to be found in reaches of low embeddedness and cobble-sized substrates. Density ranged from 0 to 4.08 larvae m-2, and was related to stream substrate characteristics, forest structure adjacent to the reach surveyed, and valley confinement. Valley confinement and substrate embeddedness co-varied in a predictable manner, demonstrating the hierarchical nature of headwater stream systems. Together, these variables explained 66% of the variation in Ascaphus density.

Use of Watershed Analysis to Define Habitat Parameters for Rare Salmonids in Herd Creek, Upper Salmon River Basin, Idaho. Bob House (SRI, Shapiro Inc., 1453 N. Ellington, Eagle, ID 83616).

Herd Creek is typical of many watersheds draining the interior Columbia Basin and the west; with lands managed by the Forest Service (72%) in the mid and upper elevations, those managed by BL M (24%) located in the lower elevations, and state (3%) and private land (1%) scattered in the lower elevations and along the mainstem, respectively. Herd Creek watershed, located in the Upper Salmon River Subbasin, drains 116 square miles that originates in high elevation (over 10,000 feet) rocky, forested areas and descends through sage-brush shrub-steppe communities to the mouth at about 5,700 feet. Her Creek was inhabited by Native Americans until 1868, with the first European settlers (trappers) arriving in the 1830s and homesteaders arriving in the 1880s. Early European use in Herd Creek has had long-lasting impacts on natural resources in the watershed. Beaver were trapped out by 1833 and unregulated, season=long livestock grazing occurred from 1880s to 1940s. Current natural resource and human use conflicts still remain. Key issues are livestock grazing and water withdrawals for irrigation. Both directly impact water quality and riparian and aquatic habitat and indirectly impact the production of depressed populations of chinook salmon, steelhead, bull trout, and westslope cutthroat trout.

The Herd Creek Watershed Analysis followed the six-step process outlined in "Ecosystem Analysis at the Watershed Scale: federal guide for watershed analysis" (Regional Interagency Executive Committee [RIEC] 1995). The purpose of this analysis is to develop a scientifically based understanding of the processes and interactions occurring within the watershed area and the effects of management practices on the watershed. The analysis was conducted:

- to provide guidance for future analyses of watersheds containing high elevation shrub-steppe communities in the Columbia River Basin (Idaho, Oregon and Washington);
- to evaluate a watershed with joint BLM/USFS grazing management;
- to address the protection, maintenance, and restoration of threatened chinook salmon, proposed threatened steelhead, and candiate (C1) bull trout and their habitats;
- to link broad policy direction defined by land management plans and regulated by laws to future site-specific management actions;
- to determine reference (potential) watershed and reach habitat objectives, from modified generic PACFISH Riparian Management Objectives (RMOs), that are keyed to specific channel types and stream reaches in Herd Creek; and
- to identify opportunities and management practices that will protect and restore natural resources within the watershed.

Although Herd Creek watershed appears to be functioning properly, naturally storing and routing soils and water and most vegetation trending towards potential natural communities, problem areas exist and continue to have major impacts on riparian and aquatic habitat. Two current problems in the lower mainstem Herd and Lake creeks are irrigation withdrawals and unregulated high-intensity grazing on private land. These actions have increased water temperatures and degraded riparian and aquatic habitat. Recent changes in management on federal land, mainly in response to the listing of chinook salmon, have dramatically improved riparian area conditions and initiated an upward trend. However, overall improvement in the capability of Herd Creek to produce more fish hinges on changes in management on private land.

Major recommendations are:

- the formation of a Herd Creek Watershed Coalition, involving a collaborative group of all land owners in the watershed, including state, private parties, and Native Americans, to devise a grazing strategy to improve lower Herd Creek.
- maintain the current livestock grazing strategy on federal land, with AUMs and livestock numbers no greater than actual numbers for 1994 and continue all current mitiation measures;
- continue non-use in the East Pass Creek Allotment because of the near-reference condtions of aquatic and riparian habitat and current high abundances of bull trout;
- provide extra protection for reaches LC-7 and WFHC-18 (they currently are functioning at risk) to quickly achieve functionality and late seral/potential natural riparian vegetation; and
- manage specific reaches to attain R4 Reference and/or Herd Creek Reference conditions instead of current PACFISH RMOs.

Predation on Juvenile Arctic Grayling in Upper Red Rock Lake, Montana. Laura M. Katzman (Cooperative Fishery Research Unit, Montana State University, Bozeman, MT) and Dr. Alexander V. Zale (Cooperative Fishery Research Unit, Montana State University, Bozeman, MT).

The only indigenous, lacustrine population of Arctic grayling (*Thymallus arcticus*) south of Canada and Alaska inhabits Red Rock Lakes National Wildlife Refuge. This genetically and behaviorally unique population of Arctic grayling has undergone a recent decline in abundance; predation by other fish species has been identified as a potential cause of it. We investigated predation on juvenile Arctic grayling at the mouth of Red Rock Creek in 1995 and 1996. All juvenile Arctic grayling pass through this area during their downstream migration to Upper Red Rock Lake. The objectives of the study were to: 1) determine the timing of the age-0 Arctic grayling migration, 2) identify the predators of age-0 Arctic grayling at the mouth of Red Rock Creek in Upper Red Rock Lake during the migration, and 3) quantify the predation of age-0 Arctic grayling at this site during the migration. Age-0 Arctic grayling migrated into the lake from early July through late August. Potential predators captured were brook trout (*Salvelinus fontinalis*), burbot (*Lota lota*), and Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) x rainbow trout (*O. mykiss*) hybrids. No Arctic grayling were found in the stomach contents of these predators. No fish were found in the stomach contents of brook trout, and only 0.1% and 4.0% fish by weight were eaten by burbot and cutthroat hybrids, respectively. Predation by fish at the mouth of Red Rock Creek during the age-0 Arctic grayling migration is probably not causing the low abundance of Arctic grayling at Red Rock Lakes National Wildlife Refuge.

Fishway Entrance Use and Passage by Adult Chinook Salmon in 1996 at Bonneville, McNary, Ice Harbor and Lower Granite Dams. Matthew Keefer (Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID).

Passage of adult chinook salmon*Oncorhynchus tshawytscha* through the fishways at Columbia and lower Snake River dams was an important study objective of the ongoing adult salmon and steelhead passage project. In 1996, fishway use by chinook salmon was monitored using radio transmitters and full receiver/antenna coverage at Bonneville, McNary, Ice Harbor and Lower Granite dams. Critical parameters studied were passage times for fish to first approach the dam and first enter a fishway, total time to pass over the dam, which fishway entrances were approached and where fish entered and exited the fishways. Due to the complexity of the fishways at Bonneville Dam, additional parameters were considered for chinook salmon that passed there, including movement by fish between fishways and fishway use by 110 fish that passed the dam, fell back and then re-passed the dam one or more times. In 1996, 853 chinook salmon were outfitted with radio transmitters and released downstream from Bonneville dam. Of these fish, 834 were subsequently recorded at Bonneville Dam, 307 were recorded at McNary Dam, 127 at Ice Harbor Dam and 106 at Lower Granite Dam. After passing a tailrace receiver, median times for chinook salmon to first approach a fishway were 1.7 to 3.1 h for dams monitored in 1996. Median times to first enter fishways were 6.5 to 10.7 h, and median times to pass over the dams were 17.5 h at Ice Harbor Dam, 23.1 h at Bonneville Dam, 25.4 h at McNary Dam and 38.2 h at Lower Granite Dam. Chinook salmon approached all fishway entrances at each dam, and many fish approached entrances more than 100 times at a dam before entering (medians of 11 to 21 approaches per fish). Entrances used by chinook to enter fishways were more restricted than entrances approached. Entrances adjacent to shorelines, spillways, and the main powerhouse entrances, which were larger and had higher discharge, were used more frequently than the smaller sluice- and orifice-gate entrances. Most exits from the fishway were also at the larger entrances, but overall they were the most effective entrances (highest entrance/exit ratio) for chinook salmon at each dam studied in 1996.

Timing of Migration and Distribution of Adult Steelhead with Radio Transmitters in the Snake River Drainage. P.J. Keniry, T.C Bjornn, K.R. Tolotti, and R.R. Ringe (Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID).

Migrations of adult steelhead in the Snake River drainage were monitored using radio telemetry in1991-1995, with 734, 694, and 500 adult steelhead released with transmitters near Ice Harbor Dam in 1991, 1992, and 1994. In 1993, 884 steelhead were trapped, tagged and released at John Day Dam in the Columbia River.

Distribution of adult steelhead was determined using records from fixed site radio receivers, mobile radio tracking, returns to hatcheries and weirs and recaptures by angers. Distribution of steelhead with transmitters was similar in all years of the study with the exception of 1993. In 1991, 1992 and 1994, approximately 10% of the steelhead tagged were last located in the Columbia River or in tributaries to the Columbia River other than the Snake River. In 1993, when fish were tagged and released at John Day Dam in the Columbia River, 52% were last located outside of the Snake River basin. Distribution of steelhead with transmitters upstream from Lower Granite Dam was similar in all four years of the study; 19 to 33% of the steelhead with transmitters that passed Lower Granite Dam were last located in Lower Granite Reservoir, about 35% in the Clearwater River basin, 15 to 20% in the Snake River upstream from Lewiston and about 20% entered the Salmon River. Timing of adult steelhead migration past the lower Snake River dams and into tributaries was determined using records from fixed site radio receivers. Most steelhead passed the lower Snake River dams in the fall with a few fish over wintering downstream from each of the dams and passing in the spring. Most of the steelhead that passed the receiver site at Asotin did so in the fall with a few fish arriving in the spring. Many of the fish that entered the Clearwater River arrived in the fall, but large numbers overwintered in Lower Granite Reservoir, the confluence of the Snake and Clearwater Rivers and the Snake River between Lewiston and Asotin. Fish arrived at upper tributary sites mainly in the spring.

Conservation Planning Under Section 10 of the Endangered Species Act and the Plum Creek Timber Company Bull Tout Project. Ted Koch (U.S. Fish and Wildlife Service, Boise, ID).

The U.S. Fish and Wildlife Service and National Marine Fisheries Service ("Services") Conservation Planning program under section 10 of the Endangered Species Act (Act) has been growing rapidly under the Clinton Administration. Conservation Planning includes issuing of take permits to non-federal entities for listed and non-listed species. Three avenues for conservation planning include Habitat Conservation Plans, Candidate Conservation Agreements, and Safe Harbor agreements.

Required elements of an applicant's plan include: (1) describing the impact of the plan, (2) efforts to minimize and mitigate the effects of their actions on protected species, (3) what alternate actions the applicant considered, and (4) any other measures necessary to evaluate the proposed action. In turn, the Services, in reviewing the plan, must find that, (1) any take of species will be incidental to - and not the purpose of - the proposed action, (2) that take of species is minimized and mitigated, (3) that the applicant will provide adequate funding to carry out the plan, and (4) that actions will not threaten the long-term survival of species.

The Services are required to comply with the National Environmental Policy Act for each instance in which a permit is issued. In the Pacific Northwest, this has generally resulted in preparation of an Environmental Impact Statement because of the large geographic scope of most applications, the wide variety of species addressed, the amount of take authorized, and the relatively controversial nature of the program.

Plum Creek Timber Company has initiated a process to prepare a habitat conservation plan, and will seek to obtain an incidental take permit for forestry and related actions on 1.7 million acres of their land in northwest Montana, north-central Idaho and western Washington. Actions for which they seek coverage include timber harvesting, related road building, log landing construction, gravel and rock mining in support of timber operations, log hauling, and mill site operation.

Conservation measures for this plan will likely fall under at least one of six general headings: (1) riparian buffer protection, (2) road construction and maintenance, (3) grazing restrictions, (4) land use planning (e.g. land sales), (5) legacy fix opportunities (exotic species, irrigation diversions), and (6) administrative adjustments. The company and the Services will seek independent scientific review of information included in the plan, with plan completion and permit issuance possible by early 1999.

Development of a Regional Database of Temperature Records for Bull Trout. Donald M. Martin (US EPA, Boise, ID) and Bruce Rieman (USFS-Rocky Mountain Research Station, Boise, ID).

The U.S. Environmental Protection Agency (EPA) recently promulgated temperature criterion for bull trout in Idaho's waters. During that process it became apparent that relatively little empirical information could be summarized to support the resulting criterion. The criterion is specific for bull trout spawning and juvenile rearing. The Final Rule as published in the Federal Register and Technical Justification from the Administrative Record are available upon request. With the advent of computerized recording thermographs, temperature monitoring has become common place. Consequently a large body of database should be available for application to this and similar problems. Eaton et al. (1995) outlined an empirical approach for defining fish temperature tolerances from temperature monitoring database associated with the presence of individual species By considering species presence and absence, as well as the occurrence of specific life stages it should be possible to develop more rigorous models or even contrast patterns of habitat use across the species range. Biologists associated with the Salvelinus confluentus Curiosity Society (SCCS) and several natural resource agencies indicated an interest in collaborating to develop a database that could serve this purpose.

We are involved in a broad-based collaborative effort to develop such a database for bull trout. The USEPA-Region 10 and the Rocky Mountain Research Station-USFS are jointly providing support and coordinating for the initial development. Any analyses could be independent or collaborative. Pending results those participating could decide to continue the effort or drop it in favor of more localized efforts. To facilitate this project we have established some simple criteria for database, a metadata template, and a protocol for development of the database. Database can be shipped on diskette in the mail or by e-mail. With some time for database entry and solving typical problems of consistency and compatibility an initial version could be ready for distribution sometime in the spring of 1998. Those interested in collaboration on further analyses or continued development of the database could propose and discuss that work at that meeting. The intent is to generate a database useful to all those who contribute information, but due Federal funds being utilized to develop this database these information would be available to anyone who requests it. We will simply to maintain a record of contributors and users to fully acknowledge any work.

Habitat Use and the Overwinter Loss of Age-0 Rainbow Trout in the Henrys Fork of the Snake River, Idaho. Matthew G. Mitro and Alexander V. Zale (Montana Cooperative Fishery Research Unit, Montana State University, Bozeman, MT 59717).

Age-0 rainbow trout were sampled in the Henrys Fork of the Snake River, Idaho, to quantify overwinter loss among river sections characterized by different habitat types. Mark-recapture and removal methodologies were used to obtain autumn and spring estimates of abundance and estimates of overwinter survival and movement in two river sections (Last Chance and Box Canyon) from 1995 to 1998. A catch-per-effort methodology was used to trace the loss of age-0 trout in Last Chance during winter. Autumn abundance estimates for the Last Chance section (moderate gradient, simple bank habitat, extensive macrophytes) were greater than for the Box Canyon section (high gradient, complex bank habitat, few macrophytes). However, the overwinter loss rate was greater in Last Chance than in Box Canyon. Fish marked in Last Chance moved upstream to Box Canyon during winter. The loss rate in Last Chance was similar among years, but the timing of loss occurred later in years with greater winter discharges. Survival rates and spring abundance in Box Canyon, but not in Last Chance, were related to an increase in winter discharges. Therefore, overwinter survival of age-0 trout was related to the interaction of complex bank habitat and winter discharges.

Infections of *Myxobolus cerebralis* in Trout from Several Idaho Drainages. Christine Moffitt, Yasunari Kiryu, Monica Hiner (Department of Fish and Wildlife, University of Idaho, Moscow, ID 83844-1136), and Steve Elle (Idaho Department of Fish and Game, Nampa, ID 83686).

Samples of wild rainbow trout collected from the Big Wood, South Fork of the Boise, and Teton River drainages in the fall of 1997 were examined using paraffin embedded histology and H&E stains of at least two aspects of each fish in an intensive and semi quantitative investigation. Smaller fish showed early pathology from *Myxobolus cerebralis*, causative agent of whirling disease, but many had no mature spores. More mature spores were observed in larger fish. Histological sections from rainbow and cutthroat trout exposed to river water for one to two days in live boxes in these same drainages showed a low prevalence of infection by situ DNA probes. Some fish exposed for 10 d in live boxes and then moved and reared for several months in pathogen free hatchery water showed clinical disease. Increased surveillance and combined laboratory and field techniques are needed to understand the dynamics of infection and estimate the risks to fish populations.

Predator Abundance and Salmonid Prey Consumption in Lower Granite Reservoir and Tailrace. George P Naughton (Department of Fish and Wildlife, University of Idaho, Moscow, ID 83844-1136)

We estimated the relative abundance and diet composition of smallmouth bass Micropterus dolomieu and northern squawfish Ptychocheilus oregonensis in the tailrace and forebay of Lower Granite Dam associated with the surface bypass collector and made comparisons with the Snake and Clearwater River arms of upper Lower Granite Reservoir. We found that the relative abundance of smallmouth bass < 175 mm in length was significantly higher in the Snake River and Clearwater River arms than in the tailrace and forebay in 1996 and 1997. Smallmouth bass >175 mm in length were generally more abundant in the Snake River arm than at the other sampling locations in 1996 and 1997. Northern squawfish >349 mm were most abundant in the tailrace boat-restricted zone while squawfish <200 mm were most abundant in the tailrace in 1996 and 1997. We found no significant differences in the relative abundance of northern squawfish 200-349 mm in length among reservoir locations in both years. Crustaceans and nonsalmonids were the most abundant food items by weight of both smallmouth bass and northern squawfish from April through August 1996 and 1997. Juvenile salmonids were not a major component of smallmouth bass and northern squawfish diets at any location in Lower Granite Reservoir and tailrace. High flows and resulting lower water temperatures and higher turbidity may have contributed to the low levels of predation on juvenile salmonids.

Distribution and Diet of Smallmouth Bass in the Hells Canyon Reach of the Snake River. R. D. Nelle (Department of Fish and Wildlife, University of Idaho, Moscow, ID 83844-1136).

The importance of predation on juvenile salmonid losses in the Columbia River Basin has been addressed; however, most of the focus has been in reservoirs with altered habitats from impoundments as well as passage related problems at hydroelectric projects. The need to address predation in other areas of the basin has been noted especially in areas where threatened stocks of juvenile salmonids rear. The potential for predation by the introduced smallmouth bass *Micropterus dolomieu* on subyearling fall chinook in the free flowing Hells Canyon reach of the Snake River could be significant, considering the habitat use of both species, water temperatures, residence time, and the smaller size of subyearling fall chinook. To examine smallmouth bass distribution and diet stomach samples were collected using boat electrofisher over seven weeks from May to October, 1996. Catch per unit effort data was used to test for differences in distribution of smallmouth bass *Micropterus dolomieui* among areas in the Hells Canyon reach of the Snake River. Prey items from stomach samples of smallmouth bass were divided into four categories (crayfish, insect, fish, and other), and then weighed. Prey fish were further identified to species and enumerated. Diet composition of smallmouth bass was expressed in frequency of occurrence of each prey taxon.

Spawning Behavior and Movement of Kootenai River White Sturgeon as Determined by Telemetry Vaughn Paragamian and Gretchen Kruse (Idaho Department of Fish and Game).

The Kootenai River white sturgeon is an Endangered Species and test flows now are provided by the U.S. Army Corps of Engineers for sturgeon spawning and rearing. Movement and behavior of sturgeon is monitored during this period by attaching radio and sonic receivers to adult fish expected to spawn. We summarized telemetry data for 50 Kootenai River white sturgeon during pre-spawn, spawning, and the post-spawning periods from 1991 through 1998. Our objectives were to identify those natural and man-induced environmental conditions that stimulated white sturgeon spawning migrations to staging and spawning areas and activated spawning. It was anticipated this information would provide management recommendations, in part, that would be useful in the recovery of this fish. White sturgeon often migrated to staging areas during autumn either from the lower Kootenai River or Kootenay Lake in B.C. Migration of sturgeon to spawning areas occurred soon after the onset of high elevation run-off during rising flows and water temperatures. Male white sturgeon migrated to the spawning reach firt, about two weeks before spawning took place, and at temperatures ranging from 6.3 to 12.1 °C. Migration of females followed about a week later at slightly warmer temperatures. Female sturgeon left the spawning reach first staying only one to 48 days while males remained six days to several months (often moving to Kootenay Lake). Abrupt decreases in flow could cause females to abandon the spawning reach and not return, although males also would abandon the spawning reach they usually would return after flows were increased. More data and analysis are provided as well as management recommendations.

Evaluation of Adult Chinook and Sockeye Salmon Passage at Priest Rapids and Wanapum Dams with Orifice Gates Closed and with an Experimental Fishway Fence - 1997. Christopher A. Peery and Ted C. Bjornn (Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID).

Adult chinook and sockeye salmon outfitted with radio transmitters were monitored at Priest Rapids and Wanapum dams, mid-Columbia River, to evaluate effects of closing powerhouse orifice gates on passage at the dams. Times for salmon to move from the tailrace to; first approach the dam, first enter a fishway and to first reach the transition pool at the base of the east-shore ladder at both dams were compared during periods when orifice gates were open and closed. We found no significant difference in passage times for chinook and sockeye salmon when orifice gates were closed at both dams. The effectiveness of an experimental fishway fence to reduce the number of fish exiting from the west end of the Priest Rapids Dam powerhouse collection channel (entrance Lew2) was also evaluated. We found that the ratio of exits/entrances at Lew2 in 1997 was not different from that observed at the same site in 1996, prior to installation of the fishway fence, in contrast to results for similar devices tested at Snake River dams.

Interactions Between Cutthroat Trout and Coho Salmon Juveniles in an Artificial Stream. Pamela Porter (Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID).

There are many factors that affect the interactions between two species. In this study I looked at the relationship between and rock cover on cutthroat trout and coho salmon size in the University of Idaho's artificial stream. Coho salmon fry were introduced into 8 artificial stream sections containing 4 treatments- no cutthroat trout-the control, small, medium and large cutthroat trout. Rock cover was present in 50 % of the treatment units. Coho salmon were removed from up and downstream traps daily. The number of coho salmon fry remaining within a treatment unit after 7 days was tested against coho salmon size (35and 45mm), cutthroat trout presence and size (90, 120 and 150mm) and rock cover for 8 trials. Rock cover did not affect the number of coho salmon remaining at the end of the trials. Coho salmon and cutthroat trout size were significant factors. For 35mm coho salmon fry, the presence of cutthroat trout of any size decreased the numbers of coho salmon fry remaining. The number of 45 mm coho salmon remaining in sections with no or small cutthroat trout was significantly greater that the number of coho salmon remaining in sections with medium and large cutthroat trout. Cutthroat trout fry (27 and 38mm) were tested in a similar manner with coho salmon juveniles (none, 45, 65 and 85mm). The number of 38mm cutthroat trout remaining at the end of the trails was not significantly different when no coho salmon or when coho salmon of 45 or 65mm were present. The number of larger cutthroat trout fry(38mm) did decrease in the presence of 85 mm coho salmon.

Salmon and Steelhead Migration Routes in the Forebays of Ice Harbor, Lower Granite, and Bonneville Dams. Tami Reischel (Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID).

Migration routes of adult salmon and steelhead in the forebays of Columbia and Snake river dams was studied at Ice Harbor Dam (1995; 1996), Lower Granite Dam (1996; 1997), and Bonneville Dam (1997). Movements of the fish were similar in all forebays with a predominant shore-orientated pattern of migration. In 1997, a study of migration routes for salmon and steelhead that passed through the Bradford Island fishway was conducted for use in consideration of proposals to reduce fallback at Bonneville Dam. Historically, a relatively high proportion of adult salmon have fallen back over Bonneville Dam during their upstream migration, particularly when there was high volumes of spill during spring runoff. Based on 1996 and earlier studies, a high proportion of fish that fellback over the dam did so after they passed through the Bradford Island fishway, followed the shoreline of the island around to the forebay of the spillway. Spring and summer chinook and sockeye salmon, and steelhead outfitted with radio transmitters and released downstream from Bonneville Dam were tracked from the Bradford Island fishway exit upriver approximately two kilometers. A radio receiver and antenna located 4 km upstream from the dam was used to record fish as they exited the study area. Preliminary estimates of fallback were about 14% in 1996 and 20% in 1997 at Bonneville Dam. A total of 253 fish (132 chinook salmon, 111 sockeye salmon, and 10 steelhead) were tracked; eight were tracked twice (fallbacks that reascended), 146 were recorded at the upstream site, and 74 had been reported as being recaptured in fisheries or at hatcheries or spawning areas. The fish followed four dominant migration routes after leaving the Bradford Island fishway: (1) Bradford Island shore – spillway – fallback (6 chinook, 4 sockeye, 1 steelhead, incomplete numbers); (2) Bradford Island shore – crossed spillway forebay to Washington shore then upstream (26 chinook, 30 sockeye, 2 steelhead); (3) Bradford Island shore – crossed channel to Oregon shore then upstream (21 chinook, 50 sockeye, 5 steelhead); and (4) fishway exit – crossed powerhouse I forebay to the Oregon shore then upstream (13 chinook, 3 sockeye, 1 steelhead).

Metapopulations and Interior Salmonids. Bruce Rieman (Rocky Mountain Research Station, Boise, ID) and Jason Dunham (University of Nevada, Reno)

Metapopulation theory has attracted a substantial interest in conservation management of native fishes. If metapopulation or other spatially influenced processes are important, effective management requires more that simply conserving or restoring habitats, it requires conserving and restoring some critical size, geometry, and connectivity of habitats as well. At present there is little empirical information to guide that management. We have initiated several projects focused on the spatial dynamics of interior salmonids at landscape and temporal scales particularly relevant to land managers. Preliminary efforts have focused on the interpretation of patterns (i.e. incidence functions, genetic structuring, population time series) rather than on more process based models. Our results suggest that the relevance of metapopulation or spatially influenced population dynamics varies among species. Fragmentation and isolation appears to be strongly associated with the distribution and persistence of Lahontan cutthroat trout, potentially important for bull trout, and unimportant for westslope cutthroat trout. Regardless of whether metapopulation processes are critical, maintenance of spatially diverse networks of habitats will be important to full expression of life history and phenotypic diversity and the maintenance of productive and stable populations. Identifying and maintaining habitats that support that diversity may be a more important issue than understanding metapopulation dynamics.

Dissolved Oxygen and Feeding Effects on Growth, Feed Conversion, Hematology and Physiology of Rainbow Trout, *Oncorhynchus mykiss*. Steve Todd (Department of Fish and Wildlife, University of Idaho, Moscow, ID 83844-1136).

Effects of four dissolved oxygen levels and two feeding regimes on growth rate, feed conversion, hematological and physiological parameters of rainbow trout (*Oncorhynchus mykiss*) were examined for 6 weeks. Nitrogen gas was used to remove oxygen from supply water using high surface area media in ABS columns. A multivariate analysis of variance (MANOVA) was used to test for significant differences (alpha < or = .05) due to treatments, and least significant differences to test for differences among treatment levels (alpha < or = .05). Relative growth rate in fish groups fed to satiation was affected linearly by dissolved oxygen. Fish exposed to 55% and 77% oxygen saturation grew at 69% and 85% of the rate of control fish (approx. 90% oxygen saturation). Relative growth rates of fish groups fed a restricted daily ration showed insignificant differences among oxygen treatments. Feed conversion among fish groups was unaffected by dissolved oxygen, but was consistently slightly higher in groups fed to satiation than for groups fed a restricted ration. Hematocrits were inversely related to dissolved oxygen. Total plasma protein levels were unaffected by dissolved oxygen, but slightly higher in fish fed to satiation compared to fish fed a restricted ration. Fish heart to body weight ratio was unaffected by oxygen or feeding treatments. A preliminary analysis of lactate dehydrogenase (LDH) activity in heart and liver tissue indicates metabolic adjustment to hypoxia in fish exposed to the lowest dissolved oxygen treatment (55%). Results of this research suggest that an improvement in oxygen conditions above moderately low levels (50-55%) has no positive effect on feed conversion of fish raised on a production scale. Instead, greater feed efficiency and waste reduction at fish farms may occur by improving feeding methods and feeding strategies.

ALPHABETICAL LISTING OF POSTER PAPER ABSTRACTS

Tailed Frog Migration: a Local Response to Seasonally Unsuitable Habitat? Susan B. Adams (U.S.D.A. Forest Service, Rocky Mountain Research Station, Boise, ID).

Movements of tailed frogs (*Ascaphus truei*), although important to our understanding of the species' population dynamics and recolonization abilities, have received little attention. The only extensive movement study to date concluded that the frogs are highly philopatric, although limited evidence in some locations suggests otherwise. I operated six, bi-directional weirs in two Montana streams during summer and early fall, 1997. The weir of primary interest was located about 100 m downstream of Moore Lake. I monitored temperature at three locations in Moore Creek. Mature *Ascaphus* moved downstream, but not upstream, in September and October, 1997. Few *Ascaphus* were trapped at the other weirs. Stream temperatures downstream of the lake reached 20.9 C, and average daily temperatures frequently exceeded 17 C. An *Ascaphus* nest with viable embryos was found at the site. The temperature at the nest was likely modified by a cold groundwater seep upstream. Temperatures near the weir were higher than those previously reported where *Ascaphus* occur. The mature frogs may summer upstream in or beyond Moore Lake, moving downstream in the fall to mate and overwinter. The findings suggest three possibilities: 1) *Ascaphus* populations can withstand higher water temperatures than those where they normally occur, 2) individuals can behaviorally thermoregulate, and/or 3) transformed *Ascaphus* will make seasonal migrations to avoid localized, seasonally unsuitable, habitat conditions. Future studies of *Ascaphus* movements should account for seasonal changes in habitat suitability. The possibility of *Ascaphus* inhabiting or migrating through lakes warrants further investigation.

Karyotypic Analysis of Endangered Kootenai River White Sturgeon (*Acipenser transmontanus*). P. Anders (University of Idaho, Aquaculture Research Institute, Fish Genetics Lab Moscow, ID 83844-2260) and M. Powell (University of Idaho, Hagerman Fish Culture Experiment Station 3059 F, National Fish Hatchery Road, Hagerman, ID 83332).

Sturgeons world wide are characterized by a large number of chromosomes, a large number of very small microchromosomes, and wide ranges in total chromosome numbers (99-256) and ploidy levels (2n-16n). Karyology of North American sturgeon species has been sporadic despite diagnostic benefits. Past karyotypic analyses of white sturgeon (*Acipenser transmontanus*) have generally involved cultured cell lines or samples from individuals of domesticated broodstock lines, both of which may not accurately represent wild white sturgeon karyotypes. The purpose of this study was to provide a karyotype from the endangered Kootenai River population, and to compare that to karyotypes from other populations of the species. Using standard blood leukocyte culture techniques, we present the first karyotypic analysis of wild endangered white sturgeon from the Kootenai River system (Idaho, and British Columbia, Canada). The modal chromosome number for *A. transmontanus* from the Kootenai River was 2n=246, based on counts of 10 chromosome spreads from each of 10 fish (n=100). This modal chromosome number falls outside the published range for white sturgeon (219-243), further suggesting uniqueness of this endangered population, and possible founder effects or population bottlenecks.

Steelhead Trout Acclimation Experiment Conducted at Sawtooth Fish Hatchery, Idaho. Randall S. Osborne, (Idaho Department of Fish and Game, 1540 Warner Ave., Lewiston, ID 83501) and Dean Rhine (Idaho Department of Fish and Game, 1540 Warner Ave., Lewiston, ID 83501)

Juvenile emigration and adult recovery rates were used to test the effects of a two week acclimation period on steelhead trout (*Oncorhynchus mykiss*) smolts reared at Hagerman National Fish Hatchery and subsequently transported and released into the Salmon River at Sawtooth Fish Hatchery. Acclimated steelhead were reared at Sawtooth Fish Hatchery for two weeks prior to being released where as non-acclimated steelhead were transported from Hagerman National Fish Hatchery and released directly into the Salmon River. Between 1992 and 1997, 370,908 acclimated and 356,881 non-acclimated steelhead were released with coded wire tags. A total of 2,579 of the acclimated and 2,000 of the non-acclimated steelhead were released with passive integrated transponder (PIT) tags.

Interrogation rates at downstream dams for PIT tagged acclimated steelhead ranged from 33.9% in 1994 (brood year 1993) to 62.7% in 1993 (brood year 1992). Interrogation rates for steelhead from the non-acclimated groups ranged from 42.7% in 1994 (brood year 1993) to 69.6% in 1997 (brood year 1996). Non-acclimated steelhead from the 1991, 1993, and 1996 broods were interrogated at significantly ($P<0.05$) higher rates than acclimated fish. For the 1992 brood, acclimated steelhead were interrogated at a significantly ($P<0.05$) higher rate. For the 1994 and 1995 broods, PIT tag interrogation rates were not significantly different. Non-acclimated steelhead from the 1991, 1994, 1995, and 1996 broods had significantly ($P<0.05$) shorter travel time to Lower Granite Dam than fish from the acclimated group. For the 1992 and 1993 broods, travel time to Lower Granite Dam was not significantly different between groups.

Adult steelhead return data are complete for only the 1991 and 1992 broods. For brood year 1991, 13 adults from the acclimated group and 15 adults from the non-acclimated group were recovered in Idaho. Recovery rates were not significantly different ($\chi^2 = 0.51$, $P = 0.475$) between groups. Sex and age composition of the adults recovered did not differ between the acclimated and non-acclimated groups ($\chi^2 < 0.001$, $P = 1.000$; $\chi^2 = 0.57$, $P = 0.449$, respectively).
For brood year 1992, 80 adults from the acclimated group and 46 adults from the non-acclimated group were recovered in Idaho. Acclimated steelhead smolts returned as adults at a significantly higher rate than non-acclimated smolts ($\chi^2 = 5.79$, $P = 0.016$). Sex and age composition of the adults recovered did not differ between the acclimated and non-acclimated groups ($\chi^2 = 0.24$, $P = 0.626$);.$\chi^2 = 1.04$, $P = 0.309$, respectively).

Effects of Dam Operation on the Distribution of Northern Squawfish (Ptychocheilus oregonensis) in the Snake River, Lower Granite Dam Tailrace, Washington. Rich Piaskowski and Paul Anders (University of Idaho, Aquaculture Research Institute, Fish Genetics Lab, Moscow, ID 83844-2260).

The goal of this study was to use radio-telemetry to assess the effects of Lower Granite Dam operation on the distribution and tailrace habitat use of northern squawfish (*Ptychocheilus oregonensis*), relative to predation of seaward migrating smolts. Lower Granite Dam is located at river kilometer 175 of the Lower Snake River in southeastern Washington and is the first dam encountered by most seaward-migrating smolts emigrating from the Snake River Basin.

Sixty-two different radio-tagged northern squawfish were observed a total of 4,059 times from April through June, 1996 and 1997 in the Lower Granite Dam tailrace. Of these, a total of 675 total observations from 59 different radio-tagged northern squawfish were analyzed, meeting independence of repeated observations and criteria of the Chi-square (c2) goodness of fit test. Under all hydraulic conditions in the Lower Granite Dam tailrace during 1996 and 1997 sampling periods, northern squawfish did not use habitat cells in proportion to their availability. This initial null hypothesis (that habitat cells were used in proportion to their availability, considering all cells simultaneously) was rejected for 1996 and 1997 datasets analyzed separately (1996: c2= 297.33 , p< 0.05, df=2; 1997: c2=118.97 , p< 0.05, df=2). A second null hypothesis, that the same habitat cells were used by northern squawfish in proportion to their availability in the absence and presence of spill, was also rejected based on separate analysis of 1996 and 1997 datasets (1996 no-spill: c2=651.54, spill c2= 40.86, p< 0.05, df=2; 1997 no-spill: c2= 261.68, spill c2= 66.78, p< 0.05, df=2). Spill from Lower Granite Dam appeared to prohibit northern squawfish from using habitats directly affected by the high water velocities in the spill plume.

Assessing Genetic Variation Among Columbia Basin White Sturgeon (*Acipenser transmontanus*). M. Powell (University of Idaho, Hagerman Fish Culture Experiment Station 3059 F, National Fish Hatchery Road, Hagerman, ID 83332), E. Brannon (University of Idaho, Moscow, ID 83844-2260), D. Campton (Abernathy Salmon Technology Center, U.S. Fish & Wildlife Service, 1440 Abernathy Creek Road, Longview, WA 98632) and P. Anders (University of Idaho, Aquaculture Research Institute, Fish Genetics Lab Moscow, ID 83844-2260).

Genetic relationships of Columbia Basin white sturgeon (*Acipenser transmontanus*) and the "definition" of their populations regarding biodiversity and conservation remain unclear. Until now, no comprehensive genetic assessment of sturgeon populations in the Columbia, Snake and Kootenai River systems has been undertaken. This project will assess inter- and intrapopulational genetic variation among white sturgeon in the Columbia, Snake, and Kootenai(y) River Basins. To address population genetics and conservation of white sturgeon Basin-wide, the Aquaculture Research Institute at the University of Idaho initiated the following comprehensive research strategy, as a collaborative project with state, provincial, federal, and private fisheries agencies and

Native American Indian Tribes. Up to 60 samples are being collected from 24 locations, or putative populations throughout the Columbia River Basin, and from two reference populations outside the Basin. This project employs three separate nuclear and mitochondrial DNA analyses to test the following null hypotheses: Ho1:White sturgeon populations in the Columbia Basin represent a single gene pool; Ho2:White sturgeon populations in the Columbia Basin represent a single Evolutionarily Significant Unit (ESU) within this area of the species distribution. Falsification of these hypotheses will critically affect conservation and management of white sturgeon populations throughout the Columbia Basin. Divergent populations may be considered significant management components of overall white sturgeon diversity, possibly requiring

alternative management and conservation strategies to ensure long term stability or recovery of individual populations. Results will be reviewed by those involved in white sturgeon research and recovery throughout the Columbia Basin, USA and Canada. This research is expected to be completed by 2001.

Developing and Testing External Tags for Adult Chinook Salmon. Dean Rhine (Idaho Department of Fish and Game, 1540 Warner Ave., Lewiston, ID 83501), David A. Cannamela (Idaho Department of Fish and Game), Peter F. Hassemer (Idaho Department of Fish and Game) and Randall S. Osborne (Idaho Department of Fish and Game, 1540 Warner Ave., Lewiston, ID 83501).

In 1995, we researched external tags for adult chinook salmon. Tagging chinook salmon with individually numbered tags when they return to the hatchery can provide useful information on run timing in addition to providing opportunities for brood stock management initiatives such as selective breeding. Due to the low number of chinook salmon returning to Idaho, potential tags were first tested on rainbow trout.

We tested 11 external tags on rainbow trout in 1995. Tags were applied to fish for a period of two months and were rated based on ease of application, durability, loss rate, and effects to fish health. Of the tags tested, the operculum staple tag ranked highest. To verify that operculum tags were safe for chinook, tags were first tested on steelhead trout. Tags were applied to hatchery chinook in 1995.

Tag loss on chinook in 1995 was unexpectedly high. Initially operculum staple tags performed well, but tag loss increased as the spawning season progressed. The primary reason for the tag loss was attributed to the rigidity of the plastic tags. In 1996 we modified the operculum staple tag by using a flexible material called TYVEK. Fewer tags were lost in 1996, however, tag loss was still unacceptable. Tag loss was attributed to handling and the continued deterioration of the salmon. Tag loss was higher on males than females because males were not killed after spawning. Tag loss was highest on I-ocean males.

We are still searching for an external tag for adult salmon and would like your ideas. Tagging individual fish facilitates hatchery operations by tracking fish inventories, identifying stocks, and tracking disease samples and fish dispositions.

Steelhead Trout Size-At-Release Experiment Conducted at Hagerman National Fish Hatchery, Idaho. Dean Rhine (Idaho Department of Fish and Game, 1540 Warner Ave., Lewiston, ID 83501), David A. Cannamela (Idaho Department of Fish and Game, Boise, ID), Randall S. Osborne (Idaho Department of Fish and Game, 1540 Warner Ave., Lewiston, ID 83501).

Over 200,000 steelhead (*Oncorhynchus mykiss*) were reared to two different sizes, tagged with coded wire tags and passive integrated transponder (PIT) tags, and released into the Salmon River in 1991 and 1992. In 1991 (brood year 1990), large and normal size steelhead averaged 241 mm fork length (FL) and 204 mm FL, respectively. In 1992 (brood year 1991), large and normal size steelhead averaged 234 and 205 mm FL, respectively. A total of 53,245 large size and 61,431 normal size steelhead, were released in 1991. In 1992, 53,463 large size and 61,431 normal size steelhead were released. Approximately 500 steelhead from each size group were released with PIT tags each year.

For brood year 1990, 70.1% of the large and 63.5% of the normal size PIT tagged steelhead were interrogated at downstream dams. Significantly ($\chi^2 = 4.59$, $P = 0.032$) more large size steelhead were interrogated than normal size steelhead. Travel time to Lower Granite Dam was not significantly different ($P = 0.40$) between groups.

For the 1991 brood, 47.1% of the large and 48.6% of the normal size steelhead were interrogated at downstream dams. The number of fish interrogated was not significantly different ($\chi^2 = 0.154$, $P = 0.694$) between size groups. Travel time to Lower Granite Dam was not significantly different ($P = 0.068$) between groups.

For brood year 1990, 129 adults from large size smolts and 93 adults from normal size smolts returned to Idaho. Large size steelhead smolts returned as adults at a significantly higher rate than normal size smolts ($\chi^2 = 11.73$, $P = 0.001$). Smolt-to-adult survival rate (SAR) for large size smolts was 0.24%; SAR for normal size smolts was 0.15%. Sex composition of the adult return was independent of smolt size ($\chi^2 = 2.23$, $P = 0.136$). Age at return was independent of smolt size ($\chi^2 = 0.271$, $P = 0.602$).

For the 1991 brood, 26 adults from large size smolts and 15 adults from normal size smolts returned to Idaho. There was no significant difference in return rates between groups ($\chi^2 = 1.12$, $P = 0.289$). Large size smolts had a SAR of 0.05%; SAR for normal size smolts was 0.03%. Sex composition of the adult return was independent of smolt size ($\chi^2 = 1.01$, $P = 0.314$). Age at return was independent of smolt size ($\chi^2 = 0.001$, $P = 1.000$).

Results suggest that releasing larger smolts may improve adult return rates if spring discharge is of normal volume. Snake River flows in 1992 were below normal and believed responsible for the low interrogation and return rates observed for the 1991 brood. Releasing larger smolts did not adversely affect adult return rates, sex ratios, or age composition even under poor migratory conditions.