Abstracts

Biological Sciences - Aquatic

Whirling Disease in Montana's Spring Creeks [AFS]

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Spring creeks in Montana provide important wild trout habitat, as well as supporting other nearby fisheries. These thermally stable, cool, clear, nutrient-rich waters allow spawning of trout to occur earlier and over extended periods, and provide ideal conditions for trout rearing, growth, and survival. In some river systems, spring creeks may sustain the bulk of spawning adults, and hence recruitment of young fish. However, these same characteristics may also increase whirling disease infection. Higher nutrient loads may foster high densities of *Tubifex tubifex*, a vector of the disease, and the moderate, steady temperatures may prolong the release of the infectious *triactinmyon* (TAM) stage of the disease. In non-spring streams, infection appears to follow a seasonal cycle of highs in the spring and fall during moderate temperatures, and lows in the summer and winter. Such a cycle may not occur in spring creeks and despite their importance, the role of whirling disease in Montana's spring creeks is unclear. The purpose of this study was to investigate how widespread whirling disease is in Montana spring creeks, and to determine factors that might affect its severity. We hypothesized that whirling disease severity would be of higher magnitude and longer duration in spring creeks, due to habitat and thermal characteristics. Nine spring creeks were sampled from January 2000 to September 2001 within eight watersheds in western Montana. Six 'extensive' sites (Anceny, Blaine, Clark Canyon, Kliendschmidt, Rock Creek and Mitchell-Slough) were sampled in the spring and fall to assess the extent of infection over a wider geographic area. Three 'intensive' sites (Ben Hart, Nelson and Willow Springs) were sampled monthly to assess seasonal changes in infection in relation to temperature, spawning timing, and *T. tubifex* abundance. Severity of infection was measured with sentinel fish cages using a paired sampling design, with cages deployed simultaneously in a spring creek and adjacent river. Redd counts were conducted on the three intensive sites twice monthly to determine timing and location of spawning. Thermal units from time of spawning were used to calculate time of emergence in relation to whirling disease infection levels. *T. tubifex* abundance, water quality, and habitat

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

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[TWS] *Montana Chapter of the Wildlife Society Annual Meeting, Fairmont Hot Springs, MT, Feb. 26 - 28, 2002* characteristics were measured to determine their association with the occurrence or severity of infection. Infection severity varied among the nine spring creeks. Five sites had little or no infection (<1.0) (Anceny, Clark Canyon, Blaine, Mitchell-Slough and Nelson); two sites had moderate infection (1.0-2.5) (Ben Hart and Blaine); and two sites showed severe infections (>2.5) (Kliendschmidt and Willow Springs). The seasonal cycle of infection in spring creeks was much different than in non-spring streams. In these spring streams infection peaked during winter months, declined sharply in the spring, and remained at low levels until the fall when infection rates began to rise again. Since spring creek temperatures are relatively constant year-round, temperature does not appear to be a primary factor driving seasonal patterns of infection. At the three intensive sites, rainbow trout spawning occurred from February through early June. Fry emergence was protracted, occurring as early as March and continuing through August. Our cage results suggest that fry emerging during late spring or later are likely to avoid high infection, even in highly infected spring creeks. In contrast, fry of fall spawning rainbow trout may be much more susceptible to infection in these systems.

Conserving Native Yellowstone Cutthroat Trout in Yellowstone Lake (or Yellowstone Gets a Very Big Boat) [AFS]

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Yellowstone National Park (YNP) contains 90 percent of the remaining range of Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*). Until recently, Yellowstone Lake was the largest and most secure habitat for long-term perpetuation of this sub-species. Since the discovery of predatory lake trout in 1994, YNP fishery managers have been engaged in a large-scale gillnetting program in an effort to protect cutthroat trout by restricting the population growth of lake trout. As the amount of effort increased, so has the number of lake trout removed. Despite our rapidly escalating fishing effort between 1996 and 1999, it became apparent that existing YNP personnel and equipment were insufficient to effectively reduce lake trout numbers throughout the entire 90,000-acre Yellowstone Lake. Additional funds were approved for the 2000-2002, allowing us to purchase "a Very Big Boat." This new fisheries vessel, designed specifically for gillnetting on Yellowstone Lake, was used throughout the 2001 field season, greatly improving the working conditions for employees and the efficacy of gillnet operations. The boat allowed a 3-fold increase in gill netting effort over 2000 and 6.5-fold increase over 1999. Preliminary results are very encouraging. Almost 15,500 lake trout were removed from Yellowstone Lake in 2001 using over 10,600 gillnet units (100 m of gillnet set/night). Catch per unit effort was reduced by more than half compared to 2000. An Idaho Department of Fish and Game hydroacoustic survey done in August of 2001 indicated that density estimates in the West Thumb area of the Lake, where the highest densities of lake trout exist, were reduced by 10 percent from previous surveys in 1997-1998. Mean total length of spawners also appears to be decreasing. However, we have by no means declared victory over the lake trout problem in Yellowstone Lake since the true extent of the lake trout population is not known. Given the available habitat in Yellowstone Lake it is apparent that lake trout will continue to expand if control efforts are eliminated. In 2002 we anticipate having 250 nets ready for use at ice-off. With an experienced crew and the boat in place, we anticipate an even greater effort during 2002. Newly acquired hydroacoustic equipment will allow us to determine areas of high lake trout density, size ranges of the fish, and depths at which the fish are residing; allowing us to identify areas where effort could be increased or decreased to improve efficacy, and evaluate the effectiveness of our removal efforts by producing an index to estimate lake trout population size annually.

Distribution and Status of Fishes in Montana Prairie Streams [AFS]

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We sampled fish on 87 occasions at 67 sites in 63, 2^{nd} through 6^{th}-order streams in the plains ecoregions of Montana during the summers of 1999 - 2001 to assess the ichthyofauna of the area. Flowing water, standing water, and dry channel were present during 66, 19 and 2 sampling occasions, respectively. Fish were present at all except two sites with water. Over 35,000 fish representing 26 native and 11 introduced species, and 9 families were captured. Native species were numerically dominant, comprising 87 percent of all individuals captured. Only two species were captured at more than 50 percent of sites: white sucker (76% of sites) and fathead minnow (75%). We assessed the conservation status of 17 native species by calculating the percentage of our sites where each species occurred, by comparing the overlap in our collections to the records in the Montana Rivers Information System (MRIS) database, and by calculating the percentage of States or Provinces where each species was considered vulnerable to extirpation. Flathead chub, lake chub, and western silvery minnow should be considered for addition to the species on the review list, and brook stickleback, northern redbelly dace, northern redbelly dace x finescale dace, and pearl dace may be more rare than currently thought. The "species on review" (SU) status of brassy minnow, creek chub, Iowa darter, and plains minnow was appropriate, as was the demonstrably secure (S5) status of fathead minnow, longnose dace, sand shiner, shorthead redhorse, stonecat, and white sucker. Sites with northern pike had fewer native species than sites where northern pike were absent (Mann-Whitney U; $P = 0.08$), and the number of native individuals was significantly and negatively related to the number of northern pike ($P = 0.03$, $r^2 = 0.29$).

Recent Efforts by Montana Fish Wildlife and Parks to Eliminate Introduced Fish Species in Private Ponds in the Flathead River Drainage [AFS]

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Introduced fish species are one of the greatest threats to and reasons for declines in native fish populations across Montana. Such decline is evident in the Flathead River Drainage where, for over a century, government agencies and private individuals have intentionally and unintentionally introduced fish species. In recent decades as agencies have reduced introductions of new species, illegal introductions continue to occur along with a rapid proliferation of private fish ponds. Currently there are over 5300 permitted private ponds across Montana and likely thousands of others that are not permitted. Although Montana Fish, Wildlife and Parks (MFWP) restricts use of some fish species, private pond owners have illegally introduced species that may escape into state waters and threaten persistence of native or existing fisheries. A question facing fisheries managers is whether or not the expansion of introduced species can be stopped and if existing introduced populations can be eliminated. In the Flathead River Drainage, MFWP has begun projects to suppress introduced fish species in conjunction with habitat improvement and other types of native fish conservation projects. These suppression efforts include applying fish toxicant to private ponds and small lakes to remove non-native species. As example to the potential danger of illegal introductions, in 2001 MFWP treated a small private pond adjacent to the Flathead River that contained a self-sustaining population of brown trout, a species not established in the Flathead River Drainage. Current state law requiring a stocking license for a private landowner to stock fish provides limited enforcement and regulatory capacity. Presently, it is largely up to fisheries professionals to be aware of the law and risks associated with private ponds, pass this information along to pond owners, build ponds that prevent fish escapement, and inform MFWP of illegal introductions.

Westslope Cutthroat Trout Restoration on the Sun Ranch [AFS]

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In 1996 the Montana Department of Fish, Wildlife, and Parks (MFWP) initiated an upper Madison River westslope cutthroat recovery project. Part of the project included an extensive inventory of fish distribution, genetics, and baseline fish habitat in the upper Madison River drainage. In 1999 MFWP published a Conservation Agreement for Westslope Cutthroat Trout in Montana. The agreement recommends protecting all existing pure and slightly hybridized westslope populations in each of the major drainages within the fish's historic range, including the Madison. In 2000, the privately owned Sun Ranch and MFWP began discussions on how to execute recovery efforts for westslope cutthroat trout on the Sun Ranch in the upper Madison drainage. A Cooperative Agreement was signed in

February 2001. The Sun Ranch has completed construction of a three-acre brood pond augmented with a solar powered aeration system. Additionally, since Montana implemented rules against wild fish or eggs entering any state or federal hatchery, the ranch built a small private hatchery. This entailed developing a spring, as well as drilling a backup well, to supply water for the incubation system. Even though previous genetic studies indicated that there was only a very slight chance of finding any pure westslope cutthroat trout within the upper Madison drainage, in June of 2001 representatives from the Sun Ranch and MFWP began collecting eggs from both Papoose Creek and Cabin Creek, tributaries of the Madison River. Genetic tests of the donor fish indicated that Papoose Creek was heavily hybridized, but Cabin Creek proved to be 100 percent pure. However, disease testing indicated that the Cabin Creek fish were infected with bacterial kidney disease. In September, 356 westslope cutthroat trout fry, approximately 65 mm in total length, were transferred from the Sun Ranch hatchery to the brood pond. These fish were to be raised and ultimately crossed with other pure westslope cutthroat trout to build gene pool for transplant into donor streams in the future. However, it was later discovered that we had inadvertently disposed of some of the pure Cabin Creek fish, and included hybridized fish in our pond transfer. Since this compromised the genetic purity of the fish in the pond, MFWP is working on an Environmental Assessment to reclaim the brood pond.

USFWS INAD Program: Aquaculture Drug Registration and INAD Administration [AFS]

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Very few drugs are approved for use in aquaculture, and the utility of these drugs is severely restricted by species, pathogen, and environmental conditions. Compassionate Investigational New Animal Drug (INAD) exemptions allow for the widespread, legal use of unapproved drugs and chemicals and provide an important mechanism to assist aquaculturists and fisheries managers to meet program objectives. The USDI Fish and Wildlife Service (FWS) National INAD Office (NIO) was formed in 1995 to administer and monitor the use of FWS INADs at federal aquaculture facilities. Since then, the role of the office has expanded to include (1) participation in an international effort to obtain U.S. Food and Drug Administration (FDA) approvals of drugs for use in aquaculture, (2) a pivotal study research program, and (3) the establishment of the National INAD Program (NIP) through which non-FWS aquaculture facilities (i.e., state, tribal, and private) can piggy-back on FWS INADs. Maintaining INAD drug use is extremely important because an initial approval for one drug can take years and usually requires generating and submitting six "data packages" to FDA for review. The six "data packages" include product chemistry, mammalian toxicity, tissue residue depletion, environmental fate, pivotal efficacy, and target animal safety. Since 1997, the NIO's pivotal study research program has been very involved in conducting pivotal efficacy and target animal safety studies. The focus of this effort has been to generate data to support new animal drug approvals for the use of chloramine-T and oxytetracycline in salmonids. Because work on chloramine-T and oxytetracycline is nearly complete, current efforts are focusing on generating efficacy and target animal safety data for Aqui-S (a potential zero-withdrawal anesthetic) and florfenicol (a potent, broad spectrum antibiotic). In addition, the NIO continues to administer and monitor the federal and non-federal use of 12 INADs. Non-federal participation on FWS INADs is administered through the National INAD Program, which is more commonly referred to as the Piggy-backin' Program. In addition to allowing widespread access to needed drugs, objectives of the Piggy-backin' Program are to consolidate the INAD process, eliminate duplication of effort, reduce workloads and costs, ensure compliance with FDA guidelines, and generate supportive efficacy and target animal safety data. Supportive data can be extremely useful in obtaining an initial aquaculture drug approval or in expanding an existing aquaculture drug label. Ultimately, the work carried out by the NIO helps provide safe and efficacious drugs, chemicals, and therapeutants to aquaculturists and fisheries managers throughout the United States.

Preliminary Response of Fish Habitat to Post-Fire Salvage Logging in Riparian Areas [AFS]

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Fish habitat in Hand Creek, a third-order trout stream in northwestern Montana, was monitored before and after post-fire timber salvage along the stream. Approximately 89 percent of Hand Creek's watershed was burned in a 1994 wildfire but most of the riparian area was only lightly burned. In subsequent years, fire-stressed spruce have become vulnerable to a spruce beetle infestation, and begun to fall across the stream. In 1996 the Flathead National Forest used helicopter logging to remove infested riparian spruce trees. Some portions of Hand Creek did not require salvage harvesting and served as control reaches for fish habitat monitoring. Fish habitat data was collected immediately following the fire in 1994, then monitored prior to salvage activities in 1996, and then again in 2000. Both the treated and control reaches changed over time, presumably due to the wildfire effects. However, no substantial difference was noted between the treated and control reaches. All stream reaches, both treated and untreated, gradually became wider and shallower. Stream banks correspondingly became slightly less stable over time in all reaches. These channel changes are likely due to increased peak flows resulting from the wildfire. Habitat complexity, as measured by the number of pools, riffles and glides, increased in the low gradient, meandering channels but not in higher gradient reaches. Large woody debris gradually increased in all units, but no difference in treated verses control reaches was detected. Fine sediments appear to be decreasing in all units, presumably due to scouring from increased flows. These changes were quantified, but due to survey design limitations, no statistical analyses were performed. It appears that fish habitat in Hand Creek has not yet been affected by riparian salvage. Helicopter logging likely prevented any short-term adverse impacts to channel conditions; however, it may be several years or decades before the full effect of the riparian salvage treatment is manifested. Untreated stream reaches have many trees still suspended over the stream channel that have not yet fallen into the stream whereas the harvested areas have little wood available for future recruitment into the stream.

Telemetry Study of Salmonids During Drought in the Big Hole River AFS

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Radio transmitters were implanted in ten arctic grayling (*Thaymallus arcticus*), mountain whitefish Prosopium williamsoni, and brook trout (*Salvelinus fontinalis*) in the upper Big Hole River during spring 2001 prior to an impending low water year. Fish were located weekly from May through October and tracking was conducted from land, water, and air. The objectives were to determine the effects of drought conditions on movement, habitat use/overlap, and mortality of these three species. Arctic grayling habitat use information will help prioritize future habitat restoration efforts. Arctic grayling tended to move downstream, while brook trout and mountain whitefish tended to move upstream from initial tagging locations. High mortality of all species occurred in late summer during low flow conditions. Seven Arctic grayling and three each of brook trout and mountain whitefish were confirmed dead by October 10th. The upper Big Hole River experienced low flows (< 20 cfs - Wisdom gauge) and high temperatures (>70 °F) for two months. La Marche Creek was identified as important grayling habitat based on the movements of one telemetered fish and snorkeling surveys. La Marche Creek was up to 9 °F cooler than the nearby Big Hole River. Funding has been secured to continue this study in 2002.

Assessment of Cabinet Gorge Fish Hatchery Ladder as a Bull Trout Passage Facility AFS

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Cabinet Gorge Dam was built in 1952 on the Clark Fork River, approximately 10 miles upstream of Lake Pend Oreille. No fish passage facilities were included in the dam design. It is surmised that the lack of upstream fish passage at this dam has had a detrimental effect on migratory fishes living in the Clark Fork River and Lake Pend Oreille system. In February 2000, Avista was issued a new operating license for Cabinet Gorge Dam by the Federal Energy Regulatory Commission (FERC). The FERC license requires that Avista improve the long term viability of native fish populations through improved fish movements and genetic exchange among native salmonid subpopulations. The Cabinet Gorge Fish Hatchery is located on the banks of the Clark Fork River downstream of Cabinet Gorge Dam. Part of the hatchery facilities include a fish ladder that is designed to collect kokanee returning to spawn; however it was discovered that bull trout also entered the ladder. The goal of this research has been 1) to determine the suitability of the Cabinet Gorge Fish Hatchery ladder and trap as a component of the long-term trap and truck program for fish passage at Cabinet Gorge Dam, and 2) to further our knowledge of bull trout behavior and movement patterns so that long-term fish passage solutions can be developed. Some bull

trout enter the Clark Fork River from Lake Pend Oreille as early as January, although most do not move into the river until at least April. However, these fish do not enter the ladder until August, with the bulk of the run occurring in September. The presence of cold water springs along the river near the hatchery may make summer residence in the river possible in spite of apparently unsuitable water temperatures elsewhere in the river. Thus, it appears that it is the urge to spawn that prompts bull trout to enter the ladder, not a search for cold water. Although the ladder is an effective device for collecting bull trout in this system, the timing of the run may make the ladder unsuitable as a tool for providing fish transport. Bull trout entering the ladder in September and then transported past the dam may not have enough time to find their way to spawning areas in tributaries upstream. Further research needs to be done to find a method to safely collect bull trout for transport earlier in the season.

A New Hypothesis for the Origin and Dispersal of the Eastslope (=Westslope) Cutthroat Trout [AFS]

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The prevailing hypothesis for the origin and dispersal of the inland cutthroat trouts involves upstream penetration of the Columbia River and headwater transfers to adjacent drainages. Data supporting this hypothesis are not conclusive, and its general acceptance is partially due to the lack of viable alternatives. Recent work with poorly dispersing aquatic invertebrates suggests another possibility. Headwater transfers of organisms in Montana are primarily from east to west, except upstream of Canyon Ferry where a massive transfer from the Snake River is suggested. Historically, the upper Snake River was not connected to the Columbia River. Before its capture by the Columbia River, the upper Snake River had highly variable connections to the southeast and across the southwest and west. These zoogeographic patterns are supported by geologic data involving the Yellowstone Hotspot and continental drift. Under the new hypothesis, the ancestor of the westslope cutthroat entered the Missouri River headwaters from the southwest before the passing Yellowstone Hotspot blocked this route by reversing the drainage. Cutthroats remaining in the upper Snake River were eliminated by the massive volcanic eruptions that occurred there. This area was subsequently recolonized by cutthroats from the nearby Great Basin. A headwater transfer, common to both hypotheses, allowed these fish into the Yellowstone River. This new hypothesis explains many, previously mysterious distributions, but it does require a more ancient origin for "eastslope" cutthroat.

Fish Bypass Channel Design and Evaluation at Huntley Diversion Dam, Yellowstone River, Montana [AFS]

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Huntley Diversion Dam was built by the Bureau of Reclamation in 1906 to convert an arid region east of Billings, Montana into a sustainable agricultural land. This irrigation diversion dam, which diverts water from the Yellowstone River, is constructed of a concrete capped weir with a hydraulic height of eight feet. The differential water height created by the dam results in a nearly vertical plunging flow and is considered a total barrier to upstream fish migration. In 1998 the Huntley Irrigation District initiated a study to design a fish pass for the dam to coincide with some major dam reconstruction related to dam safety measures. The design for fish passage is a rip-rap roughened channel built around the north abutment of the dam. The fish passage channel was constructed under the premise that it would operate over the wide range of river stages experienced at the dam site and provide favorable attraction conditions for migratory fish species attempting to move upstream. An ongoing evaluation of the fish passage at the Huntley Diversion Dam is investigating whether and how fish are utilizing this channel and possible changes that could be employed to improve passage. Results from the first year of study indicate that fish are found throughout the channel with high densities of native flathead chub and silvery minnows present in the lower section of the channel. A variety of techniques and methods used to measure passage of fish within the channel have been utilized, including fyke nets, trap nets, side-scanning hydroacoustics, time-lapse videography and electrofishing. Evaluations in 2002 will include increased efforts to determine fish movement through the channel with a new fish counting device designed for use in flowing water.

Spatial and Temporal Patterns of Rainbow Trout Introgression in the Flathead River System, Montana [AFS]

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Although the Flathead River system is considered a regional stronghold for native westslope cutthroat trout, the dynamics of non-native rainbow trout introgression in the Flathead system are poorly understood. Genetic patterns of introgression were assessed with samples from 43 sites in the Flathead River system. Admixed populations were detected in 58 percent (25/43) of the sample sites and the percentage of rainbow trout genetic contribution decreased as the distance upstream from Flathead Lake increased. Positive spatial autocorrelation was detected in North Fork tributary sites within 19 km from sampling locations (Mantel test, $r = 0.188$, $P = 0.0013$), indicating a clustering pattern among admixed sites. Temporal comparisons against 1980s surveys showed new rainbow trout introgression (7/14 sites), continued absence of hybridization (5/14 sites), and continued presence of hybridization (2/14 sites). Twelve percent of the admixed sites (3/25) showed statistically significant patterns of linkage disequilibrium, suggesting that rainbow trout introgression is spread primarily by post-F1 hybrids or several generations have passed since the non-native invasions. These data are consistent with the hypothesis that downstream sources have promulgated upstream expansion of rainbow trout introgression.

Yellowstone Fisheries, Then and Now [AFS]

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Yellowstone National Park was created by the Yellowstone Park Act of 1872, and for several years was the only wildland under active federal management. It was deemed appropriate and necessary for early visitors to fish and hunt for subsistence, as there were almost no visitor services. Early Park superintendents noted the vast fishless waters of the Park, and immediately asked the U.S. Fish Commission to "see that all waters are stocked so that the pleasure seeker can enjoy fine fishing within a few rods of any hotel or camp." The first fishes from outside the Park were planted 1889-1890. So important were fisheries during this early period of the Park that the harvest-oriented, fish management program accounted for over 310 million fish being planted in Yellowstone between 1881 and 1955. In addition, between 1903 and 1953, some 818 million eggs were collected from Yellowstone trout and shipped throughout the country. Largely due to the activities in Yellowstone and the popularity of its fisheries, recreational angling became a long-term, accepted use of national parks throughout the country. In Yellowstone National Park, fisheries management, as we understand that term today, began with the U.S. Army and was assumed by the National Park Service in 1916. Fish stocking, data gathering, and other monitoring activities began with the U.S. Fish Commission in 1889, was conducted by the USDI Fish and Wildlife Service until 1996, and has been the responsibility of the National Park Service since 1996. The indiscriminant stocking of nonnative fishes throughout Yellowstone, 40 percent of which was once fishless, has had profound ecological consequences. Most serious were the displacement of intolerant natives such as westslope cutthroat trout and grayling, hybridization of Yellowstone and westslope cutthroat trout with nonnative rainbow trout, and, most recently, competition and predation of Yellowstone cutthroat trout by nonnative lake trout. Management policies of the National Park Service since inception of the agency in 1916 have drastically changed due to insight of ecologists and the Leopold Report of 1963. As a primary goal, natural biotic associations will be maintained or, where necessary, restored to a pre-European condition. An internal conflict exists in the National Park Service mandate that states the people will "use and enjoy", and also "protect and preserve" our pristine, natural systems. Fisheries management efforts at Yellowstone are currently focused on preservation of native species, while allowing for use of these fisheries by visiting anglers through a complete catch-and-release regulation. Along with native fish preservation, our Aquatics Section activities include native fish restoration, stream and lake inventory and monitoring, and, a new emphasis on aquatic ecosystem health including water quality and macroinvertebrate monitoring of lakes and streams to serve as an early warning for advancing aquatic, invasive exotic species.

Defining and Achieving a Quality Hatchery Product [AFS]

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Using fish hatcheries, fish managers can utilize a number of species, and strains within species, to meet objectives of fisheries management goals. Each species and its associated strains have distinct traits that can be matched to a fishery's needs. It is these known strain-specific traits that are the basis for a water body's stocking program. It follows then that fisheries managers must be able to rely on a hatchery product that at very least survives transport to the water, and at best predictably fulfills its intended goal. Like any intensive culture production hatchery, Montana Fish Wildlife and Parks' Big Spring Trout Hatchery is an unnatural setting and therefore a stressful environment in which to raise fish. Because of these rearing conditions, the fish culturist must optimize every input into the fish's environment to attain a quality product. These inputs include nutrition and feeding levels, feeding methods, tolerable densities, temperature, external stressors, egg development timing, growth rates, and size structure maintenance.

Fall Chinook Salmon Spawning Activity in Relation to Day/Night and Dam Operations [AFS]

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The operations of hydropower projects on the main stem Columbia River may affect the spawning or incubation success of fall chinook salmon (*Oncorhynchus tshawytscha*) that spawn in the tailraces of these projects. In addition, the timing of redd construction may be linked to environmental cues, e.g., daylight. Understanding the relationship between environmental cues and hydropower project operations and spawning activity would provide managers with information that might allow for determination of a better balance between protection for spawning salmon and their gametes/progeny, and hydropower operations flexibility. To determine the effects of daylight and hydropower operations on fall chinook salmon spawning activity, we developed a method of detecting the sounds created when female fall chinook salmon moves substrate particles while constructing a redd. Spawning activity was recorded on digital media using hydrophone systems and associated acoustical recording systems. A hydrophone system was deployed from a boat during stratified random 24-h time blocks over a 10-day period near the peak of spawning activity in 2001. The sound files are scored and the spawning activity data (digs/minute) will be compared to time of day (day and night) as well as project operations, e.g., stable, increasing, decreasing discharge. Data will be analyzed by creating multi-way contingency tables across all model factors, then assessing these factors using a log-linear model taking the cell counts from the contingency tables as the response variable.

Ecology of Bull Trout in the Saint Mary River Drainage, Montana [AFS]

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Populations of bull trout (*Salvelinus confluentus*), have declined throughout its historic range in the contiguous United States. This decline, mainly attributed to adverse human-caused alterations of the aquatic environment, competition and hybridization with nonnative fishes, and excessive harvest by anglers, prompted the USDI Fish and Wildlife Service to formally list the bull trout as threatened throughout its historic U.S. range in 1999. The Federal Endangered Species Act listing action included the only bull trout stocks that occur naturally east of the Continental Divide in the U.S., those in the St. Mary-Belly River drainage of the upper Saskatchewan River basin, Montana. Little information on the bull trout in the drainage was available, however. Between 1997 and 2001, we used electrofishing, fish traps, and radio telemetry to determine the distribution, movements,

status, and limiting factors for bull trout in the St. Mary River drainage. Multiple age-classes of bull trout (migratory and resident life-history forms) were found in three principal tributaries, and annual spawning runs into those tributaries numbered at least 48-121 adult fish. Twenty-seven adult, migratory bull trout caught in traps were implanted with radio tags, and 556 bull trout (>250 mm TL) caught in traps or by electrofishing were PIT tagged. Subsequent movements of radio-tagged fish between spawning and feeding-wintering areas ranged to 85 km and included movements into Alberta, Canada. Although most tagged bull trout contacted or recaptured during consecutive spawning seasons exhibited spawning-stream fidelity, several adult fish were found in different streams during consecutive years. Upstream and downstream movements of tagged bull trout past a major diversion dam on the river were also documented. Bull trout in the St. Mary drainage are negatively affected by dams, entrainment into an irrigation canals, and modified flow regimes, problems now being addressed by management agencies. This ongoing study is a cooperative effort among the Blackfeet Tribe, Glacier National Park, USDI Bureau of Reclamation, and the USDI Fish and Wildlife Service.

Native Lake Trout Distribution in the Upper Missouri River Drainage of Montana [AFS]

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The lake trout (*Salvelinus namaycush*) populations of Elk and Twin Lakes have long been suspected to be of native glacial origin. Recent examinations of the literature and modern genetic analysis have validated this assumption. Naturalist reports from the late 1800s described visits to both lakes and observations of lake trout prior to 1890 when the species was first introduced into the intermountain west by humans. A meristic and morphological examination of the lake trout throughout its range of distribution in 1971 concluded that the lake trout of Elk and Twin Lakes represent a unique glacial refuge population in the upper Missouri River drainage. Genetic examination of specimens from Twin and Elk Lakes in 1994 led to the conclusion that the fish were of a distinct haplotype representative of a native glacial relict with arctic roots in northern Alaska and Canada and a common refuge in Montana and southwest Alberta. More recent and detailed genetic examination of fish from both lakes in 2000 concurred with the 1994 findings and concluded that both populations represent an uncontaminated native stock of the same glacial origin. These samples also suggested that low variation in mitochondrial DNA could be associated with a genetic "bottleneck" caused and maintained by low numbers of breeding individuals within the populations. Both Elk and Twin Lakes appear to support relatively low numbers of lake trout among populations of sympatric native species such as burbot, white and longnose sucker, and mottled sculpin within systems that have been managed as sport fisheries via plants of nonnative salmonids such as Yellowstone cutthroat, rainbow, and brook trout. Trend data for lake trout populations and sympatric species are presented for both lakes.

Fish Habitat Protection in Montana – A Proud History [AFS]

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Although Montana's fish and game agency has been in existence for over 100 years, the first fishery biologist was not hired until 1947 and regional offices that included district fisheries biologists were not established until 1955. From the onset, fisheries biologists understood that big dams, water pollution, grazing, timber harvest, highway construction, and irrigation were major threats to fishery habitat. In their minds, protecting habitat was the key to preserving the wild fisheries that Montana was known for. From the beginning, Montana's habitat program was based on the premise that fish habitat in streams consisted of three essential elements: water quantity; water quality; and physical habitat features including the bed, banks, riparian areas, and floodplain. Armed with the convictions that Montana's fishery resources were worth fighting for and the wherewithal to get things done, these early biologists helped establish many of the habitat protection tools that we rely on today.

Hydroelectric Development and Associated Risks to the Fishery Resources of the Kali Gandaki River [AFS]

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Several hydroelectric projects are proposed in Nepal because of growing energy demands, the extreme topography, and its vast water resources. One affected river is the Kali Gandaki, which flows through a 4000 m elevational change. It originates on the Tibetan plateau and flows south through the Himalayan Mountains before turning east through the foothill and Terai regions, and emptying into the Bay of Bengal. Construction began on the Kali Gandaki 'A' Hydroelectric Project in 1997 and is now nearly complete. The 144-megawatt project will be operated as run-of-the-river with limited peaking. Operations will have major effects on a fishery comprised of 57 species from twelve families. These fish include resident and migratory types, with each exhibiting specific life-history strategies that require accessibility to suitable habitat. As a consequence of this project, fish will endure a loss of habitat, stress and mortality from entrainment, and blocked passage. Protection strategies include a trap-and-haul transport program, intake screens, release facility, instream flows, and hatchery supplementation. However, biological information is limited, and the proposed strategies may not be completely effective for all

species and all life stages. Therefore, an adaptive management approach is integrated into a mitigation plan that will involve on-going research to continually improve management policies protecting the fishery.

Pallid Sturgeon Propagation at Miles City State Fish Hatchery [AFS]

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Pallid sturgeon were put on the endangered species list on September 6, 1990. In an effort to supplement and restore this species, the USDI Fish and Wildlife Service, through its Garrison Dam and Gavins Point National Fish Hatcheries, began capturing adults for egg collection and culture, with the intent of future releases back into the Missouri River below Fort Peck Reservoir. In December 1998, the Missouri River iridovirus was detected at both of the federal facilities and they had to be quarantined and the fish destroyed. In order to continue the culture of pallid sturgeon, the Miles City State Fish Hatchery was asked to participate in the recovery program. In April 2001, six adult sturgeon (2 female, 4 male) were collected from the Missouri River and transported to the Miles City hatchery. One female and two males were put into each of two 12-ft circular tanks. During June, weekly egg samples were collected and staged for development. On 25 June, it was determined that the eggs were at optimum condition, so both the males and females were injected with LHRH, with the females getting a second injection the following day. Green eggs were detected in the tank approximately 24 hours after the first injection. Milt was pre-collected the morning of 26 June and spawning began at 6:00 pm, continuing at 2-hour intervals until 6:00 am the following morning. All eggs were coated with Fuller's Earth and put into incubation jars. A total of 235,000 eggs were collected with an average eye-up rate of 95 percent. All eggs had hatched by 1 July and were transferred to 6-ft circular rearing tanks on 5 July. Due to handling stress, no initial inventory was taken that day. In mid-July a severe parasite infection occurred, causing high mortality. These fish were started on a dry diet, Biodiet #1 starter and have progressed to 1.5 mm pellets. These fish are currently 5 to 6 inches long and are free of any iridovirus. They are scheduled to be planted back into the Missouri River in August.

An Examination of 1995 and 1996 Creel Census Data for the Madison River, Montana and Evidence of Possible Effects Due to Whirling Disease [AFS]

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The parasite that causes whirling disease was first discovered in Montana in rainbow trout from the Madison River in December 1994. In response, the Montana Department of Fish, Wildlife and Parks (MFWP) initiated an intensive creel census survey in 1995 and

1996. In 1995, the creel survey covered the entire Madison River from Quake Lake to the headwaters of the Missouri River at Three Forks; and in 1996, the section from Slide Inn to Windy Point (~20 river miles) was surveyed. The results from these two surveys, when compared with historical creel censuses, provide a great deal of insight into the effects of the disease on the fishery and the angling community. The Madison River rainbow trout fishery declined significantly from pre-whirling disease levels in the late 1970s and early 1980s to the period post-1994. The decline is evident in catch rate data, population estimates, and angler use surveys. However, it appears that as whirling disease was reducing the numbers of rainbow trout, the brown trout population became proportionally more available for capture by anglers. Trout population declines as measured by the annual electrofishing surveys paralleled the catch rate declines recorded in the creel surveys. Despite these declines, the anglers who chose to fish the Madison River were generally satisfied with their fishing experience according to the 1995 angler satisfaction survey. However, MFWP's biennial mail-in surveys have shown a slight decrease in angler use of the Madison River. The economic and ecological impacts of whirling disease affect anglers and many non-angling members of the Montana community. The Madison generates a significant amount of income for the surrounding area, and for the state. By fully understanding how whirling disease has affected the Madison River fishery, FWP hopes to determine the best management strategy to facilitate recovery.

Summer Movements of Sculpin, Salmonids, and Western Toads in a small Montana Stream [AFS]

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We studied the movements of fishes and amphibians in Chamberlain Creek, Montana from 24 July to 16 August, 2001. We operated six weirs with two-way traps, and one additional upstream trap, at various distances (from 14 to 1596 m) along the stream to quantify the timing, direction and distance of individual movements. We captured and marked 9 western toads (*Buffo boreas*) and 567 fishes of six species, including 368 westslope cutthroat trout (*Oncorhynchus clarki lewisi*), and 172 slimy sculpin (*Cottus cognatus*). We estimated that 14 percent of slimy sculpin and 48 percent of westslope cutthroat trout were mobile (passed at least 2 weirs), and most maintained detectable home ranges. We recaptured 173 westslope cutthroat trout, detecting net movements (distance between the two most distant capture locations) of up to 1581 m (median 91 m). Home ranges of 126 westslope cutthroat trout ranged from less than 18 to 1581 m (median 64 m). We detected net movements by slimy sculpin of up to 209 m and home ranges between 18 and 176 m (median 26 m). Western toad home ranges varied from 283 to 1596 m. All species moved more frequently during night/twilight (n=296) than during day (n=83). At the two-way traps, more fish were captured moving downstream (n=419) than upstream (n=277), although westslope cutthroat trout moved more frequently moving downstream at night and upstream during the day. Western toads were only captured in the morning, and although we detected upstream movements, we only captured toads in downstream traps. The results demonstrate considerable summer movement by fish and amphibians.

History of Fish Management on Forest Lands [AFS]

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The history of fish habitat management in the Forest Service is a history of environmental law in the United States. Starting with the creation of forest reserves in the late 1800s to the present day, fish habitat management programs have always had a place in the management of our National Forests. With the passing of legislation such as the National Forest Management Act, National Environmental Policy Act and the Endangered Species Act, fisheries has taken on a more complex and an ever increasing role in how are forests are managed for other resources. Fisheries biologists in the Forest Service have always been few in number and represent less than 300 in an agency of over 30,000 employees. A fisheries job in the Forest Service has never been easy and often confrontational, stressful and frustrating. In spite of these drawbacks, the agency has always been blessed with truly professional and dedicated fisheries professionals.

Biological Sciences - Terrestrial

A Private Sector Initiative to Enhance Conservation of Wolves [TWS]

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The Turner Endangered Species Fund is a private, non-profit charity dedicated to conserving biodiversity. We concentrate our efforts on carnivores, grasslands, plant-pollinator complexes, and species that historically ranged onto properties owned by R.E. Turner. As such, one of our priorities has been to advance wolf conservation. We are