ABSTRACTS

BIOLOGICAL SCIENCES - AQUATIC ECOSYSTEMS

THERMAL TOLERANCE OF ARCTIC GRAYLING AND COMPARISONS WITH SUMMER WATER TEMPERATURES IN THE BIG HOLE RIVER [AFS]

Patrick A. Byorth, Samuel C. Lohr, Calvin M. Kaya, and W. Patrick Dwyer
Montana Department of Fish, Wildlife & Parks, Dillon, MT

Among the factors potentially limiting abundance of Arctic grayling in the Big Hole River, Montana are warm mid-summer water temperatures. To assess affects of high temperatures on survival of Arctic grayling, we determined critical thermal maxima (CTM) and resistance times to a range of temperatures. We compared these parameters with water temperature records from the Big Hole River in years of drought and above-normal precipitation. Thermal tolerance increased with acclimation temperature. Highest mean CTM was 29.4° C for fish acclimated to 20°C. Ultimate upper incipient lethal temperature was estimated to be 25° C. A group of Arctic grayling acclimated to 20° C contracted parasitic and bacterial infections. Thermal tolerance of the diseased group was lower than uninfected fish acclimated at the same temperature. Comparisons of thermal tolerance parameters with thermograph records indicate that in drought years, such as 1992, Arctic grayling in the Big Hole River may be subjected to potentially lethal temperatures. In 1993, with higher than normal precipitation, water temperatures did not reach or exceed lethal limits.

BEWARE OF HITCHHIKERS - ZEBRA MUSSELS [AFS]

Pat Dwyer
U.S. Fish and Wildlife Service,
Fish Technology Center, Bozeman, MT

The zebra mussel (*Dreissena polymorpha*), an exotic species, is invading North American waters with severe ecological and economic effects. The mussel is believed to have been introduced from Europe when ballast water from sea-going ships was dumped into Lake St. Clair in 1987. Since that time, it has spread down the Mississippi drainage and is moving west. The life history of the organism is unlike other American freshwater clams or mussels. The early life stage of the zebra mussel is pelagic with eggs and newly hatched larva (veligers) floating in the currents for up to 15 days before attaching to rocks or other substrate where they may remain. Effects to

Title footnote indicates orgaization, location and date presentation was made:

[MAS] *Montana Academy of Sciences, Butte, MT, April 1994*
[TWS] *Montana Chapter of the Wildlife Society, Kalispell, MT, March 1994*
[AFS] *Montana Chapter of the American Fisheries Society, Billings, MT, February 1994*

serious in some areas, due to changes in the food web caused by the mussels' ability to thoroughly filter nutrients and tie them up in biomass. Economic effects can be huge, due to the mussels' biofouling characteristics, costing the taxpayers vast amounts of money. A plan has been prepared discussing the mechanism by which the mussels' pathways are identified, and the means by which those pathways can be interrupted. The westward spread of the zebra mussel may be stopped or at least slowed, but this will require a great deal of public education and cooperation among agencies.

Responses of Riparian and Stream Ecosystems in Central Montana To Varying Duration, Timing, and Intensity Of Livestock Grazing[AFS]

Carol Leigh Endicott
Biology Department, Montana State University, Bozeman

Riparian vegetation plays a key role in maintaining fish populations in Rocky Mountain streams bordering rangelands. Excessive use of riparian areas can lead to loss of riparian overstory, stream bank degradation, increased sedimentation, loss of fish cover, higher summer and lower winter stream temperatures, and reductions in fish populations. The objective of this study is to evaluate how riparian and stream habitats respond to varying duration, timing and intensity of livestock grazing on several ranches in central Montana. Comparisons include: fenced (no grazing) and unfenced (year-round) stream sections; winter and summer grazing; and fenced and early summer grazing. Results indicate differences between grazed and fenced sections in terms of fish habitat parameters, herbaceous cover, and woody vegetation. Sections excluded from livestock grazing tend to have more stable banks and complex debris within the stream. Fenced sections show greater density and species diversity of woody riparian species. Comparison of fenced with grazed sections suggests that fenced sections have greater capacity to retain organic matter, and that increased retention is due to greater physical complexity of the habitat in terms of debris, substrate, and vegetation. Comparison of summer grazed and winter grazed treatments suggests that winter grazing may result in increased pressure on woody species. Analysis of benthic macroinvertebrate communities indicates some differences in abundance and functional feeding group composition between fenced and early season grazed sections.

Current Status of Salmonid Broodstock Management In the U.S. Fish & Wildlife Service "The National Broodstock Program" [AFS]

Dave Erdahl
U.S. Fish and Wildlife Service
Fish Technology Center, Bozeman, MT

The National Broodstock Program (NBP) originated in the early 1970's. It was developed to work in concert with the newly established National Fish

Health Policy for the production of certified, disease-free eggs. Although the NBP was for the most part successful in accomplishing its primary goal, for a number of years it was a fairly loosely structured program with little formal documentation or policy. In some instances, broodstock stations continued to run their own programs as they best saw fit. However, in 1988 specific broodstock policy as well as implementation guidelines were developed that more strictly governed the actions of all broodstock hatcheries. These changes dramatically increased both the scope and accountability of the NBP. Today the NBP provides a solid foundation of principles, procedures, and techniques by which the U. S. Fish and Wildlife Service is better able to manage both wildstock and domestic broodstocks. Key elements of the NBP include the formal broodstock policy and implementation guidelines, the Inland Salmonid Broodstock Management Handbook, individual Station Broodstock Management Plans, and the Trout Strain Registry. In addition to improving the management of broodstocks today, the NBP will hopefully help to assure the role of broodstock management in future fisheries programs.

Designing a Watershed Reserve Network to Protect and Restore Native Aquatic Biodiversity in the Northern Rocky Mountains [AFS]

Chris Frissell and J. A. Stanford
University of Montana
Flathead Lake Biological Station, Polson, MT

Existing environmental laws and policies have failed to stem the decline of native fishes and other aquatic species. The Endangered Species Act, for example, has not been successful in recovery of fishes because species are not listed until irreversible ecosystem deterioration and biotic depletion have occurred. As a proactive alternative, we are compiling a regional database and developing a Geographic Information System (GIS) for conservation planning for key aquatic and riparian species in major drainage basins of the northern Rocky Mountains. Applying principles of conservation biology and watershed science, we will use these data to assess the adequacy of existing conservation reserves for protecting regional biodiversity, and to identify additional candidate areas that could most effectively maintain well-distributed assemblages of native species. For success, the first priority of restoration and recovery programs must be to secure a network of intact drainage basins and ecologically functional river segments that retain rich compliments of indigenous species and serve as refugia from the intrusion of non-natives.

Fort Peck/Missouri River Paddlefish [AFS]

Kent Gilge
Montana Department of Fish, Wildlife and Parks, Chinook, MT

An overview of the Fort Peck/ Missouri River paddlefish stock including historical pressure and harvest is presented. Unique aspects of the fishery are covered as well as ongoing and future research objectives.

Seasonal Distribution and Habitat Use of Westslope Cutthroat Trout In a Sediment-Rich Basin In Montana [AFS]

Susan Comings Ireland
Biology Department, Montana State University, Bozeman

Several hierarchical scales were used to investigate critical habitat requirements for westslope cutthroat trout (*Oncorhynchus clarki lewisi*), the Taylor Fork drainage, southwest Montana. Using a basin scale, high densities (18-33 cutthroat per 100 m^2) were found in only 2 of the 10 surveyed reaches. Elevation, stream order, presence of exotic species, and proximity to spawning grounds were possible reasons for clumped distributions. On a reach scale, slow-water channel unit types (i.e. pools and glides) provided the most important habitat for cutthroat in both summer and winter. Channel unit measurements were analyzed to determine fish-habitat relationships. Using measurements from channel unit types throughout the drainage, significant correlations between cutthroat trout densities and stream-size related variables were found. Using measurements only from areas with high cutthroat densities resulted in significant correlations with habitat variables better describing fish habitat use, such as cover and mean depth. Because the drainage is naturally erosive, sedimentation and disturbance from land use practices did not appear to affect fish density or distribution. Cutthroat movement was generally limited after spawning, and during summer and winter. Upper Wapiti Creek and upper Cache Creek reaches appear to contain two distinct subpopulations of cutthroat. These reaches are important for the maintenance of viable cutthroat populations in the Taylor Fork drainage.

Bacterial Kidney Disease Management and Control Strategies In Montana [AFS]

James E. Peterson
Montana Department of Fish, Wildlife and Parks, Great Falls, MT

Renibacterium salmoninarum, the bacterium that causes bacterial kidney disease (BKD), has been found at federal, state and private fish hatcheries in Montana. Presence of this pathogen has created a regulatory problem, since

range of the pathogen in feral and wild populations in Montana is unknown. The Montana Department of Fish, Wildlife and Parks has initiated a statewide survey to determine the range of the organism in Montana. Meanwhile, management strategies to deal with the pathogen at the hatcheries where it is known to occur are being considered. Erythromycin injections are currently being used to control mortality and to limit vertical transmission of the disease with eggs. Since erythromycin is not registered by the Food and Drug Administration (FDA) for use in food fish, it must be used with an investigational new animal drug (INAD) permit issued by the FDA. INAD tissue residue research conducted at the Yellowstone River State Fish Hatchery in Montana and the University of Idaho has resulted in some interesting erythromycin residue data. Retention of erythromycin persists in kidney tissue and in eggs for extended time periods which should allow good control of the BKD organism, but it leaves the muscle tissue rapidly.

Paddlefish Management in North Dakota [AFS]

Greg Power
North Dakota Game and Fish Department, Bismarck, ND

North Dakota's only paddle fish (*Polyodon Spathula*) occur in the Missouri and Yellowstone Rivers upstream of Williston. The paddlefishery in North Dakota is relatively new with the first season initiated in 1976. Regulations remained fairly static until 1992 when the season limit was reduced to allow the current harvest of two fish.

Historically, paddlefish research in North Dakota was limited to cooperative movement/ migration studies between Lake Sakakawea and the Yellowstone River. In recent years, research funding has focused on identifying rearing grounds in upper Lake Sakakawea and developing year class indexing methodology for young-of-the-year paddlefish. Current research focuses on determining the effects of predation on young paddlefish. In the past few years, approximately 2000 adult paddlefish have been tagged in North Dakota. Data from those tagged fish are helpful in ascertaining exploitation rates and movement information. The establishment of a caviar operation in North Dakota (similar to the Glendive, MT operation) has allowed for additional collection of valuable paddlefish data.

Montana Fish, Wildlife and Parks, the North Dakota Game and Fish Department, and Dr. Dennis Scarnecchia from the University of Idaho have collaboratively developed a Paddlefish Management Plan. This document will assist in directing future paddlefish management in North Dakota and Montana.

Overview of the Paddlefish Management Plan For Stocks in Montana and North Dakota [AFS]

Dennis L. Scarnecchia
Department of Fish and Wildlife Resources,
University of Idaho, Moscow

A plan has been prepared for the cooperative interstate management of paddlefish (*Polyodon spatula*) in Montana and North Dakota. The goals of the plan include providing for an orderly and sustainable recreational harvest, providing a basis for cooperative interstate management, facilitating data collection for stock assessments, conducting relevant research, protecting and improving habitat quality in the rivers and reservoirs, defining the role of artificial propagation, and increasing public knowledge and awareness of paddlefish. A key component of the plan is the development of an age structure model with yield forecasting capabilities based on indices of abundance of young-of-the-year, yearling, and early recruited (male) paddlefish. A second key component is the movement toward a rationally derived, total harvest quota for the Yellowstone-Sakakawea stock. Current research activities directed toward the management plan include age structure analysis of stocks, development of age-specific estimates of catch-per-unit-effort, and development of sampling methods for assessing year class strengths of young-of-the-year and yearlings in Lake Sakakawea. A draft plan underwent public review in 1994 and the final plan was published in early 1995.

The Yellowstone River Paddlefish History and Status [AFS]

Phillip A. Stewart
Montana Department of Fish, Wildlife and Parks, Miles City, MT

The paddlefish (*Polyodon spatula*) is native to the Yellowstone River, but a large fishery has existed only since the early 1960's. The population probably expanded following the closure of Garrison Dam in North Dakota in 1953. Recent studies suggest decreased recruitment to the spawning population.

Factors Affecting Growth Rates of Cutthroat Trout in Alpine Lakes: Kookoo and Triangle Lakes in the Absaroka-Beartooth Wilderness [MAS]

Richard K. Stiff
Montana State University, Bozeman

This study is investigating factors contributing to unexpectedly low growth rates observed in Kookoo Lake, an alpine lake, in the Absaroka

Wilderness, Montana. Results reported are preliminary data, from the first year of a 4 year study. The focus is on Kookoo Lake, a 2.5 ha lake, 9.1 m in depth, at an elevation of 3,109 m, which has exhibited retarded growth rates from two separate strains of cutthroat trout. Triangle Lake, a similar lake 1 km higher in the same drainage, provides a control. Field studies were conducted during the last week of the months of June, July, and August. Stream volume of the outlet streams were measured to approximate flushing rates. Water samples were analyzed as to heavy metal content, and profiles developed for concentrations of phosphate, nitrate, ammonia, DO, as well as temperature. Water hardness, pH, and alkalinity were also tested. Vertical plankton tows were used to qualify and quantify zooplankton. Chlorophyll-a samples were concentrated on filters using a Gelman filtration apparatus, and quantified using a spectrophotometer. Benthos was also sampled, identified and counted. Light penetration was analyzed via secchi disc measurement. Preliminary data did not support the idea of natural mineral contamination. Chlorophyll-a measurements were inconclusive. Kookoo Lake was found to turn over at three times the rate of Triangle Lake suggesting flushing as a possible restrictive mechanism. Zooplankton populations were significantly different with smaller densities of small copepods (*Mesocyclops*) dominating the fauna of Kookoo Lake while larger densities of large *Daphnia* dominate in Triangle Lake, suggesting some sort of community shift, possibly due to larger densities of fish previously stocked in Kookoo Lake. Benthos in both lakes was dominated by *Chironomas*. Water clarity was much higher in Kookoo Lake than Triangle Lake, with good quantities of light reaching the substrate at all depths in Kookoo, while little light reaches the substrate in Triangle Lake. Profiles indicated chemical and temperature stratification at ice-out, and no stratification throughout the summer. Both lakes will be stocked with McBride cutthroat trout at a density of 247/ha in the summer of 1994, and health and growth rates analyzed in 1995-96. Data previously collected from other cutthroat lakes with no reproductive capacity will be utilized to develop age-length regressions and length-weight regressions for comparison. Final findings may be utilized to more accurately project suitable stock densities for other alpine lakes. Since neither of these lakes have been impacted by human use, the data provided may also prove useful in analyzing the impact of mining operations in other pristine areas. Further study of these factors in other alpine lakes would be necessary to provide some statistical correlation to growth rates.

PACFISH [AFS]

Rick Stowell
USDA Forest Service, Missoula, MT

In many areas of the West Coast, naturally reproducing stocks of Pacific salmon and steelhead are at risk of extinction. Of more than 400 stocks recently evaluated by the American Fisheries Society, 214 were considered to be at "moderate" or "high" risk of extinction, or of "special concern." The remaining stocks were deemed to be already extinct (about 100), or "secure" (about 120). The underlying reasons for the decline of these stocks vary by

species and geographic area. In general, their continued existence is threatened by some combination of hydro-electric development and operation, harvest, hatchery influences on disease and genetic fitness and habitat conditions. Habitat conditions on National Forest System lands are important to conserving many of the "at risk" stocks. The Forest Service manages approximately one-half of the remaining freshwater anadromous fish spawning and rearing habitat in the lower 48 states and more than one-quarter of such habitat in Alaska. For stocks threatened primarily by non-habitat factors, the quality of National Forest System habitats can play an important role in moderating the rate of decline, providing time to resolve problems associated with hydro-electric operations, harvest and hatcheries. Because of the importance of the issues, the Forest Service has developed a strategy for managing 3 Pacific salmon and steelhead habitats on National Forest System lands (PACFISH) within the Columbia River Basin. The strategy will contribute to the conservation of Pacific salmon and steelhead stocks, possibly precluding the need for federal listing of some species. The purpose of this presentation is to provide background information for development of the strategy, and to increase awareness about the issues within the Forest Service and with outside groups as well.

The Depletion of Oxygen in Georgetown Lake, Montana During the Winter Months [MAS]

Mike J. Trabert
Montana Tech, Butte

This study measured dissolved oxygen concentrations at six locations on Georgetown Lake through the winter months. Previous studies of the lake only investigated dissolved oxygen concentrations at the Dam during winter. The dissolved oxygen profiles were consistent with what limnologists have reported earlier. The dissolved oxygen in the lake showed a decrease as a function of time. In the time period between January to May the epilimnion zone which contained greater than 4 mg l^{-1} of oxygen decreased from 11 to 5 feet beneath the ice. Temperature was also recorded during the visits to the locations. Water samples were collected around the lake to determine the average value of the BOD for the lake. The BOD ultimate range was from 5.0 to 0.5 mg l^{-1}; BOD rate range was from 0.021 to 0.22 mg l^{-1} day^{-1} at 20 °C. Sediment samples were collected in the fall of 1992 and again in the Spring of 1993. The SOD values were very dependent on the location where the samples were collected. The SOD rate range was from 4.1 to 0.55 9 m^{-2} day^{-1} at 20 °C. The model used to determine the dissolved oxygen content in the lake was developed by incorporating dissolved oxygen values observed during the winter and adjusted the BOD and SOD rates to 4 °C to fit the actual conditions that were observed. The theory of the model is Mass O_2 in cell i = Mass O_2 starting - SOD - BOD + O_2 transfer. The oxygen transfer term incorporates advection, dispersion and diffusion from the adjacent cells having a higher oxygen content. The model calculates the dissolved oxygen concentration for different lake elevations during the winter for each day following ice cover.

Role of Fish Hatcheries in the Future [AFS]

Larry Visscher
U.S. Fish and Wildlife Service, Denver, CO

The role of fish hatcheries in the restoration and management of the nation's fisheries resources has come under increased scrutiny and, in some cases, attack. What is the basis for this situation and where are we going in the future? Management has always had a critical role in directing the hatchery programs. Management has not always assumed these responsibilities or, in many cases, they have not been given the opportunity to direct hatcheries to produce the specific stocks needed. Hatcheries have not always been able to produce the requested fish because of limited disease-free egg sources, production capabilities, quality control, etc. It is time for both management and hatcheries to work together to provide specific products for specific management situations. Management will be called upon to prepare comprehensive stocking plans which define their specific product needs. These plans would also contain a monitoring component to evaluate whether or not the stocking was successful. Hatcheries will be called upon to furnish a quality product which will match the fish requested by management. When the program is directed at the restoration or recovery of a listed species or species in serious decline, the hatchery will prepare comprehensive propagation and genetics management plans before any actions are taken. These fish will be produced in new facilities designed to rear fish under more natural conditions. All planned actions will be evaluated on the basis of genetic risk.

Biological Sciences - Terrestrial Ecosystems

Riparian-Wetland Inventory Procedures [AFS]

Dan Hinckley and Vito Ciliberti
Bureau of Land Management, Billings, MT
Scott Miles and Paul Hansen, Montana Riparian Association
Missoula, MT

In 1987, the Montana State Office of the Bureau of Land Management (BLM) and the Montana Riparian-Wetland Association started to develop riparian-wetland inventory procedures. The procedures were designed to meet the needs of field specialists in BLM Resource Areas. Field specialists identified condition or ecological health, and potential of riparian-wetland areas as the items most needed. The specialists also thought that the