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WATER: THE ESSENTIAL INGREDIENT

Keynote Session: Montana's Water Allocation System – Past and Future

The History of Montana's Instream Flow Protection Program. Stan Bradshaw (Trout Unlimited).

Montana's Water Allocation System and River Fisheries. Rich Moy (Montana Department of Natural Resources and Conservation).

Potential Impacts of Global Climate Change on Montana's Rivers. Matt Reeves (University of Montana).

Montana Water Allocation in the 21st Century: Outlook for Instream Flows. Holly Franz (Attorney; Gough, Shanahan, Johnson & waterman)

Basin Closures, Murphy Rights, and Water Reservations: Will Instream Flows be Adequately Protected in the 21st Century? Chris Hunter (Montana Department of Fish, Wildlife and Parks)

River Flow Restoration: Do We Have the Necessary Tools and Resources? Stan Bradshaw (Trout Unlimited).

Hydrologic Impacts of Flood to Sprinkler Conversion. Mike Roberts (Montana Department of Natural Resources and Conservation).

The 2002 Farm Bill Conservation Programs: Opportunities for Private Lands Conservation in Montana. Carrie Mosley (Natural Resources and Conservation Service)

Applying the Tools: Watershed-Scale Flow Restoration Initiatives

Trout Unlimited's Western Water Project. Laura Ziemer (Trout Unlimited)

Instream Flow Restoration in the Jefferson River Drainage. Bruce Rehwinkel (Trout Unlimited), Dave Amman (Montana Department of Natural Resources and Conservation), and Ron Spoon (Montana Department of Fish, Wildlife and Parks)

Restoring the Musselshell by Restoring Rural Democracy. Bill Milton (Lower Musselshell Watershed Coordinator).

Instream Flow Restoration in the Blackfoot River Drainage. Ron Pierce (Montana Department of Fish, Wildlife and Parks).

Pallid Sturgeon in Montana: Is the Extinction of Wild Fish Inevitable

Status of Wild Pallid Sturgeon in Montana. Kevin Kapuscinski (Montana Department of Fish, Wildlife and Parks; Pallid Sturgeon Recovery Biologist).

Pallid Sturgeon Recovery: The Past and Future. Steven Krentz (U.S. Fish and Wildlife Service; Pallid Sturgeon Recovery Team Leader)

U.S. Army Corps of Engineers Perspective. Casey Kruse (U.S. Army Corps of Engineers; Section Chief for Endangered Species)

The Plight of the Pallid Sturgeon ……… Why We've Got to be Right, Right Now. Bob Snyder (Montana Department of Fish, Wildlife and Parks; Native Species Program Manager)

Contributed Papers

Factors Influencing the Distribution of Topeka Shiners in Kansas Streams. Christopher S. Guy (Montana State University), Sally J. Schrank, Matthew R. Whiles, and Brent L. Brock.

Sauger Aggregation and Harvest in the Lower Yellowstone River. Matthew Jaeger (Montana State University), Alexander V. Zale (Montana State University), Thomas E. McMahon (Montana State University), and Brad Schmitz (Montana Department of Fish, Wildlife and Parks).

Spotted Bass Habitat Structure Use in an Experimental Stream. Stan L. Proboszcz (Kansas State University) and Christopher S. Guy (Montana State University)

Coalbed Methane Investigations in the Tongue River Basin. Carol Endicott (Confluence Consulting Inc).

Don't be afraid: An Attempt to Use Alarm Pheromones of Flathead Minnows and Rainbow Trout as an Attractant to Enhance Gill Net Captures of Northern Pike in Milltown Reservoir. David A. Schmetterling (Montana Department of Fish, Wildlife and Parks) and Michael Young (Rocky Mountain Research Station)

A History of Instream Flow Protection in Reese Creek, Yellowstone National Park. Dan Mahony (National Park Service).

Fish-friendly Irrigation Methods on Small Western Montana Streams: Successes, Failures, and Funding Opportunities. Ron Pierce, Ladd Knotek and Mark Lere (Montana Department of Fish, Wildlife and Parks)

The Use of a GIS-based Water Balance Model in Managing Stream Flows for Various Life History Stages of Resident and Fluvial Fish Species. Carol Endicott (Confluence Consulting, Inc.) and David Marshall (DTM)

Some Effects of Streamflow and Reservoir Storage on Selected Trout Population Dynamics. Dick Oswald (Montana Department of Fish, Wildilife and Parks).

Salmonids on the Fringe: Distribution, Habitat Use, and Response of Salmonids to Upslope Riparian Forest Composition in High Gradient Headwater Streams, Southeast Alaska. Mason D. Bryant (U.S. Forest Service), Nikolas Zymonas (Montana State University) and Brenda E. Wright (U.S. Forest Service)

Using Trace Element Compositions of Juvenile Westslope Cutthroat Trout Scales to Determine Stream Origin in the North Fork Flathead River, Montana. Brian Marotz and Clint C. Muhlfeld (Montana Department of Fish, Wildlife and Parks).

Status of Westslope Cutthroat Trout in the United States: 2002. Brad Shepard (Montana Department of Fish, Wildlife and Parks), Bruce May (U.S. Forest Service), and Wendi Urie (U.S.

Forest Service)

The Sun Ranch Westslope Cutthroat Trout Recovery Program. Buddy Drake (Drake and Associates).

The State of Montana's Aquatic Nuisance Species Management Plan. Bob Wiltshire (Federation of Flyfishers).

Abundance of Juvenile Salmonids Along Stabilized and Natural Main-channel Banks of the Upper Yellowstone River. Douglas Rider and Alexander V. Zale (Montana State University).

Use of Remote-site Incubators to Reestablish Lacustrine Arctic Grayling Spawning Stocks. Glenn D. Boltz and Lynn R. Kaeding (US Fish and Wildlife Service).

Efficacy and Safety of AQUI-S™ as an Anesthetic. Jim Bowker, Molly Poehling, Dan Carty, Dave Erdahl, and Bonnie Johnson (Bozeman Fish Technology Center).

Radio Telemetry and Water Chemistry Describe the Behavior of Rainbow Trout Attempting Upstream Passage at Milltown Dam, Montana. David Schmetterling (Montana Department of Fish, Wildlife and Parks)

Factors Influencing Brook Trout Invasion and Their Replacement of Westslope Cutthroat Trout. Brad Shepard (Montana Department of Fish, Wildlife and Parks).

Impacts of Terrestrial Weeds on Aquatic Habitats and the "Anglers Against Weeds" program. Bob Wiltshire (Federation of Flyfishers).

Poster Papers

Iodophor Use DuringWater-hardening of Westslope Cutthroat Trout Eggs. Jay Pravecek (Montana Department of Fish, Wildlife and Parks) and Michael E. Barnes (South Dakota Game, Fish and Parks)

Successful Off-season Use of Westslope Cutthroat Trout Males. Jay Pravecek and Mark Seeeney (Montana Department of Fish, Wildlife and Parks)

ABSTRACTS

The History of Montana's Instream Flow Protection Program

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Montana's water law is grounded in the doctrine of prior appropriation—the right to put water to a beneficial use is based on priority in time. When there is not enough water to meet all needs, the user with the earliest priority date gets water first. The conventional wisdom was that water left instream was not a beneficial use.

In the 1960s, the idea of an instream beneficial use for fish first gained credibility. In 1969, the legislature passed legislation allowing the Montana Fish and Game Department to appropriate water for instream use on twelve streams. The Department filed claims on those streams in early 1970s.

In 1973, the legislature codified Montana's water law into the Water Use Act. In addition, the legislature authorized state, local, and federal agencies to apply for instream flow reservations. There have been three instream reservations in Montana—the Yellowstone, the upper Missouri, and the Lower Missouri.

The Water Use Act was amended in 1976 to require a statewide adjudication of pre-July 1, 1973 water right claims. State and federal agencies claim instream rights in the adjudication. In 2002, the Montana Supreme Court affirmed that right of the agencies to file those claims.

In 1989, the legislature authorized a pilot instream leasing program allowing the Department of Fish, Wildlife, and Parks to lease existing water rights with priority dates intact. In 1995, the legislature passed two statutes authorizing pilot programs for instream leases to be held by private entities.

Montana's Water Allocation System and River Fisheries

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To understand how Montana's water allocation system may change in the 21st Century, we need to understand past changes. California miners brought the water law doctrine of first in time, first it right or the Prior Appropriation Doctrine to Montana in the 1860s. It is still alive and well. Before 1973, Montana did not have a water law to guide the orderly use and appropriation of state's waters. There was more than one way to obtain a water right. The passage of the 1973 Water Use Act changed this. The Act set up a centralized system of all water right records, one process for obtaining water rights, a system to adjudicate pre-1973 water rights and a statute to reserve water for future consumptive uses and to maintain instream flows. Even though our State Constitution requires that we "shall maintain and improve a clean and healthful environment for present and future generations", our water law allows streams and rivers to become fully appropriated and go dry. A number of changes in Montana's water law, however, have occurred over the past 30 years that recognize the importance of leaving water instream for fish and wildlife, recreation, and water quality dilution. These laws include water reservations, water leasing, basin closure, pre-1973 claims for fish and wildlife, and Murphy water rights. But the demand for more water by agriculture, industry, municipalities and instream users will only increase. The tools in our toolbox may not be enough. Everyone will need to work together to create new tools and solutions in the 21^{st} Century.

Potential Impacts of Global Climate Change on Montana's Rivers

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The earth's climate is predicted to change due to a buildup of greenhouse gasses. The heat trapping property of these gasses is well documented and undisputed. At the global scale, sea ice extents are declining, carbon dioxide levels and average temperatures are increasing. Additionally, sea levels and the number of frost-free days are increasing. The earth is undeniably warming, yet predicting the extent of change, particularly in the environmentally diverse northern Rockies ecosystem, is challenging and remains debated. The general trends however, indicate that temperatures are rising across this region, while precipitation is decreasing. For example, in Helena Montana annual mean temperature has increased 1.3°F, while precipitation has decreased up to 20% in some parts of the state. Temperature trends remain less ambiguous than either temporal or spatial variations in expected precipitation. Projections made by the Intergovernmental Panel on Climate Change

(IPCC) and results from the United Kingdom Hadley Centre's climate model (HadCM2) predict temperatures could rise by a range of 1-8°F in spring and summer and by a range of 2-10°F in fall and winter by 2001 within the region. Under this scenario, within Montana, growing seasons and forest and rangeland productivity will likely increase and snow pack will decrease thereby decreasing stream flows. This situation could alter floral and faunal composition of an area depending on length and severity of climate change.

Montana Water Allocation in the 21st Century: Outlook for Instream Flows

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Basin Closures, Murphy Rights and Water Reservations: Will Instream Flows be Adequately Protected in the 21st Century

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Climate change, the legal trend toward the public trust doctrine and increasing urbanization will determine the protection that instream flows will receive in this century. Western water law is really quite young. It has changed substantially with regard to instream flows in the last quarter century. We now have the ability to reserve water for instream uses and also to lease water. The trend in water law is toward more protection for instream flow as the public trust doctrine is increasingly extended to water law. Bean Lake III is the most recent and local example. Over the course of the next century this trend will continue with more protections afforded to instream flows. Climate change will be a huge factor in how instream flows are viewed by society. Many climate change scientists believe that while flows will be higher during the winter in Montana, they will be lower and stream temperatures will be higher in the summer. The result will be a contraction in salmonid distribution in Montana. How will this affect society's view of instream flows. Will people demand that more water be left instream to try to reduce the impact on trout fisheries? At the same time it is likely that western Montana will continue to become more urbanized while eastern Montana continues to lose population. People in cities are more likely to support water for instream flows than are agricultural users. As the cities gain greater political influence in the state legislature there may be a greater political will to do more to establish and protect instream flows.
My view is that during the course of the next century we will see stronger legal protection for instream flows, the public will become increasingly concerned about instream flows due to the contraction of salmonid populations caused by climate change and the demographic/political shift to an urbanized western Montana will all lead to greater protections for instream flows. By the end of the century the tools we rely on today will be a memory just like us.

River Flow Restoration: Do We Have the Necessary Tools and Resources?

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Any discussion of tools and resources has to be within the context of existing law that recognizes water rights as property. Current instream flow tools in Montana do two things:
(1) provide for some protection against future consumptive uses;
(2) Provide some drought relief on specific streams in which leases or conversions of

existing, senior rights to instream rights have been negotiated with willing water users.

Leasing and conversions of existing rights are slow to implement, but have shown promising tributary benefits.

Current tools don't provide for base flows that trump all other water rights. It is unlikely that we'll soon see such a provision. If such a measure were to be enacted, it might not survive judicial scrutiny.

The Public Trust Doctrine may offer an additional tool in the future. California, having applied to Public Trust Doctrine to water rights, has realized some benefits to instream values. It has not been, however, a panacea.

Voluntary watershed efforts on the Blackfoot, Big Hole, and the Jefferson have shown some promising results, but have some limitations.

Additional tools that have yet to be tapped to their fullest potential are management of existing storage to improve instream flows, expansive public interest criteria that incorporates instream values to assess new consumptive use permit applications, and the use of the Clean Water Act TMDL process. In addition, the Washington Supreme Court has held that stream flows are a component of water quality that can be protected under the Clean Water Act.

Hydrologic Impacts of Flood to Sprinkler Conversion

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Flood irrigation techniques have been practiced in Montana for over a hundred years. Nearly half of the irrigated land in Montana still utilizes some form of flood irrigation. The recent trend of converting flood-irrigated land to sprinkler-irrigated lands will have impacts on streamflows. In most cases, by converting to sprinkler, irrigators divert less water to irrigate the same parcel of land that was historically flood irrigated. These conversions can provide benefits to water quality and if the excess water is left in the stream, short-term increases to streamflows. They also may increase hay production through more consistent application of water and by extending their irrigation season in water-short years. In some cases, water leftover by sprinkler conversions, water that typically would return to streams under flood operations, is used to put additional land into production. Consequently, sprinkler conversion projects can increase the overall volume of water consumed, deplete returns flows, and cause a net depletion of streamflows. If water conservation is the goal of resource managers when conversions are made, they must carefully compare the water balance for the existing flood system to that for the proposed sprinkler system to determine the hydrologic consequences of this action.

The 2002 Farm Bill Conservation Programs: Opportunities for Private Lands Conservation in Montana

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Conservation programs of the 1996 Farm Bill administered by the Natural Resources Conservation Service (NRCS) brought millions of dollars to Montana's private landowners from 1997-2002. These volunteer conservation programs benefited Montana's soil, water, plant and animal resources. Recent passage of the Farm Security and Rural Investment Act (FSRIA) of 2002 will continue to strengthen the United States Department of Agriculture's (USDA) conservation efforts on American's private lands. FSRIA reauthorized many popular and effective programs such as

the Environmental Quality Incentives Program (EQIP), the Wildlife Habitat Incentives Program (WHIP), the Wetland Reserve Program (WRP), the Farm and Ranchlands Protection Program (FRPP), the Conservation Reserve Program (CRP) and it's spin-off programs the Conservation Reserve Enhancement Program (CREP) and the Farmable Wetland Program (FWP). These programs were reauthorized with significant funding increases included. Also included in the 2002 Farm Bill are the new programs Grassland Reserve Program (GRP) and the Conservation Security Act (CSP) along with special provisions for limited resource producers, beginning farmers, and technical service providers.

Applying the Tools: Watershed-Scale Flow Restoration Initiatives

Trout Unlimited's Western Water Project

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In 1998, Trout Unlimited initiated its Western Water Project in two states, Colorado and Montana, in order to squarely address the problem of dewatered streams. Since then this experiment has paid off with steady progress in both creating additional tools for instream flow protection, and with on-the-ground projects to protect and enhance streamflows. Now five years later, the Western Water Project operates in six states with an additional federal issues staffer in Washington, D.C. Trout Unlimited is beginning to see region-wide results that are grounded in the specifics of each state.

Just as the relative success of various "Tools for Instream Flow Protection" presented today are necessarily specific to particular river basins and tributaries, each Western state has its own politics, culture, and laws governing water. One of the strengths of the Western Water Project is its ability to share knowledge across state boundaries, and gain a perspective on the uniqueness of state-based water law and politics. This presentation will compare and contrast the relative progress among the Intermountain West states, focusing on how other states compare to Montana's streamflow protection efforts. This presentation will attempt to integrate this AFS Meetings' prior presentations in the context of a broader, west-wide view, and set the stage for specific, Montana examples of streamflow protection that will follow. Inviting discussion, this presentation will conclude with suggestions on how Montana may be able to incorporate some of the progressive elements of streamflow protection that exist in other Western states.

Instream Flow Restoration in the Jefferson River Drainage

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The Jefferson River is perhaps one of Montana's most chronically dewatered rivers due to past over-appropriation of water rights in the drainage. Long-term monitoring of the fishery of the Jefferson show the impacts of flow shortage on the health of the fishery, and fishery impacts are acute during drought years. Water users and the Jefferson Watershed Council (JWC) developed a drought plan in 1999 to attempt to reduce the impacts of drought on the fishery of the Jefferson. This plan was implemented in each of the last three years and the voluntary effort improved stream flow in a 25-mile reach of the upper Jefferson River. Although the “tool” of a voluntary drought plan is very beneficial and important to get modest flow improvements during severe drought, a larger and more ambitious “tool” is needed to significantly improve stream flow. The JWC is exploring the concept of improving the water delivery system to benefit both water users and aquatic life. A pilot project designed to reduce ditch seepage loss in the Jefferson Canal was implemented on monitored in 2002. Results of this project document water savings and indicate that improving canal efficiency may be an effective tool to help restore instream flow in the Jefferson River. Results also showed that improved canal efficiency reduced the burden felt by water users that voluntarily contributed water to the river.

Restoring the Musselshell by Restoring Rural Democracy

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The Musselshell River, a tributary of the Upper Missouri, drains over 8000 square miles of Central Montana's mountains and plains. Less than 10000 people reside within the borders of the watershed. Over 350 farms and ranches located along the Musselshell's mainstem and the tributaries rely on the seasonal flow to support some portion of their agricultural enterprises. A number of small communities rely on the waters for municipal needs. In the past, the river has supported a fair to good cold water fishery in the upper reaches and a warm water fishery in the lower reaches. In 1991, The Montana Legislature, declared the Musselshell a chronically dewatered stream. In 1996, the Musselshell was placed on Montana's 303(d) impaired stream list thus requiring a restoration plan be developed to voluntarily address streambank stability and flow management. The watershed has experienced various levels of drought for over six years.
The presentation will briefly explore the possible meanings of the following statement: there is no shortcut to lasting solutions and lasting solutions never last. How does a community and a landscape come to terms with each other? In human perception scarcity always exists. The act of restoring instream flows implies scarcity. How does the idea of democracy and respecting the individual voice respond to scarcity? If there is a better outcome for the whole, what role do the parts play in realizing that outcome? The speaker will offer for discussion, one, a process for public dialogue, along with the corresponding attributes useful for that dialogue; and two, how the process when skillfully applied can lead and has led to better outcomes for people and the landscapes they live in.

Instream Flow Restoration in the Blackfoot River Drainage

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Since 1988, the Blackfoot River drainage has been the site of a private lands cooperative wild trout restoration initiative, focusing on the recovery of imperiled native fish. In 2002, Montana Fish, Wildlife and Parks identified habitat restoration opportunities on 94% (83 of 88) of inventoried streams, including 33 streams (38%) with potential for fisheries-related irrigation improvement such as instream flow enhancement. Tools to maintain and enhance instream flows in the Blackfoot are: 1) a basin closure to new water right appropriations, 2) two drought planning tools (the FWP Murphy water right and the Blackfoot Emergency Drought Response (BEDR) Plan), and 3) the restoration program. The restoration program provides a long-term mechanism for increasing instream flows. On private lands, instream flow problems often overlap with other agricultural-related habitat problems ranging from degradation of riparian areas to non-point pollution of entire stream reaches. Within this context, the Blackfoot restoration program attempts to address multiple limiting factors. Like all elements of the restoration program, enhancing instream flows relies largely on voluntary cooperation of private landowners. Meeting landowner and instream flow objectives remain critical to our long-term success. Technical aspects of enhancing instream flow as well the social considerations of three instream flow case studies outline the successes and challenges of instream flow enhancement. These case studies further illustrate methods of conflict resolution regarding strongly held utilitarian views of water-use held by many water-users and the role watershed groups can play regarding local social issues.

Pallid Sturgeon in Montana: Is the Extinction of Wild Fish Inevitable?

Status of Wild Pallid Sturgeon in Montana

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Two pure pallid sturgeon populations exist in Montana waters of the Missouri River; one upstream of the Fort Peck Dam (RPMA #1), and one between the Fort Peck Dam and the headwaters of Lake Sakakawea, including the lower Yellowstone River (RPMA #2). These populations are comprised of large, old-aged individuals, as there has been no natural recruitment during the past 20 years. Attempts are made each year to collect broodfish from RPMAs #1 and #2, and a variety of assessments are conducted during the remainder of the field season in each area to monitor stocked hatchery-reared pallid sturgeon. Broodfish collection is becoming increasingly difficult in both areas as wild pallid sturgeon abundances dwindle. Krentz (1995) estimated that 50 wild pallid sturgeon remained in RPMA #1 during 1995. I employed a modified Schnabel procedure to estimate that 178 wild pallid sturgeon remained in RPMA #2 during 2001. Upper and lower 95% confidence limits were 351 and 96, respectively. I used simple linear regression to quantify the relationship between wild pallid sturgeon abundance and time during 1991-2001. Assuming no natural recruitment, wild pallid sturgeon in RPMA #2 would be extirpated during 2017. Stocking hatchery-reared pallid sturgeon has been and continues to be the focus of recovery efforts in RPMA #2. The stocking plan goal for RPMA #2 is to have 1,600 adult pallid sturgeon 15 years after ten years of stocking. This goal is unlikely to be achieved, as 5,000-7,000 hatchery-reared pallid sturgeon must be stocked each year during the next 13 years; the most ever stocked was 3,061 during 2002. An iridovirus and an inability to capture broodfish has hindered the progress of the stocking plan, but current stocking strategies do not allow for stocking rates necessary to achieve the stocking plan goal. Furthermore, researchers cannot accurately estimate survival, growth, and condition of hatchery-reared pallid sturgeon due to extremely low recapture rates. Habitat rehabilitation must begin immediately if wild pallid sturgeon are to persist. The stocking plan can successfully augment the existing wild population only if the basic ecology of hatchery-reared pallid sturgeon is understood, survival of stocked individuals is quantified, and the stocking plan is modified accordingly.

Pallid Sturgeon Recovery - The Past and the Future

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Pallid Sturgeon and the topic of extinction is not a new concept. After all, that is what led biologists to come to the conclusion that the species desperately needed the protection of the endangered species act and listed this unique species as endangered. Endangered is classified under the Endangered Species Act as any species which is in danger of extinction throughout all or a significant portion of its range.

The fact that we are again discussing the risk of extinction suggests that the existing data for pallid sturgeon supports that this species will "blink out"; if actions are not continued to preserve, protect and restore habitats it needs to complete its life history. Whether or not pallid sturgeon will disappear in Montana, can be just as easily discussed in any part of the pallid sturgeon range.

Recovery efforts are underway and will continue to insure that the next generations can say they've seen a "dinosaur fish". With a cooperative efforts of State, Federal, Tribal, and public involvement, the pallid sturgeon can be recovered and those efforts will also prevent other similar species from following the same path. Current efforts on stocking and restoring habitats that will benefit the pallid sturgeon recovery, will likely prevent the extinction of the pallid sturgeon in some of the best remaining habitat available in Montana and North Dakota.

U. S. Army Corps of Engineers Perspective

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No abstract was submitted.

The Plight of the Pallid Sturgeon...Why We've Got to be Right, Right Now.

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The pallid sturgeon *(Scaphirhynchus albus)* is functionally extinct in Montana. Spawning is spurious with no recruitment to the two Montana populations in at least 50 years. The population consists entirely of all old-aged fish predicted to decline to extinction in 2017. Little is known about this species and recovery planning is occurring without an understanding of most of the requirements of the species. This environment of uncertainty is affecting the decisions about the restoration of the pallid sturgeon. Because of the imminent demise of the wild pallid sturgeon population, there isn't time to be wrong. The wild pallid populations in the upper and lower Missouri and Yellowstone rivers, the only sources of gametes available for augmentation stocking until the captive broodstock program at Gavins Point NFH is proven, are a tenuous and undependable sources of eggs. The wild populations will probably become extinct before the hatchery-based populations are established. Unless adequate numbers of hatchery fish are stocked, there will be insufficient, or no, fish that survive to sexual maturity, making recovery of the species impossible. Five recommendations are made including: sufficient numbers of hatchery fish need to be released; improvements are needed in capture, handling and fish culture techniques; habitat restoration needs to start immediately; decisions should use worst-case estimates; the decision-making process needs improvements; there needs to be a stronger commitment to the recovery of the pallid sturgeon by the USFWS and Montana FWP.

Contributed Papers

Factors Influencing the Distribution of Topeka Shiners in Kansas Streams

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The Topeka shiner *Notropis topeka* has declined in abundance throughout its historical range in the central U. S. As a result, this minnow was listed as a federally endangered species in 1999. The objective of our study was to quantitatively assess the instream physical, chemical, and biological parameters and landscape-level factors influencing the distribution (i.e., extant or extirpation) of Topeka shiners. We sampled 26 streams in the Flint Hills region of Kansas: 12 sites where Topeka shiners are extant, and 14 sites where they are extirpated. Multivariate analysis of variance was used to test whether variables were different between extant and extirpated sites. Mean catch per effort of largemouth bass in stream pools was higher at extirpated sites, and species diversity by trophic guild and richness in stream pools were higher at extirpated sites. Stepwise logistic regression was used to develop a model to predict whether Topeka shiners were extant or extirpated. Number of small impoundments per watershed area, catch per effort of largemouth bass *Micropterus salmoides* in pools, and length of pool were the only significant variables in the logistic model. Our model correctly classified 83% of extant sites and 85% of extirpated sites. In a landscape-level analysis of 111 streams, only number of small impoundments per watershed area was significant in the logistic model. These results provide predictive tools to assess instream and landscape-level characteristics for habitat management and possible reintroduction of Topeka shiners in Kansas Flint Hills streams.

Sauger Aggregation and Harvest in the Lower Yellowstone River

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Sauger (*Stizostedion canadense*) movement and exploitation rates were assessed and compared to determine susceptibility to overharvest in the lower Yellowstone River, Montana. Overharvest, especially at times when sauger were thought to be aggregated, had been identified as a possible factor contributing to low abundances. Seasonal movement and aggregation were investigated by telemeterizing and tracking 30 fish in 2001 and 31 fish in 2002. Exploitation rates were assessed by tagging 1033 sauger with reward tags. Tag-shedding rate was estimated by double-tagging and nonreporting rate was estimated using postcards as tag surrogates. Sauger aggregated near spawning areas in spring and subsequently dispersed 5 to 300 km upstream where they remained for the rest of the year. Exploitation occurred primarily in early spring and late autumn. Exploitation rates were low overall (10-15%) and were lower in spring when sauger were aggregated than in autumn when they were dispersed. Tag-shedding rate of both tags was low (2%) and nonreporting rate was high (69%). Annual survival was high (70%). Entrainment in irrigation diversions may have accounted for as much as one third of natural mortality.

Spotted Bass Habitat Structure Use in an Experimental Stream

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A common method used to enhance salmonid populations is to improve lotic habitat by installing habitat structures. However, the effects of habitat-enhancement structures have not been evaluated for spotted bass *Micropterus punctulatus* populations. This study was conducted to evaluate use of habitat-enhancement structures (half-log, rootwad, and undercut bank), by age-0 spotted bass in an experimental stream. Three habitat structures and a no structure area were randomly arranged in an experimental stream. Fish were observed for two days after structure placement. Light intensities and current velocities were measured for each habitat arrangement. Laboratory results were similar to natural stream habitat use by adult spotted bass. For example, each habitat structure type was used significantly more ($P < 0.05$) than the no structure area. Half-log was used significantly more ($P < 0.05$) (30 %) than both undercut bank (17 %) and rootwad (11 %). Light intensity and current velocity were important variables influencing habitat use. For example, use of half-log structure was a function of low velocity and light intensity. These results suggest half-log structure may provide the most suitable cover for age-0 spotted bass.

Coalbed Methane Investigations in the Tongue River Basin

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Coalbed methane (CBM) is an emerging energy resource in many western states. Ground water, often rich in salts and other toxic constituents, is a by-product of CBM development. Management of this water presents a considerable challenge to methane producers and regulatory agencies. We conducted this investigation to assist decision making with regard to fate of the produced water. One component of this study was a review of the literature addressing effects of dissolved solids on fish, macroinvertebrate, and aquatic plants. In addition, we conducted assessments of the biological, chemical, and physical integrity of streams in the Tongue River basin using protocols developed by the EPA. These assessments provided both baseline data on streams likely to be influenced by CBM development and upstream/downstream comparisons of streams where CBM development was already occurring. A primary conclusion drawn from the literature review was that different taxa demonstrate wide variation in response to dissolved solids. Therefore, predicting effects based on laboratory tests is overly simplistic and unlikely to protect overall biological integrity. Baseline assessments of tributary streams in the Tongue River basin indicated varying levels of biological, chemical, and physical conditions among streams due to variation in land use, geology, and water quantity. Comparisons of streams above and below CBM development suggested that elevated dissolved solids may have deleterious effects on fish and aquatic life, however, drought and local geology may also be contributing factors. We recommend additional investigation to pinpoint sources of salts in the impacted stream. Finally, we recommend that methane producers and agencies collect baseline data to identify sensitive areas and adaptively manage CBM development.

Don't be Afraid: an Attempt to Use Alarm Pheromones of Fathead Minnows and Rainbow Trout as an Attractant to Enhance Gill Net Captures of Northern Pike in Milltown Reservoir.

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Illegally introduced northern pike in Milltown Reservoir, a shallow reservoir at the confluence of the Clark Fork and Blackfoot rivers, represent a threat to resident and migratory native fishes, among them federally threatened bull trout and state "species of special concern" westslope cutthroat trout. While annual drawdowns and seasonal trap netting have reduced northern pike abundance, we wished to increase the effectiveness of gillnetting to enhance removal of adult northern pike. Recent studies have demonstrated that many fishes are highly responsive to pheromones—molecules used for chemical communication in many fish species—and that this responsiveness can be exploited for management purposes. Because some studies revealed that northern pike are attracted to Schreckstoff, an alarm pheromone released from the skin cells of fathead minnows, and that this pheromone requires breakage of the skin cells and survives freezing, we obtained frozen, macerated fathead minnows to use as an attractant within gill nets modified into cylinders. Because rainbow trout also release Schreckstoff from their skin cells and because northern pike in Milltown Reservoir were previously exposed to this prey species, we created a paste of juvenile rainbow trout from fish obtained from the Arlee Fish Hatchery for the last several days of the experiment. The test was conducted for 10 days, with equal numbers of treatment (with attractant) and control (no attractant) nets, and all nets were checked at least twice daily. The results were very surprising, and suggested several improvements for future studies of this kind.

A HISTORY OF INSTREAM FLOW PROTECTION IN REESE CREEK, YELLOWSTONE NATIONAL PARK

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National parks are regarded as pristine environments where optimal opportunities for native fish preservation exist. Despite this, aquatic habitat degradation does occur, often in boundary areas where only a portion of a watershed falls under National Park Service (NPS) jurisdiction. Reese Creek, a small stream located at the northern boundary of Yellowstone National Park, was historically dewatered for irrigation by adjacent landowners. This stream is one of only a dozen Yellowstone River tributaries between Yellowstone National Park and Livingston, MT. where Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* can spawn. In the early 1980s, NPS began negotiating with private irrigators to obtain an instream flow, but an acceptable agreement was not reached until 1991. Periodic sampling by U.S. Fish and Wildlife Service in 1984, 1986, and 1992 documented spawning by cutthroat trout, rainbow trout *Oncorhynchus mykiss*, and hybrids of the two species. To provide better protection for fish using Reese Creek, in 1991 NPS added rotating self-cleaning fish screens to the head gates in order to prevent fry entrainment into irrigation ditches. Unfortunately, improper design caused the fish screens to not work as planned. In 1999, improvements to the diversion structures, including installation of a solar power source, were completed. Subsequent sampling has yielded few fish in the irrigation ditches. Tagging studies suggest that the uppermost diversion acts as a barrier to upstream movement of non-native species in the downstream sections of Reese Creek. However, additional genetic and population sampling and stream flow modeling at points of diversion need to be completed before Reese Creek can be recommended as a Yellowstone cutthroat trout restoration site.

Fish-Friendly Irrigation Methods on Small Western Montana Streams: Successes, Failures and Funding Opportunities

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Fisheries-related irrigation impacts in western Montana take three primary forms: 1) loss of habitat to dewatering, 2) reduced fish passage and 3) entrainment of out-migrant fish to irrigation ditches. In west-central Montana, native salmonids (westslope cutthroat trout and bull trout) are heavily impacted by normal irrigation practices because they rely on diverted tributaries for spawning/rearing and exhibit movements that coincide with the irrigation season. Correcting fish passage and entrainment impacts during irrigation diversion operation usually requires some form of fish ladder and ditch screening device. Designs should 1) consider the geomorphic and hydrologic setting, 2) identify specific fisheries and irrigation objectives, and 3) consider maintenance needs in order to be effective. The pros, cons and monitoring results of several fish ladders (Denil, step-pool and natural channel bypass) and five fish screening devices (flat plate screens (self-cleaning and manual), Brencail, rotating electric drums, infiltration galleries and turbulent fountain fish screens) are outlined. The Fisheries Restoration and Irrigation Mitigation Act (FRIMA), passed by Congress in 2000, established a funding program to plan, design and construct fish screens, fish passage devices and related features to mitigate impacts on fisheries associated with irrigation system water diversions by local government entities in the Pacific drainage of Oregon, Washington, Idaho and Montana. The FY2002 appropriation for Montana ($1 million) was used to fund 15 fish screen and passage projects located on waters west of the continental divide.

The Use of a GIS-based Water Balance Model in Managing Stream Flows for Various Life History Stages of Resident and Fluvial Fish Species

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Because of increasing demands upon limited surface water and current drought conditions, native fish in Montana's streams face threats due to inadequate flow. Efforts to increase in stream flow through water conservation efforts or water rights leasing have not kept up with this increasing threat. This paper outlines the integrated use of fish life history analysis and water balance modeling to determine an optimal strategy for managing flows using a three-stage process. First, flow requirements during critical life stages (i.e. spawning, incubation, emergence, drift, and rearing) are determined for the native fish assemblage in critical stream reaches. Second, a continuous simulation hydrologic model is constructed and calibrated using HSPF (Hydrologic Software Program Fortran) software developed by EPA. Data for the model are preprocessed and managed using ArcView GIS software. HSPF uses continuous meteorologic and hydrologic records to compute stream flow hydrographs taking into account rainfall interception, surface runoff, diversions, groundwater interactions, snowmelt, and evapotranspiration. Analysis of yearly, simulated hydrographs generated for the critical stream reaches is used to determine the in stream flow deficits from the flow requirements. The third and final stage is to use the Montana DNRC water rights database, within the project GIS, to determine a cost effective permitted water right or combination of water rights that could be obtained or conserved to provide the additional flows to meet critical life stage requirements.

Some Effects of Streamflow and Reservoir Storage

on Selected Trout Population Dynamics

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Between 1982 and 2002, the Missouri River headwater drainages experienced two extremely wet climatic periods, each of which was followed by periods of extreme drought. Over the 20 year study period, trout populations in free – flowing rivers, irrigation storage reservoirs, and river tailwaters below reservoir dams were studied in order to discern salmonid population response to ample and reduced flow regimes. During the study, salmonid populations responded positively to ample flow regimes and declined markedly as flow regimes were reduced during drought. Data strongly suggest that the population dynamics most predictably and significantly affected by flow include standing crop, densities of large, mature fish in the population, and condition factor, particularly that of the large, mature segment of the population. Population density and juvenile recruitment also responded positively to increased streamflow but were not always reduced under restricted flow conditions suggesting that other variables might influence those dynamics as significantly as flow.

Salmonids on the Fringe: Distribution, Habitat use, and Response of Salmonids to Upslope Riparian Forest Composition in High Gradient Headwater Streams, Southeast Alaska

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We compared the species composition, habitat relationships, and longitudinal distribution of salmonids in small, 1st to 2nd order, high gradient headwater streams in two extensively logged watersheds in southeast Alaska. Fish populations were sampled by electrofishing and with minnow traps, and habitat measurements characterized channel morphology, large woody debris, and riparian vegetation. Dolly Varden (*Salvelinus malma*) were predominant in the high gradient reaches and were found in reaches with gradients exceeding 20%. Ripe sea-run Dolly Varden were observed in the uppermost accessible reaches. Juvenile coho salmon (*Oncorhynchus kisutch*) fry and parr were also found in high gradient (up to 10%) reaches and were the dominant species in the low gradient reaches. Juvenile steelhead trout (*Oncorhynchus mykiss*) were present during the spring and fall. Coastal cutthroat trout (*Oncorhynchus clarki clarki*) were found in one stream. Density of all species decreased as gradient increased. Significant and positive relationships were observed between density of Dolly Varden as well as juvenile coho salmon and the abundance of pools. A positive relationship was observed between juvenile coho salmon density and the number of pieces of large wood. The abundance of coho salmon parr was lower in streams with a history of landslides. Salmonids will use high gradient reaches where they are accessible and pools are present. Headwater tributaries comprise a large proportion of the stream length in most watersheds and the combined contribution from these tributaries to the fish community may be large. These results underscore the importance of maintaining continuity throughout the entire watershed.

Using Trace Element Compositions of Juvenile Westslope Cutthroat Trout Scales to Determine Stream Origin in the North Fork Flathead River, Montana

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We used laser ablation inductively coupled mass spectrometry to quantify Mg:Ca, Mn:Ca, Sr:Ca, and Ba:Ca levels in scales from juvenile westslope cutthroat trout *Oncorhynchus clarki lewisi* collected from five streams of the North Fork Flathead River during the summer of 2001. We also

determined Mg:Ca, Mn:Ca, Sr:Ca, and Ba:Ca levels in the water throughout the North Fork Flathead River drainage during the summer of 2001. The chemical compositions of trout scales were related to Sr:Ca and Ba:Ca levels in the water. Multivariate elemental signatures of the scales differed significantly among streams, and a canonical discriminant analysis revealed that streams were significantly separated in discriminant space. A forward stepwise discriminant function analysis was used to classify individual fish back to their natal stream. Overall classification accuracy was 91%, and ranged from 83% for Langford Creek to 100% for Camas Creek and Sage Creek. Finally, the trace element levels at the focus and edge of individual scales were significantly correlated, suggesting that the sampled fish were rearing in their respective natal tributary. These data indicate that trace element signatures may be used as natural tags to identify natal stream origin of cutthroat trout. In the future, this technique may be used to 1) monitor the effectiveness of habitat and passage programs, 2) identify and protect important populations, and 3) determine life history.

Status of Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) in the United States: 2002

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The distribution and abundance of westslope cutthroat trout (*Oncorhynchus clarki lewisi*; WCT) have reportedly declined from historical levels over part or all of their historical range. For the U.S. range of WCT we used existing information provided by 112 fisheries professionals applied through a consistent methodology to assess the extent of their historical range, their current distribution, including genetic status, and evaluated the foreseeable risks to 539 populations designated as “conservation populations” by management agencies. We estimated that WCT historically occupied about 56,500 miles of habitat within the U.S. WCT currently occupy an estimated 33,500 miles of historically occupied habitats (59%). Genetic testing has been completed across about 6,100 miles of habitat (18% of occupied habitats), but sample sizes were variable and sample sizes of 25 fish or more (a sample size that likely would detect as little as 1% levels of introgression with a 95% level of confidence) made up only 30% of the samples. WCT with no evidence of genetic introgression currently occupied about 3,400 miles (10%) of currently occupied habitats. Another 1,000 miles of currently occupied habitats (3%) contained WCT that were probably part of a mixed stock where the WCT were not introgressed. We suggest that even though genetic sampling was nonrandom, sampling likely occurred more frequently in WCT populations that appeared non-introgressed, some, if not much, of the habitat currently occupied by WCT that has not been genetically tested likely support populations that are not introgressed. Much of the habitat currently occupied by WCT was located in designated parks (2%), wilderness areas (19%), and roadless areas (40%), and almost 70% of habitats currently occupied lie within federally managed lands. A total of 563 separate WCT populations currently occupying 24,450 miles of habitat were designated as “conservation populations”. These conservation populations were spread throughout the historical range, occuring in 67 of the 70 hydrologic units historically occupied by WCT. Most of these conservation populations were believed to be “isolets” (457 or 81%); however, metapopulations occupied much more of the habitat (21,600 miles or 88%). Of the 563 designated conservation populations, 339 (60%) had at least some component that was genetically unaltered and 172 (30%) consisted entirely of stream segments that were genetically unaltered. In general, more of the isolet populations were at higher risk due to temporal variability, population size, and isolation risk than metapopulations, but were at less risk from genetic and disease factors than metapopulations. These data and population designations suggest that two

different conservation management strategies are needed and being implemented to conserve WCT. One strategy concentrates on preventing introgression, disease and competition risks by isolation and the other concentrates on preserving metapopulation function and multiple life-histories by connecting occupied habitats.

The Sun Ranch Westslope Cutthroat Trout Recovery Program

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After mistakenly stocking hybridized fish into the Sun Ranch brood pond in September of 2001, we eradicated all fry in the pond on February 28, 2002 by using antimycin through the ice. After completing this task, the steering committee, composed of representatives of Montana Fish, Wildlife & Parks, U.S. Forest Service and the Sun Ranch, began identifying and selecting pure westslope cutthroat donor streams in the Madison, Gallatin and Centennial drainages. Previous partial samples indicated pure, healthy westslope populations in Bean, Bear, and Jones Creeks, all in the Centennial Valley. Completed samples verified the purity of the West Fork of Cabin Creek in the Madison drainage, and the West Fork of Wilson Creek in the Gallatin. While attempting to collect fish for disease samples in the Centennial Valley, sampling crews discovered that the adult populations in those three streams had mysteriously disappeared. No fish over six inches was observed in any of those systems. As a result, this year's egg take occurred in the W.F. of Cabin Creek and the W.F. of Wilson Creek. On October 14, 2002, 589 pure westslope cutthroat trout fry were transferred from our hatchery to the brood pond.

The State of Montana's Aquatic Nuisance Species Management Plan

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In 1990, the Non-indigenous Aquatic Nuisance Prevention and Control Act (NANPCA) was passed by Congress to address aquatic nuisance species (ANS) problems in the United States. This legislation provided an opportunity for federal cost-share support for implementation of state plans. The reauthorization of NANPCA in 1996 into the National Invasive Species Act (NISA) established a goal of preventing new ANS introductions and limiting the dispersal of existing ANS in all of the states. NISA specifies, among other things, that state plans identify feasible, cost-effective management practices and measures that can be implemented by the state to prevent and control ANS infestations in a manner that is environmentally sound. Throughout 2001 and 2002 development of a Montana ANS plan was conducted by a diverse group of public and private entities. The Montana plan has been approved by the ANS Task Force, making Montana eligible for federal cost share funding in 2003. When fully implemented, this plan provides a comprehensive approach to dealing with ANS in Montana.

Abundance of Juvenile Salmonids Along Stabilized and Natural Main-Channel Banks of the Upper Yellowstone River

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We compared juvenile salmonid use of stabilized banks (riprap, barbs, jetties) of the upper Yellowstone River to their use of natural, unaltered habitats by electrofishing in spring, summer, and fall, 2001 and 2002. Total fish captured during the study were rainbow trout (n = 2763, 62%), followed by brown trout (n = 1189, 27%), mountain whitefish (n = 334, 8%), Yellowstone cutthroat trout (n = 166, 4%), and brook trout (n = 1, < 1%). Mean abundances of all species combined along 50-m sites were highest at riprap (12.215), followed by jetties (10.590), outside bends (8.443), barbs (7.923), straight sections (5.423), and inside bends (1.538) were the lowest. Presence of boulders, either natural or artificially placed, was the best indicator of juvenile fish presence regardless of bank type. Somewhat surprising, bank stabilization did not directly decrease quality or quantity of juvenile salmonid habitat along the main channel of the upper Yellowstone River. However, our study only looked at juvenile salmonids and did not address the effects of bank stabilization on habitat for sub-adult or adult fish, invertebrate availability and or spawning habitat.

Use of Remote-site Incubators to Reestablish Lacustrine Arctic Grayling Spawning Stocks

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The lacustrine Arctic grayling *Thymallus arcticus* that inhabit the Upper and Lower Red Rock Lakes, in the upper Centennial Valley of southwest Montana, spawn exclusively in the lakes' tributaries. Both the distribution and number of those spawning stocks declined substantially during the previous century. Our main objective was to evaluate the use of remote-site incubators (RSIs) to produce Arctic grayling fry of wild parentage. The five streams adjacent to which RSI sites were established were either present-day or historical Arctic grayling spawning habitats. Native, adult Arctic grayling caught from nearby Red Rock Creek were artificially spawned, and their fertilized eggs were placed in 12 RSIs in 2000, 8 in 2001, and 10 in 2002. Estimated percent fry emergence for individual RSIs ranged between 0.0% and 94.5% (mean, 44.8%). Multiple-group logistic regression revealed that most of the variation in percent emergence was explained by models that had year and RSI site as predictors. Mean percent emergence in 2000 (73.4% $\pm$ 15.1% [i.e., the 95% CI]) was larger than those in 2001 and 2002 (pooled mean, 26.5% $\pm$ 11.9%), which did not differ. Among RSI sites, mean percent emergence at East Elk Springs Creek (69.8% $\pm$ 22.2%) was larger than the mean of the pooled data for the other sites (35.3% $\pm$ 13.5%), whose means did not differ among themselves. In 2002, Arctic grayling were observed spawning in Elk Springs Creek, downstream from 2 RSI sites, where such spawning was last reported in the late 1960s. We believe the Arctic grayling observed spawning in 2002 were produced in the RSIs in 2000. Additional indications of Arctic grayling spawning in this and other study streams will be sought in 2003. We conclude that RSIs may be a useful tool in our attempts to reestablish Arctic grayling spawning stocks in the Red Rock Lakes area.

Efficacy and Safety of AQUI-S^{TM} as an Anesthetic

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Anesthetics are widely used in the culture of captive populations of fish and management of wild fish populations. Most aquatic biologists have used the fish anesthetics FINQUEL™ or Tricaine-S™ (i.e., MS-222), which are approved by the U.S. Food and Drug Administration (FDA). Both products work well; however, the FDA-imposed 21-d post-exposure withdrawal period limits their use. Consequently, there is a niche for a fish anesthetic that can be used with no post-exposure withdrawal period. AQUI-S™ is an anesthetic that may fill this niche, and thus the U. S. Fish and Wildlife Service's (FWS) Aquatic Animal Drug Approval Partnership (AADAP) program is involved in efforts to gain FDA approval of AQUI-S™ for use on all fish. At concentrations of 40 - 60 mg/L, AQUI-S™ rapidly anesthetizes salmonids to the handle-able stage; however, at these same concentrations, cool- and warm-water fishes are anesthetized relatively slowly. Thus, testing cool- and warm-water fishes at AQUI-S™ concentrations > 60 mg/L will be required. The FWS AADAP program has also initiated studies to determine (1) whether the highest proposed AQUI-S™ efficacious exposure concentrations provide an adequate margin of safety to the fish being treated, (2) product stability over the course of 1 d, and (3) reproducibility of time required to anesthetize fish to the handle-able stage. An overview of efficacy data, as well as preliminary results from other recently initiated studies, will be presented.

Radio telemetry and water chemistry describe the behavior of rainbow trout (*Oncorhynchus mykiss*) attempting upstream passage at Milltown Dam, Montana

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Milltown Dam, located at the confluence of the Clark Fork and Blackfoot rivers has no provision for upstream fish passage, but a fish trap is located in the center of the dam in the radial gate raceway has been used to capture and transport some fish. In order to determine how fish approach the dam on their upstream migrations, how long it takes them to find the fish trap and how the water source in the trap affects fish captures, I implanted 16 rainbow trout with radio transmitters and individually tagged 621 I captured in the fish trap. I transported all radio tagged and 197 VI tagged rainbow trout 4.3 km downstream of Milltown Dam. I used a data-logging receiver to determine locations of radio tagged fish in the tailrace. In order to determine which water source fish were using, I analyzed the concentration of Barium from within the trap and adjacent rivers. After tagging and translocation, fish returned to Milltown Dam rapidly (most < 2 days) and were first detected along river margins. Once rainbow trout arrived at the dam, they stayed there up to 48 days attempting to pass upstream. Ninety-five percent of all the fish locations (n=4831) were in their capture water source. Fish entered a foreign water source after a mean of 12 days, but stayed briefly. These data imply the necessity for two fish traps or fishways at the dam that accommodate both water sources for the duration of a fish's migration period.

Factors Influencing Brook Trout (Salvelinus fontinalis) Invasion and Their Replacement of

Westslope Cutthroat Trout (Oncorhynchus clarki lewisi)

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Distribution and abundance of westslope cutthroat trout (Oncorhynchus clarki lewisi; WCT) and brook trout (Salvelinus fontinalis) and their relation to habitat characteristics were studied in three adjacent streams of the upper Jerry Creek watershed, a tributary to the Big Hole River in southwestern Montana, USA. WCT dominated populations in Delano and upper Jerry creeks, while brook trout dominated populations in Libby Creek. Densities of WCT were significantly different among the three streams (ANOVA; P=0.001) with Libby Creek containing significantly lower WCT densities than the other two streams. While small sample size precluded statistical testing, observations of habitat characteristics indicated that Libby Creek had higher average daily water temperatures (1 to 2 C higher with maximums >14 C versus < 12 C in adjacent Delano Creek), more woody debris, a higher level of fine sediments within the streambed, and a higher proportion of pool habitats than the other two streams. The only known differences in management between these three streams was the fact that timber was harvested using clear-cut techniques along the stream channel of Libby Creek. While similar areas of timber were harvested in the Delano and Jerry watersheds, these harvests did not include riparian clear-cutting. While this evidence must be considered circumstantial, it appears that brook trout invasion and either displacement or replacement of WCT in this drainage may be related to one or more of the following factors, either operating alone or in synergy: increases in water temperature; increases in levels of fine sediments within the streambed; increases in frequency of woody debris; and/or increases in pool frequency. Since past studies have implicated timber harvest activities for raising water temperatures, increasing delivery of fine sediments to stream channels, and increasing woody debris delivered to the stream channel immediately following harvest; it is possible that timber harvest activities in Libby Creek contributed to the observed differences in species composition between these three streams. More research is needed to statistically validate these observations.

Impacts of Terrestrial Weeds on Aquatic Habitats and the Anglers Against Weeds Program

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Invasive weeds infest millions of acres in the Western U.S. resulting in diminished ecosystem diversity, loss of productivity and expensive control projects. Although no studies have been conducted that directly measure the impacts of terrestrial weeds on riparian and aquatic habitats, existing data suggests that the impacts may be significant. Increased water runoff, increased sediment transport and loss of native vegetation can all be expected from noxious weed infestation. Control of weeds in riparian areas is problematic. Few herbicides can safely be used in these areas and biological control is often not effective. Anglers Against Weeds is a program that enlists outdoor recreationists in riparian control efforts to create weed free access sites. This program results in healthier riparian areas, an informed sporting public and improved landowner/ angler relations.

Poster Papers

Iodophor Use during Water-Hardening of Westslope Cutthroat Trout Eggs

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Westslope cutthroat trout Oncorhynchus clarki lewisi eggs were subjected to iodophor (active iodine) concentrations of 0, 25, 50, 75, 100, and 125 mg/L during water-hardening for 30 m. Embryo survival to the eyed-egg stage was not significantly different between any of the treatments. Because of their relative safety and their potential to decrease coldwater disease outbreaks, the use of iodophor concentrations of up to 125 mg/L for 30 m during water-hardening of westslope cutthroat trout eggs is recommended.

Successful Off-Season Use of Westslope Cutthroat Trout Males

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Westslope cutthroat trout Oncorhynchus clarki lewisi adults normally spawn in streams in the spring when the water temperature is around 10^{o} C and flows in streams are high. In this experiment, westslope cutthroat males were successful when artificially spawned with a hatchery-reared, fall-spawning rainbow trout Oncorhynchus mykiss on a November spawn date. We are not aware of any other literature documenting successful off-season spawning of any cutthroat trout. Because westslope cutthroat males were successful in producing progeny so far away from the typical spawning time, we believe that we will be successful in collecting viable milt from wild males in the spring as needed.