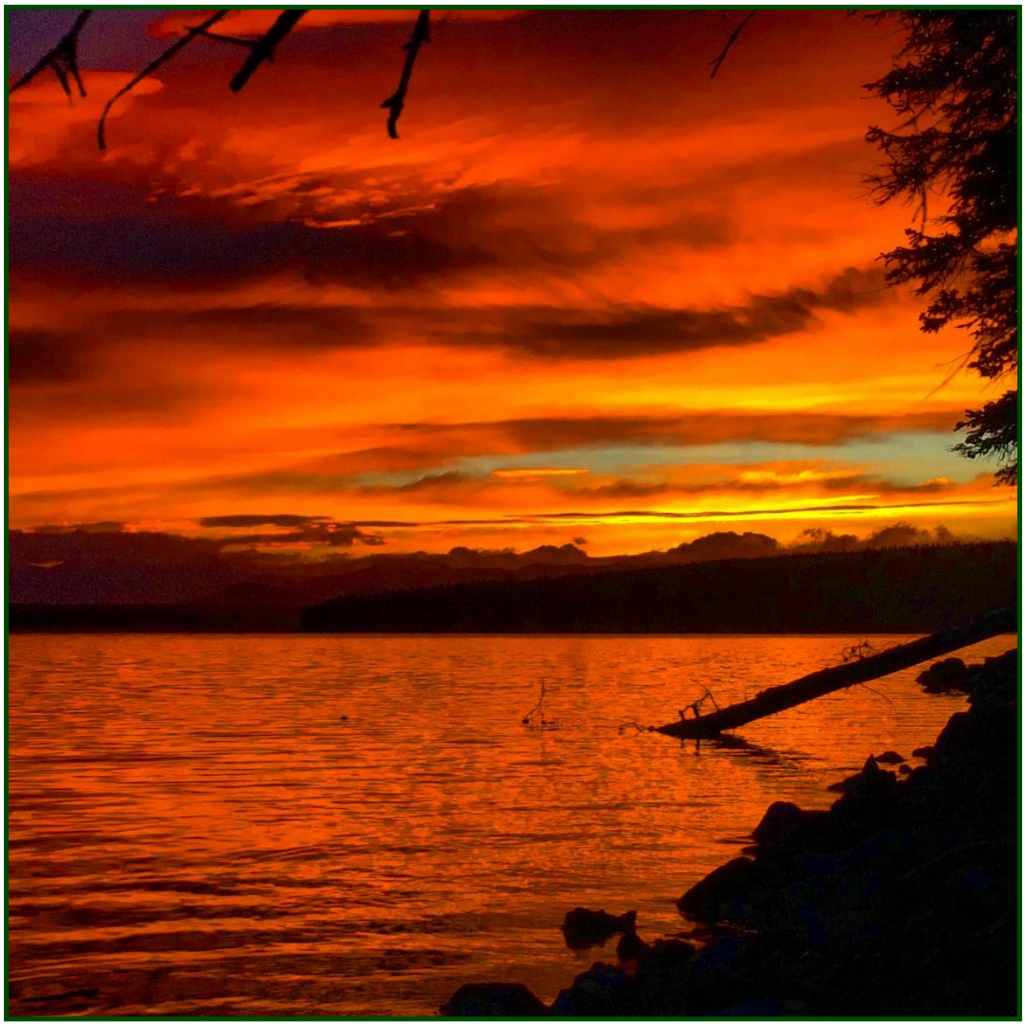
Montana Cooperative Fishery Research Unit

2016 Briefing Booklet



MONTANA COOPERATIVE
FISHERY RESEARCH UNIT

Coordinating Committee Meeting
Missoula, Montana
13 April 2016

Personnel and Cooperators

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    Research Scientist

Cooperators and Collaborators

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Graduate Students Advised by Unit Faculty

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Colleen Detjens	M.S.
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Andrew Gilham	M.S.
Jeffrey Glaid	M.S.
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Sean Lewandoski	M.S.
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Alex Poole	M.S.
T. David Ritter	M.S.
John Syslo	Ph.D.
Nathan Thomas	M.S.
Jacob Williams	M.S.

Graduate Students Advised by Cooperating Faculty

Eric Scholl	Ph.D.
Shane Vatland	Ph.D.

Graduate Students Receiving Degrees

Jan Boyer graduated with a M.S. in Fish and Wildlife Management and is working for the U.S. Fish and Wildlife Service as a Fisheries Technician and Crew Leader.

Andrew Gilham graduated with a M.S. in Fish and Wildlife Management and is working for the U.S. Fish and Wildlife Service Montana Fish and Wildlife Conservation Office as a Fisheries Biologist.

Sean Lewandoski graduated with a M.S. in Fish and Wildlife Management and is working for the Prince William Sound Science Center as a Fisheries Research Assistant.

T. David Ritter graduated with a M.S. in Fish and Wildlife Management and is working for the Bureau of Land Management as a Fisheries Technician.

John Syslo graduated with a Ph.D. in Fish and Wildlife Biology and is working for Michigan State University as a postdoctoral researcher.

Shane Vatland graduated with a Ph.D. in Fish and Wildlife Biology and is working for the Nez Perce Tribe Department of Fisheries Resource Management as a Project Leader.

Research Technicians

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Statement of Direction

Research of the Montana Cooperative Fishery Research Unit will continue to focus on applied fisheries-management problems and issues. Our studies are initiated in response to the needs of the Cooperators and other management agencies and are designed to provide information useful in directly improving management of aquatic resources. Technical areas of special emphasis include habitat associations and requirements of fishes, large-river fish assemblages, native aquatic community restoration, effects of exotic fishes on native species, and regulated-river and reservoir fisheries. Other topics will be addressed as needed, in keeping with the Cooperative Research Program's mission to best meet the needs of the Cooperators by remaining flexible and open to new areas of inquiry, as exemplified by our current emphasis on prairie streams. When Cooperator's needs occur outside our areas of expertise, we will recruit the assistance of appropriate University faculty.

Unit staff will advance the training and education of graduate students in fisheries science at Montana State University by teaching up to one graduate-level course per year, chairing graduate committees of Unit students, and serving on graduate committees of non-Unit students. In-service training will be provided to Cooperators and other agencies as the need exists.

Connectivity in a montane river basin: salmonid use of a major tributary in the Smith River system

Investigator
Alexander Zale
Unit Leader

Graduate Student
T. David Ritter, M.S.

Duration
July 2009 – May 2015
Completed

Collaborators
Grant Grisak
Montana Fish, Wildlife and Parks
George Liknes
U.S. Forest Service

Funding
Montana Fish, Wildlife and Parks
MSU index 4W2688

The Smith River is a popular recreational sportfishery in western Montana, but salmonid abundances there are relatively low and limited by high summer water temperatures and low discharges. Smith River tributaries may serve as thermal refuges and also as important spawning and nursery areas. Tributaries unaltered by anthropogenic disturbances may be especially important. If so, maintaining connectivity between the main-stem river and its tributaries would be essential. Moreover, an understanding of salmonid habitat use and management in a stressed system could help identify potential climate change adaptation strategies and tactics. Our goal was to determine the roles of a major undisturbed tributary in the life histories and movements of salmonids in a montane river basin. Our focus was on Tenderfoot Creek, a remote, unaltered major tributary to the Smith River. A PIT-tag detection network monitored the seasonal movements of rainbow × cutthroat hybrid trout, Mountain Whitefish, Brown Trout, and Brook Trout. Abundances were estimated by electrofishing and snorkeling. Despite thermally stressful conditions in the Smith River, no tagged fish were directly observed using Tenderfoot Creek as a thermal refuge, although such use probably occurred at the confluence within the Smith River. Interchange between Tenderfoot Creek and the Smith River was common for Brown Trout, Mountain Whitefish, and rainbow × cutthroat hybrid trout and consisted mostly of spawning migrations. Some large, presumably dominant Brown Trout appeared to establish permanent territories within Tenderfoot Creek. Spawning effort by Mountain Whitefish and rainbow × cutthroat hybrid trout was high; about 7,568 Mountain Whitefish were observed in spawning aggregations in autumn and estimated abundance of rainbow × cutthroat hybrid trout juveniles (25,127) was much higher than that of other taxa. Brown Trout also spawned in Tenderfoot Creek (159 redds counted in 2011 and 2012), and Brook Trout spawned in side channels and tributaries. Tenderfoot Creek is heavily used by Smith River fishes for spawning; maintaining its connectivity and habitat quality is therefore beneficial to recruitment to the Smith River fishery.

Salmonid movements and thermal hydrodynamics at a montane river system confluence: thermal refugia in the Smith River basin

Investigator
Alexander Zale
Unit Leader

Collaborator
Grant Grisak
Montana Fish, Wildlife, and Parks

Research Assisstant III
T. David Ritter, M.S.

Funding
Montana Fish, Wildlife, and Parks
MSU index 4W4785

Duration
January 2014 – December 2015
Completed

The Smith River is a popular recreational sportfishery in western Montana, but salmonid abundances there are relatively low and limited by high summer water temperatures and low discharges. Smith River tributaries may serve as thermal refuges and also as important spawning and nursery areas. Tenderfoot Creek was identified as one such tributary and was the subject of a detailed multi-year study, the goal of which was to evaluate the importance of Tenderfoot Creek to the salmonid populations of the Smith River. Contrary to expectations, Tenderfoot Creek was not used as a temporary thermal refuge by Smith River resident fish during periods of high water temperatures; rather, the outflow of Tenderfoot Creek may have been used instead. Moreover, methods used to identify thermally stressful conditions in 2012 may have not been as appropriate as previously thought. In addition, knowledge of Tenderfoot Creek's role as a nursery area was still incomplete. In 2014, we investigated salmonid movements and thermal hydrodynamics at the confluence between Tenderfoot Creek and the Smith River, evaluated the use of a remote monitoring point to describe temperature regimes in the Smith River, and developed a temperature model to estimate local temperatures in the Smith River using data from the remote monitoring point.

Salmonids used the cool direct and hyporheic discharges from Tenderfoot Creek as a thermal refuge within the Smith River. Water temperatures in the outflow of Tenderfoot Creek in the Smith River were cooler than those of the Smith River outside of this plume during the summer thermal stressful period; the mean difference between temperatures in the Tenderfoot Creek outflow and the Smith River outside of this coolwater plume was 2.9 °C and ranged from 0.5 °C to 6.1 °C. Because of this, use of the Tenderfoot Creek outflow was higher than would otherwise be expected for similar-sized areas in the Smith River; PIT-tagged fish preferred the coolwater plume of the outflow over the area on the opposite bank, which ostensibly afforded better cover. Use of the coolwater outflow of Tenderfoot Creek by PIT-tagged fish increased when conditions in the Smith River outside of this plume became stressful. The Tenderfoot Creek outflow (as well as those of other coldwater tributaries) may be critical for salmonids when water

temperatures in the mainstem river are stressful, so managers may want to consider limiting recreational use of outflow areas during such times.

The following budget covers both of the preceding Tenderfoot Creek projects (indexes 4W2688 and 4W4785), which were integrated and overlapped in time.

Total Project Cost		$ 212,322.74
Beginning Balance - January 2015		28,034.75
Expenditures – January 2015 - December 2015		
Salaries and Benefits	19,483.66	
Contracted Services	0	
Supplies	6,063.20	
Communications	0	
Travel	1,340.12	
Rent	0	
Repairs and Maintenance	0	
Tuition	1,147.77	
Total Spent		28,034.75
Balance		0
Waived IDCs		12,335.29

Seasonal movements of rainbow trout, brown trout, and mountain whitefish in the Smith River, Montana

Investigator
Alexander Zale
Unit Leader

Collaborator
Grant Grisak
Montana Fish, Wildlife, and Parks

Graduate Student
Michael Lance, M.S.

Funding
Montana Fish, Wildlife, and Parks
MSU index 4W5241

Duration
January 2015 – December 2018

The Smith River is a tributary to the upper Missouri River in central Montana and is a popular and important sport fishery for brown trout, rainbow trout, and mountain whitefish. The Smith River, collectively with its tributaries, constitutes a large, intact river network. In connected watersheds, fish migrations and other movements are typically common and diverse. These movements allow fish to use variability of riverscapes over space and time, making populations more robust to disturbance. Therefore, understanding the timing and scale of fish movements is useful for the management of fisheries in connected watersheds. We therefore initiated a study of movements of brown trout, rainbow trout, and mountain whitefish throughout the Smith River watershed. Movement is being studied by tagging fish with PIT tags and subsequently monitoring their movements with a network of stationary PIT tag readers. We have tagged over 6,000 fish and monitored their movements at 14 sites throughout the watershed resulting in over 15,000 relocations of tagged fish. We have observed that fish movement is common and variable with observed movements from 1 to over 100 kilometers. Movement associated with spawning is most common, but substantial movement related to feeding and pre-winter movements also occurs. During the coldest periods of winter and the hottest periods of summer, movement is substantially dampened. We plan to continue to study the scale and timing of fish movements throughout 2016 and into 2017 to document common and pervasive movement patterns and thereby determine appropriate spatial scales over which these populations should be managed. In addition, we plan to investigate the influence of environmental conditions on movements through continued monitoring of water temperature and discharge.

Total Project Cost		$ 150,922.00
Beginning Balance - January 2015		150,922.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	18,833.07	
Contracted Services	1,607.28	
Supplies	13,906.91	
Communications	0	
Travel	7,117.30	
Rent	925.00	
Repairs and Maintenance	0	
Tuition	2,399.30	
Total Spent		44,788.86
Balance		106,133.14
Waived IDCs		19,707.10

Relationship between intensity of livestock grazing and trout biomass in headwaters of East Front Rocky Mountain streams, Montana

Investigators
Alexander Zale
Unit Leader
Bradley Shepard
B. B. Shepard and Associates

Graduate Student
Andrew Gilham, M.S.

Collaborators
Robert Bramblett, MSU
Andrea Litt, MSU

Funding
Wildlife Conservation Society
MSU index 423187

Duration
June 2012 – December 2015
Completed

Livestock grazing is the most common land-use practice in the western United States. Riparian and stream habitats are particularly susceptible to effects of poorly-managed livestock grazing. About 80% of stream and riparian habitats in the western United States are thought to have been damaged by livestock grazing, but because grazing usually pre-dated assessments of fish populations and stream habitats, before and after comparisons are impossible. The spatial and temporal complexity of livestock grazing make it difficult to isolate its effects on instream habitat and channel morphology characteristics. Moreover, instream habitat and channel morphology are also influenced by inherent watershed characteristics (i.e., basin area, gradient, discharge). We assessed the effects of livestock grazing on 25 separate 150-m long sample sites (1400 to 1585 m in elevation) within ten headwater basins along the northeastern Rocky Mountain Front in north-central Montana. We used scat counts as an index of relative grazing intensity to assess the effects of livestock grazing on channel morphology characteristics, stream substrate, instream cover, and trout biomass. To our knowledge, this effort is the first to quantify livestock grazing intensity using scat counts to assess grazing effects on trout biomass. We assessed potential effects that grazing intensity had on habitat condition and fish biomass using linear mixed models, which also accounted for watershed and sample site effects. We found that the proportion of fine sediment in the streambed increased as the number of scats increased ($P < 0.001$), but the area of undercut banks declined as scat counts increased ($P < 0.001$). Estimated trout biomass declined as number of scats increased, even when we accounted for random effects of stream and year in a linear mixed-effect model ($P = 0.009$). Our results corroborate previous findings that livestock grazing along stream channels may reduce trout biomass, but unlike previous studies we actually quantified grazing intensity using scat counts. Because increased livestock grazing intensities were related to increased levels of fine sediments in streambeds and smaller areas of

undercut streambanks, we suggest that these factors may be related to why increased livestock grazing reduced trout biomass.

Total Project Cost		$ 43,646.76
Beginning Balance - January 2015		3,687.57
STIP interest		3.87
Expenditures – January 2015 - December 2015		
Salaries and Benefits	3,645.58	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		3,645.58
Balance		45.86
Waived IDCs		1,604.06

Baseline population abundance estimate and development of a monitoring plan for queen conch at Turneffe Atoll Marine Reserve

Investigators
Alexander Zale
Unit Leader
Robert Bramblett
Assistant Research Professor

Graduate Student
Alex Anderson, M.S.

Collaborators
Craig Hayes, Turneffe Atoll Trust
Leandra Cho-Ricketts, University of Belize

Funding
Turneffe Atoll Trust
Student Support Project
MSU index 423192

Duration
August 2012 – December 2015
Completed

We quantitatively sampled 217 sites in all nearshore habitats at Turneffe Atoll in June, July, August, and December 2013 to produce a baseline assessment of queen conch distribution, abundance, and size structure, and 2) develop a monitoring plan to detect changes in conch abundance. We collected 2,385 conch, most of which were found in the north, southwest, and northeast sections of the atoll, especially in seagrass, sand and algae, and sparse patch reef habitats at depths of less than 15 feet. The distribution of conch was patchy. None were found at 90 sites, less than 5 were found at about half of the sites, and more than 40 were found at each of 12 sites. The high-density sites were spatially clumped and represented large areas of very high conch abundances. The overall mean abundance of conch atoll-wide was 10.99 (± 0.44) individuals per 800-m^2 site or 137.4 (± 5.5) individuals per hectare, which extrapolated to the total conch habitat at the atoll resulted in a total abundance estimate of 3,323,558 (± 133,388) juvenile and adult individuals. Monitoring sampling should be focused on habitats and sections where conch were abundant, such as sand and sparse algae, sparse and medium seagrass, and sparse patch reef habitats in the north, northeast, and southwest sections.

Legal conch (shell length ≥ 7 inches) numbered 611 of 2,385 (25.6%) atoll-wide and varied in abundance among sections and habitats of the atoll; most were found in the north and northeast sections in sand and sparse algae, seagrass, and sparse patch reef habitats. Age 1 to 3 individuals made up almost all of the population, but almost all age-3 and some age-2 individuals appeared to be harvested in the first few months of the conch fishing season. We found 265 lipped queen conch (11.1% of 2,385 queen conch sampled), 217 of which (9.1%) had lip thicknesses greater than or equal to 4 mm, the minimum lip thickness at which sexual maturity can be attained. Accordingly, at least 394 of 611 legal queen conch sampled were immature (64.4%) and few conch reached sexual maturity before harvest. Adult densities were sufficient for successful

reproduction (based on research in the Bahamas) at only 15 of 217 sites; these included two deep-water (> 50 feet) spur and groove sites, which provide support for the concept of a deep-water refuge.

The conch population at Turneffe Atoll is abundant and productive despite intense harvest of individuals soon after achieving legal size and the presence of relatively few mature individuals. Apparently, these few mature individuals are able to produce sufficient offspring to populate the fishery, or recruitment is derived from spawning stocks elsewhere, or some combination thereof exists. A slightly larger legal size (e.g., 7.5”) would ensure that more individuals reach maturity, and thereby enhance sustainability of the population, and would increase average meat weight produced per individual. However, a larger legal size would increase the proportion of the population that is permanently protected from harvest because more individuals would mature, and stop growing in length, at lengths less than the legal size. Enhanced recruitment resulting from more reproduction could offset this effect. Feasibility and effectiveness of an increased size limit could be examined experimentally in a limited area at the atoll.

Total Project Cost		$ 46,211.00
Beginning Balance - January 2015		2,503.24
STIP interest		3.81
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		0
Balance		2,507.05
Waived IDCs		0

Effect of water chemistry and pressure on lake trout embryos

Investigator
Alexander Zale
Unit Leader

Collaborator
Todd Koel
Yellowstone National Park

Graduate Student
Alex Poole, M.S.

Funding
National Park Service, CESU
MSU index 4W5648

Duration
September 2015 – August 2019

Nonnative lake trout, whether intentionally or illegally introduced, often cause ecological harm to native ecosystems and their suppression is a priority in a number of western waters, as is the case in Yellowstone Lake, Yellowstone National Park, Wyoming. Native Yellowstone cutthroat trout are threatened with extirpation by an illegally introduced nonnative lake trout population. A suppression program has been ongoing since 1995 on Yellowstone Lake that targets juvenile and adult lake trout using gill nets. This traditional method of nonnative fish removal is not species selective and Yellowstone cutthroat trout are often caught as bycatch. Concerns over increasing amounts of bycatch as the Yellowstone cutthroat trout population responds positively to lake trout removal have led park managers to seek alternative suppression methods. To date, relatively few studies have evaluated suppression methods that target embryonic or larval life history stages of invasive fishes. A method that could induce mortality of embryos on spawning grounds is sought by park managers as an additional tool in the suppression of lake trout on Yellowstone Lake.

The goal of this study is to identify suitable chemical compounds and physical means that can induce lake trout embryonic mortality. Previous research on the toxic effects of chemicals on salmonid embryos has focused on prolonged exposure. We seek to evaluate embryonic mortality in a realistic management based approach using short-term exposures. We are assessing the effectiveness of chemical compounds and seismic air canons for causing lake trout embryonic mortality in laboratory trials. The most promising techniques will then be assessed in field trials on Yellowstone Lake.

Total Project Cost		$ 90,017.00
Beginning Balance - January 2015		90,017.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	3,118.31	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
IDCs @ 17.5%	545.71	
Total Spent		3,664.02
Balance		86,352.98
Waived IDCs		826.35

Environmental DNA as a means to estimate relative abundance of Yellowstone cutthroat trout spawning in tributaries to Yellowstone Lake

Investigator
Alexander Zale
Unit Leader

Graduate Student
Colleen Detjens, M.S.

Collaborators
Todd Koel
Yellowstone National Park
Mike Schwartz
U.S. Forest Service

Duration
January 2016 - December 2020

Funding
National Park Service
MSU index 4W4525 (Institute on Ecosystems)

The population of Yellowstone cutthroat trout in Yellowstone Lake is one of the largest genetically pure populations within the species' native range and is therefore a conservation priority. The population has been stressed by several factors over the years, including whirling disease and drought. However, the most serious threat is illegally introduced lake trout. First detected in 1994, lake trout have continued to pose a threat to native cutthroat trout by way of competition and predation. As a result of these threats, particularly in response to the introduction of lake trout, fisheries managers in Yellowstone National Park have invested a sizable amount of effort and funds in the recovery of the Yellowstone cutthroat trout population. In addition to the efforts aimed at removing lake trout, park biologists are also concerned with assessing the recovery of Yellowstone cutthroat trout based on a series of metrics that define desired conditions for Yellowstone Lake. One such metric is the assessment of cutthroat trout spawning in tributary streams.

Environmental DNA (eDNA) has recently garnered significant attention for its potential in assisting fisheries monitoring programs. The method, which involves collecting a water sample and testing for specific species presence or absence, has proven successful in many instances. Furthermore, several studies have suggested that relative abundance may be inferred from eDNA concentrations. We aim to provide a better understanding of the relationship between eDNA concentrations and fish abundance, specifically as it relates to spawning cutthroat trout in Yellowstone Lake tributaries. Repeated sampling of 12-13 tributaries will occur from April through July. Samples will be collected at several locations in each tributary and analyzed using qPCR. Visual surveys will be conducted in conjunction with water sample collection. A sonar fish counter located on a large tributary and an electronic counter on a smaller tributary will also be used to compare to eDNA amounts.

Assessing limiting factors precluding re-establishment of Arctic Grayling in Elk Springs Creek

Investigator
Alexander Zale
Unit Leader

Graduate Student
Jason Marsh, M.S.

Duration
March 2015 – September 2018

Collaborators
George Jordan, Bill West, and Jeff Warren
U.S. Fish and Wildlife Service
Matt Jaeger
Montana Fish, Wildlife and Parks

Funding
U.S. Fish and Wildlife Service
(no MSU involvement)

Habitat fragmentation can have significant effects on migratory fish populations. Arctic Grayling (*Thymallus arcticus*) spawned in 11 tributaries of Upper Red Rock Lake in southwest Montana in the early 1900s but now persist in only Red Rock Creek. Elk Springs Creek, a spring-fed tributary to Upper Red Rock Lake, historically had a large Arctic Grayling spawning presence. Grayling were so abundant that the U.S. Bureau of Fisheries operated a spawning station near the springheads from 1898 to 1910 for the collection of grayling gametes. However, operation ceased after an unsuccessful egg take in 1910 that coincided with the diversion of water from Elk Springs Creek into low-gradient marsh habitat (Swan Lake) by duck hunters. Swan Lake may be inhospitable to upstream-migrating Arctic Grayling spawning adults and downstream-migrating juveniles. Managers have recently attempted to restore a spawning run using remote site incubators (RSIs) with little to no success. We will use passive integrated transponder (PIT) tags to determine movements of Arctic Grayling in Elk Springs Creek before and after reconnection of the stream to Upper Red Rock Lake.

Fort Peck water chemistry analyses

Investigator
Alexander Zale
Unit Leader

Research Scientist
Michael Duncan

Collaborator
Heath Headley
Montana Fish, Wildlife and Parks

Funding
Montana Fish, Wildlife and Parks
MSU index 4W5407

Duration
April 2015 – August 2016

Montana Fish, Wildlife and Parks annually stocks millions of walleye fry and fingerlings into Fort Peck Reservoir. However, the contribution of those stocked fish to the fishery remains poorly understood. Knowledge is lacking about important nursery areas and general movements of walleye in the reservoir and its tributaries. Given suitable water chemistry variability among areas of interest (i.e., Fort Peck Reservoir, its tributaries, and hatcheries), otolith microchemistry analysis may provide the information needed to quantify the proportion of stocked and wild walleye in the fishery as well as identify movements and habitat use. A preliminary study indicated that water chemistry variability was sufficient to characterize natal origins of hatchery-reared fingerlings and movements of walleye in Fork Peck Reservoir and its tributaries. Of the nine adult walleye included in the preliminary study, the Missouri River served as a nursery area for five (55%) walleye. Two (22%) walleye used the Upper Reservoir as a nursery area. The Lower Reservoir and Upper Big Dry Arm regions each provided nursery habitat for one (11%) fish, respectively. Every walleye in the study dispersed from its nursery area and occupied at least three study area regions. Two fish (22%) each occupied five of the regions at least once. Two (22%) of the walleye occupied the Musselshell River at least once. Four (44%) of the walleye occupied the Upper Big Dry Arm at least once. Our current, more extensive study will 1) assess the contribution of hatchery-reared fingerlings to the Fort Peck fishery, 2) assess the contribution of each sampling region to juvenile rearing, and 3) describe general movements of walleye in Fort Peck Reservoir and its tributaries by analyzing the microchemistry of otoliths from 600 to 700 fish. The otolith microchemistry chemistry of fish reared in tanks with altered water chemistry will also be analyzed to determine if conditions can be created to differentiate hatchery-reared fry from wild fry captured in Fort Peck Reservoir.

Total Project Cost		$ 28,800.00
Beginning Balance - January 2015		28,800.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	13,005.88	
Contracted Services	3,467.50	
Supplies	0	
Communications	52.85	
Travel	1,636.11	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		18,162.34
Balance		10,637.66
Waived IDCs		7,991.43

Annual evaluation and development of benchmarks for lake trout suppression in Yellowstone Lake

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
Todd Koel
Yellowstone National Park

Graduate Student
John Syslo, Ph.D.

Funding
National Park Service, CESU
MSU index 4W4470

Duration
July 2013 – June 2018

Introduced lake trout threaten to extirpate native Yellowstone cutthroat trout, a keystone species in the Yellowstone Lake ecosystem of Yellowstone National Park. A National Park Service (NPS) lake trout suppression program has been on-going since 1994; however, the effort has not resulted in a lake trout population decline. Consequently, recovery of the cutthroat trout is lacking. In August 2008, a panel of 15 independent scientists convened and evaluated the program. It was determined that because of the lack of an adequate monitoring design, existing data and analyses are insufficient for guiding the program. A top recommendation was that NPS address this issue and ultimately determine the level of harvest required to reduce lake trout abundance and set quantifiable benchmarks for the number of lake trout to be removed annually. Statistical catch at age and matrix population models are used to assess the efficacy of the lake trout suppression program and quantify targets for exploitation and fishing effort. The abundance of lake trout age-2 and greater increased from 91,000 (72,000 - 110,000; 95% CI) fish in 1998 to 790,000 (558,000-1,021,000; 95% CI) fish in 2012. Large increases in fishing effort from 2012 through 2015 resulted in high fishing mortality and likely prevented lake trout abundance from continuing to increase. In both 2014 and 2015, fishing effort was about 75,000 100-m net nights, which exceeded the recommended target of 45,000 100-m net nights. The fishing effort in 2014 and 2015 resulted in an instantaneous fishing mortality of 0.93 (0.66-1.20; 95% CI) and a population growth rate of 0.77 (0.66-0.94). Thus, lake trout abundance is predicted to decline if the amount of fishing effort in 2014 and 2015 is maintained.

Total Project Cost		$ 85,165.00
Beginning Balance - January 2015		65,328.78
Expenditures – January 2015 - December 2015		
Salaries and Benefits	13,921.47	
Contracted Services	62.54	
Supplies	0	
Communications	0	
Travel	834.07	
Rent	0	
Repairs and Maintenance	0	
Tuition	2,675.05	
IDCs @ 15%	3,061.27	
Total Spent		20,554.40
Balance		44,774.38
Waived IDCs		4,635.71

Electroshocking to induce mortality of lake trout embryos in Yellowstone Lake

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
Todd Koel
Yellowstone National Park

Graduate Student
Nathan Thomas, M.S.

Funding
National Park Service, CESU
MSU index 4W4973

Duration
July 2014 – January 2018

Lake trout have been intentionally or inadvertently introduced into many lakes throughout the West, and their establishment often causes declines in native species abundances. For example, introduced lake trout threaten to extirpate native Yellowstone cutthroat trout in Yellowstone Lake, Yellowstone National Park. Consequently, it was deemed that suppression of the lake trout was needed to conserve Yellowstone cutthroat trout in Yellowstone Lake. Gillnetting is the primary method used to suppress lake trout in Yellowstone Lake and this method has been used since the program began in 1995. Unfortunately, lake trout are not the only fish species collected in gill nets. Some Yellowstone cutthroat trout are captured in gill nets and die; thus, the exploration of alternative methods to suppress lake trout to minimize bycatch of the targeted species is gaining popularity. Currently, the use of electricity as an alternative suppression method has received considerable attention. An electrofishing grid was developed and implemented in 2013 in Swan Lake, Montana, that caused greater than 90% mortality in lake trout embryos up to 20 cm in the substrate. A similar mobile electrofishing grid was also developed for the National Park Service, Yellowstone Lake, and was evaluated in 2015. Embryo (two days post-fertilization) mortality was 99% (0.6 SE) at the substrate surface, 51% (20.8 SE) for embryos buried 20 cm in the substrate, and 8% (4.3 SE) for embryos buried 40 cm in the substrate. Results indicated that embryo mortality was a function of the depth, which is similar to the Swan Lake study. Lower mortality rates for embryos buried at 20 cm within the substrate in Yellowstone Lake compared to Swan Lake is probably due to lower water conductivity in Yellowstone Lake, resulting in a smaller electrical field. Fieldwork in 2016 will evaluate the efficacy of using a suction dredge pump, tarps, and placing lake trout carcasses on spawning areas to induce higher mortality in lake trout embryos.

Total Project Cost		$ 128,852.00
Beginning Balance - January 2015		114,123.27
Expenditures – January 2015 - December 2015		
Salaries and Benefits	25,932.53	
Contracted Services	391.15	
Supplies	2,510.84	
Communications	0	
Travel	3,647.56	
Rent	2,227.00	
Repairs and Maintenance	4,715.70	
Tuition	4,620.15	
IDCs @ 17.5%	7,707.87	
Total Spent		51,752.80
Balance		62,370.47
Waived IDCs		11,671.90

Mobile tracking of lake trout in Yellowstone Lake

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
Todd Koel, Pat Bigelow
Yellowstone National Park

Graduate Student
Jacob Williams, M.S.

Funding
National Park Service, CESU
MSU index 4W5738

Duration
September 2015 – August 2019

Suppression of lake trout in Yellowstone Lake is a high priority for Yellowstone National Park. Nearly two million dollars are spent on suppression annually and this effort is projected to continue for several years. Insight into the movement, holding, staging, and spawning habits of lake trout will be useful in the current suppression efforts and will also provide information for novel suppression methods. The specific objectives of the study are: 1) identify locations of each tagged lake trout throughout the suppression season and relay those locations to the contracted netting crews, 2) identify movement corridors and diel movement patterns, and 3) identify spawning locations.

Total Project Cost		$ 90,017.00
Beginning Balance - January 2015		90,017.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	20.00	
Supplies	1,529.10	
Communications	0	
Travel	211.45	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
IDCs @ 17.5%	308.10	
Total Spent		2,068.65
Balance		87,948.35
Waived IDCs		466.54

Reproductive readiness and behavioral ecology of wild hatchery-reared pallid sturgeon in the Missouri River above Fort Peck Reservoir, Montana

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
David Trimpe
U.S. Bureau of Reclamation

Graduate Student
Luke Holmquist, M.S.

Funding
Bureau of Reclamation
MSU index 4W4723

Duration
January 2014 – June 2017

Pallid sturgeon are an endangered species indigenous to the warm turbid waters of the Yellowstone, Missouri, and Mississippi rivers. The population declines observed in pallid sturgeon are probably a function of habitat alteration and fragmentation from the construction and operation of dams on the large rivers they inhabit. The pallid sturgeon population in the upper Missouri River, upstream of Fort Peck Reservoir, has experienced significant decline such that only a few (< 20) wild fish remain in the population. To augment the declining population, stocking of age-1 hatchery-reared pallid sturgeon produced from wild broodstock began in 1998 (i.e., 1997 year-class) to prevent extirpation of the species in the upper Missouri River. The objectives of this study are: 1) determine age and size of HR pallid sturgeon at first sexual maturity, 2) determine the spawning periodicity of HR pallid sturgeon, 3) determine if reproductively active (RA) HR pallid sturgeon use habitat and move similarly to RA wild-born adult pallid sturgeon, 4) determine if experimental discharge releases from upstream reservoirs provide a cue for RA pallid sturgeon to migrate further upstream during spawning migrations, and 5) assess spawning success of female pallid sturgeon. To accomplish these objectives, radio-tagged pallid sturgeon were captured in the early-spring and assigned to reproductive classifications based on sex (determined using sex-steroid concentrations) and origin of the fish (hatchery or wild). During the presumed spawning season, weekly locations were obtained for each individual and habitat characteristics were recorded at each location. The youngest RA male HR pallid sturgeon was 14 years old and the youngest female was 18. The RA HR female was a first for this area. One male HR pallid sturgeon was confirmed to have an annual spawning cycle, but two HR males that were RA in 2014 were not ripe when sampled in 2015. Mean total movement distances (± SE) during the spawning season were greater for both RA males than for immature fish. Mean total movement distances were 90.8 km (48.1) for RA wild males, 95.6 km (49.7) for RA 1997-year class males, and 18.0 km (4.5) for immature 1997-year class males. Interestingly, all three females tracked in this study in 2014 and 2015 became atretic. These preliminary results indicate that reproductively active pallid sturgeon from a hatchery origin have similar behavior to wild

pallid sturgeon in this reach of the Missouri River. All previously tagged fish will be recaptured in early spring of 2016 for reproductive assessment, and tracked weekly in the spring and summer of 2015 and 2016.

Total Project Cost		$ 101,678.63
Beginning Balance - January 2015		30,351.80
Additional Funding 2015		95,056.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	24,073.51	
Contracted Services	97.19	
Supplies	7,871.41	
Communications	0	
Travel	6,646.14	
Rent	12,000.00	
Repairs and Maintenance	1,435.28	
Tuition	7,083.85	
IDCs @ 17.5%	10,361.30	
Total Spent		69,568.68
Balance		55,839.12
Waived IDCs		15,689.95

Density of pallid sturgeon and food web dynamics in the Missouri River: Inferences regarding carrying capacity and density-dependent response of pallid sturgeon to the contemporary stocking protocol

Investigators

Christopher Guy
Assistant Unit Leader
Wyatt Cross
Associate Professor, Ecology, MSU
Jay Rotella
Professor, Ecology, MSU

Graduate Students

Eric Scholl, Ph.D.
Adeline Dutton, M.S.

Collaborators

Zachary Shattuck
Montana Fish, Wildlife and Parks

Funding

Montana Fish, Wildlife and Parks
MSU index 4W4311

Duration

January 2013 – December 2017

Pallid sturgeon have been stocked annually in the Missouri River below Ft. Peck Reservoir and the Yellowstone River since 1998. Survival estimates for hatchery-reared pallid sturgeon are relatively high. Thus, there is growing concern among biologist that they have stocked too many pallid sturgeon; therefore, negatively influencing growth and survival of conspecifics and allospecifics. The effects of hatchery-reared pallid sturgeon on food-web dynamics is unknown. The objectives of this study are: 1) estimate density and standing stock of the pallid sturgeon population, 2) estimate survival rate of the hatchery-reared pallid sturgeon, 3) compare density estimates to estimates of hatchery-reared pallid sturgeon at large from survival estimates and stocking history, 4) estimate production of the prey base (i.e., macroinvertebrates and small-bodied fishes), 5) assess the potential of food limitation for hatchery-reared pallid sturgeon, 6) use population and production models to estimate carrying capacity, and 7) compare estimated carrying capacity to estimated historical abundance.

Pallid sturgeon abundance was estimated using mark-recapture techniques at targeted sites of aggregation. Preliminary results indicate that although mark-recapture estimates of abundance differ from previously published abundance estimates, confidence intervals between the two approaches are nearly overlapped. Diet analysis between pallid sturgeon and shovelnose sturgeon indicated a higher degrees of resource overlap in the regulated Missouri River compared to the Yellowstone River. Additionally, while no fish were collected in the diets of shovelnose sturgeon, pallid sturgeon above 350 mm did consume fish. Macroinvertebrate assemblage structure, abundance, and biomass differ between the two rivers, with high estimates of assemblage abundance and biomass directly downstream of Fort Peck Dam. Further, in reaches that are predominantly sand, under-represented habitats (small patches of rock habitat, large woody debris) support higher macroinvertebrate abundance and

biomass, suggesting that these habitats may be resource “hot-spots” for invertivores. These data suggest that estimates of resource availability may be strongly tied to distinct habitat types and larger areas within the river. Ultimately, habitat maps constructed using side-scan sonar will be combined with spatially explicit estimates of macroinvertebrate community structure and production, to estimate the amount of available macroinvertebrate food resources to pallid sturgeon among river reaches. These estimates will be combined with diets and abundance estimates of pallid sturgeon to estimate the supply of resources relative to demand.

Total Project Cost		$ 369,727.00
Beginning Balance - January 2015		43,473.30
Additional Funding 2015		117,570.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	80,023.16	
Contracted Services	377.59	
Supplies	4,546.35	
Communications	16.77	
Travel	12,585.54	
Rent	5,450.00	
Repairs and Maintenance	2,104.13	
Tuition	7,856.65	
Total Spent		112,960.19
Balance		48,083.11
Waived IDCs		49,702.48

White sturgeon mitigation and restoration in the Columbia and Snake rivers upstream from Bonneville Dam

Investigators

Molly Webb, Kevin Kappenman
Bozeman Fish Technology Center
U.S. Fish and Wildlife Service
Christopher Guy
Assistant Unit Leader

Collaborators

Brad Cady, Brad James
Washington Department of Fish and Wildlife

Duration

October 2006 – September 2015
Completed

Funding

Oregon Department of Fish and Wildlife
MSU indexes 4W1587, 4W1960, 4W2412, 4W2965, 4W3495, 4W4289, 4W4725, 4W5180

During 1 April 2014 through 31 March 2015, Montana State University and U.S. Fish and Wildlife Service collected gonadal biopsies from adult white sturgeon in Bonneville Reservoir with Washington Department of Fish and Wildlife. The objective of this research was to describe the maturation cycle in wild white sturgeon above Bonneville Dam and compare the reproductive cycle in that population to that below Bonneville Dam. This was the second year of data collection in the study area. Gonadal tissue was collected by biopsy and processed histologically. In 2014, 61 fish were handled during the season (June-August), 58 were new fish to the study, and three were handled twice or more in the season (i.e., within season recapture). Fifty-eight gonad samples were collected for histological analysis from white sturgeon in Bonneville Reservoir. Of the 58 gonad samples, 38 were collected from females, 15 from males, one fish was intersex (predominately testicular tissue), and four samples did not contain germ cells. The reproductive structure of the adult white sturgeon population in Bonneville Reservoir was determined using the 2012 and 2014 data. Of the females (n=81), 67% were pre-vitellogenic (Stages 1 and 2), 24% were vitellogenic (Stages 3 and 4), 1% were post-vitellogenic or ripe (Stage 5), 4% were postovulatory (Stage 7), and 4% were undergoing follicular atresia (Stage 8). Of the males (n=47), 75% were pre-meiotic (Stage 2), 6% were mid-spermatogenic (Stage 3 and 4), 6% were spermiating (Stage 5), and 13% were post-spermiation (Stage 6). Proportionally, there were slightly less females capable of reproducing at the onset of the spawning season (post-vitellogenic or ripe, post-ovulatory, and undergoing follicular atresia) in Bonneville Reservoir (9%) compared to below Bonneville Dam where 11% of the adult females were reproducing or undergoing follicular atresia every year. Proportionally, the number of reproducing males (spermiating or post-spermiation) was similar in Bonneville Reservoir (19%) compared to below Bonneville Dam (18%).

Total Project Cost		$ 88,295.00
Beginning Balance - January 2015		0
Additional Funding – 2015		11,295.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	7,815.74	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
IDCs @ 44%	3,479.26	
Total Spent		11,295.00
Balance		0
Waived IDCs		0

Environmental and endogenous factors affecting egg quality and caviar yield in farmed sturgeon

Investigators

Christopher Guy
Assistant Unit Leader
Molly Webb
U.S. Fish and Wildlife Service

Funding

Western Regional Aquaculture Center
MSU index 4W3678, 4W3927, 4W4360

Duration

June 2011 – July 2017

Several families of the captive broodstock of pallid sturgeon are experiencing high levels of accumulation of gonadal fat that impairs reproductive performance. Sturgeon farmers in California and Idaho also observe highly variable roe yield in mature sturgeon associated with accumulation of fat in the ovaries. Environmental, genetic, and developmental factors can all affect gonadal fat accumulation, but the role of these factors is not well understood. Understanding these effects is essential for conservation propagation of endangered sturgeon species and sustained production of high-quality sturgeon caviar. Aquaculture farms in California and Idaho were used to conduct a collaborative study, with participation of four states and four sturgeon farms, aimed at investigating the environmental effects on ovarian adiposity, roe yield, and caviar quality. To date, we have demonstrated the effect of diet on gonadal adiposity. We are currently describing the mechanism of fat accumulation during gametogenesis and will complete the studies focusing on how genetic relatedness affects gonadal fat accumulation within the next year. These results will be directly applicable to sturgeon conservation propagation programs to understand the influence of culture conditions, genetics, and developmental factors on the reproductive performance of captive populations.

Total Project Cost		$ 68,247.00
Beginning Balance - January 2015		33,885.75
Expenditures – January 2015 - December 2015		
Salaries and Benefits	11,380.46	
Contracted Services	30.97	
Supplies	1,498.45	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		12,909.88
Balance		20,975.81
Waived IDCs		5,680.35

Exploitation, abundance, and large-scale movements of burbot in the upper Wind River Drainage

Investigator
Christopher Guy
Assistant Unit Leader

Graduate Student
Sean Lewandoski, M.S.

Duration
July 2011 – June 2015
Completed

Collaborators
Mark Smith, Paul Gerrity
Wyoming Game and Fish Department

Funding
Wyoming Game and Fish Department
MSU index 4W3554

Regionally important recreational fisheries exist for burbot in the Wind River drainage of Wyoming; however, burbot populations in the region may not be stable and exploitation could be limiting these populations. We addressed this hypothesis by estimating exploitation from tagging data. Bias in our exploitation estimates was minimized by using a multistate capture-recapture model that accounted for incomplete angler reporting and tag loss. We determined that exploitation varied from 0.02–0.32 (95% CI: 0.00–0.67) in the study lakes. Burbot populations are suspected to be vulnerable to exploitation due to elevated density-dependent catchability caused by burbot aggregating behavior during the fishery; therefore, fishery resilience assuming different levels of density-dependent catchability was investigated using demographic parameters from our tagging study and the literature. Fisheries with low initial exploitation (0.02–0.11) were resilient in all simulation scenarios, whereas the resilience of fisheries with intermediate exploitation depended on the assumed level of inverse density-dependent catchability. Based on these results, the importance of exploitation as a limiting factor on burbot populations in the region is variable and, for some populations, instability in population abundance is due to population stressors other than exploitation.

Total Project Cost		$ 154,890.00
Beginning Balance - January 2015		21,530.11
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		0
Balance Unexpended		21,530.11
Waived IDCs		0

Spawning characteristics and early life history of mountain whitefish in the Madison River, Montana

Investigator
Christopher Guy
Assistant Unit Leader

Graduate Student
Jan Boyer, M.S.

Collaborator
Travis Horton

Funding
Montana Fish, Wildlife and Parks
MSU index 4W3860

Duration
January 2012 – June 2015
Completed

Mountain Whitefish were historically common throughout much of the Intermountain West. However, within the last decade Mountain Whitefish have exhibited population-level declines in some rivers. In the Madison River, Montana, anecdotal evidence indicates Mountain Whitefish abundance has declined and the population is skewed toward larger individuals, which is typically symptomatic of recruitment problems. Recruitment is influenced by factors including reproductive development, spawning behavior, and juvenile distribution. Describing these factors and identifying efficient methods for sampling age-0 fish would form a foundation for investigating mechanisms influencing recruitment. We collected otoliths and gonad samples (n = 147) to characterize fecundity, age-at-maturity, and spawning periodicity. We implanted radio tags in mature Mountain Whitefish (n = 138) and relocated tagged fish in autumn 2012 - 2014. Timing of spawning was determined from spawning status of captured females (n = 85) and from density of eggs collected on egg mats. In spring 2013, we evaluated backpack electrofishing, seining, minnow traps, and lighted minnow traps at sampling sites downstream of Varney Bridge (n = 92). In spring 2014, we seined backwater and channel sites (n = 221) to describe age-0 distribution. Mountain Whitefish in the Madison River were highly fecund (18,450 eggs/kg body weight) annual spawners, and age at 50% maturity was 2.0 for males and 2.6 for females. In 2013 and 2014, spawning occurred between the third week of October and first week of November. Movement varied as a function of spawning behavior, and prespawning movements trended downstream. During spawning, adults and embryos were concentrated in the downstream 26 km of the study site, a reach characterized by a complex, braided channel. Of the gears tested, seines were most efficient at sampling age-0 Mountain Whitefish. The downstream reach had the highest catch-per-unit effort of age-0 Mountain Whitefish. Within this reach, age-0 fish were associated with silt-laden backwater and eddy habitats. Maturation and fecundity were similar to other populations, and reproductive development appeared normal, thus factors influencing recruitment probably occur post spawning. Spawning and age-0 rearing sites were

concentrated in a small area, thus future work should investigate stressors present in incubation and rearing areas.

Total Project Cost		$ 160,819.00
Beginning Balance - January 2015		9,469.94
Expenditures – January 2015 - December 2015		
Salaries and Benefits	6,286.35	
Contracted Services	0	
Supplies	141.60	
Communications	0.98	
Travel	415.96	
Rent	0	
Repairs and Maintenance	0	
Tuition	2,625.05	
Total Spent		9,469.94
Balance		0
Waived IDCs		4,166.77

Relations among Arctic Grayling, non-native salmonids, and abiotic conditions in the Big Hole Watershed, Montana

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
Travis Horton
Montana Fish, Wildlife and Parks

Graduate Student
Austin McCullough, M.S.

Funding
Montana Fish, Wildlife and Parks
Student Support Project
MSU index 423194

Duration
August 2012 – December 2016

Climate change, habitat alterations, interactions with non-native species, and over-exploitation have been suggested to influence Arctic grayling abundance and distribution, although little quantitative information exists to support these hypotheses. As a result, Arctic grayling in Montana were designated as a Species of Concern and petitioned for protection under the Endangered Species Act (ESA). In 2014, ESA protection was not warranted because of on-going conservation and increasing trends in abundance and distribution. Conservation activities for Arctic grayling in the Big Hole Watershed began in the early 1980s and have increased considerably over the last decade. Management actions were implemented based on presumed relationships among Arctic grayling and their environment. The objective of this study is to evaluate the abiotic and biotic factors hypothesized to influence Arctic grayling abundance and distribution in the Bighole River watershed. Arctic grayling and non-native salmonids were sampled at 32 sites, habitat data were collected at 441 sites, stream discharge data were collected at 21 sites, and stream temperature data were collected at 33 sites. Linear and non-linear correlation analyses were used to evaluate the relationships among non-native salmonids, habitat, stream discharge, stream temperature, and Arctic grayling catch-per-unit-effort (*C/f*). The strongest positive correlation was between Arctic grayling *C/f* and total non-native salmonid *C/f* (r=0.61, n=95), and the strongest negative correlation was between the $\log_e$ of Arctic grayling *C/f* and median stream temperature (r=-0.54, n=63). Interestingly, these preliminary results contradict the *a priori* predicted relationship between non-native salmonids and Arctic grayling abundance.

Total Project Cost		$ 10,398.00
Beginning Balance - January 2015		1,986.56
STIP interest – 2015		2.40
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	750.60	
Total Spent		750.60
Balance		1,238.36
Waived IDCs		330.26

Evaluation of juvenile bull trout outmigration in Thompson Falls Reservoir

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
Lee Nelson
Montana Fish, Wildlife and Parks

Graduate Student
Jeffrey Glaid, M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W4708

Duration
November 2013 – December 2016

Bull trout populations in the Thompson River drainage have declined over the past century. An assessment conducted in 2008 by the U.S. Fish and Wildlife Service concluded that the Thompson Falls Hydroelectric Project was adversely affecting bull trout in the Thompson River drainage. Bull trout population declines have been attributed to impacts from habitat fragmentation, habitat degradation, and the introduction of non-native species. The objectives of this study are: 1) characterize the spatial and temporal aspects of outmigrating subadult bull trout within the Thompson River drainage, 2) describe travel time and rate, and 3) to estimate survival rate of outmigrants. We assessed the objectives by examining life-history heterogeneity, distribution, and movement throughout the drainage. In the summer of 2015, we PIT-tagged 576 subadult bull trout (100 – 300 mm) from Fishtrap Creek and the West Fork Thompson River (Thompson River tributaries). Outmigration was monitored by instream PIT antennas at the confluences of the Thompson River tributaries and confluence of the Thompson River with Thompson Falls Reservoir. Subadult bull trout ≥ 35 g that were sampled during autumn weir-trapping at the tributary confluences were acoustic- (n=29) or radio-tagged (n=14). Between July and December 2015, 11% of the PIT-tagged bull trout were detected outmigrating from the Thompson River tributaries. Detection data for all tagged bull trout that entered the Thompson River (n=194) revealed that 13% entered Thompson Falls Reservoir. Radio-tagged outmigrating bull trout exhibited a high degree of site fidelity between intermittent downstream movements within the Thompson River. Interestingly, sixteen bull trout were recovered with signs of mink predation. Our preliminary results demonstrate low outmigration rates in the Thompson River drainage and a prolonged inhabitance in the mainstem Thompson River, which was contrary to our prediction of a large-scale pulsed outmigration by subadult bull trout.

Total Project Cost		$ 90,348.00
Beginning Balance - January 2015		7,007.08
Additional Funding – 2015		45,424.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	22,864.13	
Contracted Services		
Supplies	1,920.01	
Communications	5.75	
Travel	8,179.69	
Rent	500.00	
Repairs and Maintenance	14.03	
Tuition	4,723.60	
Total Spent		38,207.21
Balance		14,223.87
Waived IDCs		16,811.17

Walleye suppression in Buffalo Bill Reservoir

Investigator
Christopher Guy
Assistant Unit Leader

Graduate Student
Daniel Kaus, M.S.

Collaborators
Mark Smith, Jason Burckhardt, Travis Neebling
Wyoming Game and Fish Department

Duration
July 2015 – June 2018

Funding
Wyoming Game and Fish Department
MSU index 4W5474

A popular recreational fishery for *Oncorhynchus* spp. (rainbow trout, cutthroat trout, and rainbow x cutthroat hybrids) exists in Buffalo Bill Reservoir, Wyoming. In 2008, illegally introduced walleye were discovered in Buffalo Bill Reservoir and they have the potential to negatively affect the existing trout fishery. For example, a recently completed diet and bioenergetics study indicated that *Oncorhynchus* spp. were the primary diet item for walleye in the reservoir. Thus, the Wyoming Game and Fish Department is interested in evaluating the feasibility of a walleye suppression program. The objectives of this project are: 1) estimate vital rates and abundance, 2) construct age-structured population models, 3) evaluate population response to varying suppression scenarios, and 4) estimate potential cost of each suppression scenario. This project will allow the Wyoming Game and Fish Department to make an informed decision with regard to the effort and cost associated with maintaining the wild *Oncorhynchus* spp. fishery without resorting to supplemental stocking.

Total Project Cost		$ 54,826.00
Beginning Balance - January 2015		54,826.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	6,112.54	
Contracted Services	315.00	
Supplies	1,710.73	
Communications	0	
Travel	337.48	
Rent	0	
Repairs and Maintenance	0	
Tuition	1,892.80	
IDCs @ 20%	2,073.71	
Total Spent		12,442.26
Balance		42,383.74
Waived IDCs		2,488.45

Enhancing native aquatic species through the USFWS Propagation Program in Region 6

Investigators

Molly Webb
Bozeman Fish Technology Center
U.S. Fish and Wildlife Service
Christopher Guy
Assistant Unit Leader

Duration

June 2015 – September 2017

Funding

U.S. Fish and Wildlife Service
USGS RWO 70, MSU index 4W5511

Collaborators

Krissy Wilson, Utah Division of Wildlife Resources
Harry Crockett, Colorado Parks and Wildlife
Jordan Hofmeier, Kansas Department of Wildlife, Parks, and Tourism
Chelsey Pasbrig, South Dakota Game, Fish and Parks

The U.S. Fish and Wildlife Service (USFWS) Fisheries Program and its fish hatchery system were established 130 years ago to address a growing concern over the observed decline in the United States' fishery resources and a lack of information concerning the status of the nation's fisheries. Currently, the National Fish Hatchery System (NFHS) plays a vital role in meeting federal mitigation obligations, restoring and maintaining native fisheries, and participating in the recovery of threatened and endangered aquatic species. However, a significant focus still remains on the propagation of non-native species rather than meeting conservation objectives through the USFWS Region 6 (R6) Fisheries and Aquatic Conservation (FAC) Program. The R6 FAC Program actively stocks, manages, and promotes recreational fisheries for native and non-native species, with 9% of the aquatic species in R6 stocked within their native range and 91% stocked outside their native range (native range defined by U.S. Geological Survey Nonindigenous Aquatic Species website nas.er.usgs.gov). Given the R6 is stocking predominately non-native species, there is room for the R6 FAC Program and NFHS to improve their actions in the conservation of threatened and endangered aquatic species and imperiled or declining native species to further align R6 with USFWS national priorities. This project used a decision-support tool (Bayesian Network) to classify and prioritize native aquatic species that could benefit from conservation propagation (species listed as Tier I and II in State Wildlife Action Plans) in Utah, Colorado, Kansas, and South Dakota. We are currently initiating the project with the state of North Dakota. Mussels have ranked within the top 10 species in need of propagation along with fishes in each state that included mussels in their analysis.

Total Project Cost		$ 61,303.00
Beginning Balance - January 2015		61,303.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		0
Balance		0
Waived IDCs		0

Predicting effects of climate change on native fishes in northern Great Plains streams

Investigators

Robert Bramblett
Assistant Research Professor
Alexander V. Zale
Unit Leader
Dave Roberts
MSU Department of Ecology

Collaborators

Robert Gresswell, USGS Northern Rocky Mountain Science Center
Kathy Chase, Roy Sando, and Rod Caldwell USGS Montana Water Science Center

Duration

September 2011 – September 2015
Completed

Funding

U.S. Geological Survey, CESU
MSU index 4W3769, 4W4344

The fish assemblages of Great Plains streams may be perceived as “living on the edge,” because water quantity and water quality are often precariously close to ecological tolerance limits. At the same time, prairie streams provide critical “green lines” of habitat, in a sea of semi-arid prairies for both aquatic and terrestrial wildlife. For example, in Montana, prairie streams are a stronghold of native biodiversity that support 25 native fish species, 14 amphibian and reptile species, and more than 130 bird species. It appears, however, that changes in water quantity and quality associated with global climate change may substantially alter these networks of biodiversity. Our goal is to predict the effects of climate change on the hydrology and biota of northern Great Plains streams. Predicted changes in precipitation and air temperature were linked to changes in streamflow and in turn, fish assemblages by using empirically derived relations between streamflow and fish assemblages as follows: (1) simulated baseline daily streamflows at about 1,500 fish sample sites in eastern Montana using the Precipitation-Runoff Modeling System (PRMS) and existing precipitation, temperature, and basin characteristics; (2) modeled relations between streamflow characteristics and baseline fish assemblage structures at these fish sample sites; (3) used PRMS to simulate future daily streamflows at the fish sample sites using projected precipitation and temperature output from a regional climate model; and (4) modeled future fish species distribution based on streamflow projections. We are currently interpreting the results of fisheries modelling. Results will help fishery and land managers understand and plan for potential effects of climate change on the hydrology and fish assemblages of northern Great Plains streams.

Total Project Cost		$ 210,537.00
Beginning Balance - January 2015		16,170.13
Expenditures – January 2015 - December 2015		
Salaries and Benefits	13,734.39	
Contracted Services	0	
Supplies	27.43	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
IDCs @ 17.5%	2,408.31	
Total Spent		16,170.13
Balance		0
Waived IDCs		3,646.89

Yellowstone River native fishes movement and habitat selection

Investigator
Robert Bramblett
Assistant Research Professor

Post M.S. Student
Brian Tornabene

Collaborators
Kenneth “Mike” Backes and Matt Jaeger
Montana Fish, Wildlife and Parks

Duration
March 2014 – March 2015
Completed

Funding
Montana Fish, Wildlife and Parks
MSU index 4W4856

The Yellowstone River retains some of the least-altered large river habitat remaining in the Rocky Mountains and Great Plains because it is the longest unimpounded river in the contiguous United States. Several species of concern, and culturally important species occur in the Yellowstone River, however, sparse information exists on their movements and habitat use, which precludes science-based management and conservation of these species. We studied movements and habitat use of Blue Suckers, Burbot, Channel Catfish, Shovelnose Sturgeon, and Spiny Softshells on over 600 km of the Yellowstone River from the Clarks Fork downstream to the confluence with the Missouri River. Blue Suckers and Shovelnose Sturgeon had long home ranges and extensive movements whereas Burbot, Channel Catfish, and Spiny Softshells had smaller home ranges. Blue Suckers used the Yellowstone River in spring through autumn and emigrated to the Missouri River for overwintering. All species readily passed upstream of Matthews and Wolf Rapids, but passage at diversion dams varied among structures, species, and discharge levels—albeit to a smaller extent. Blue Suckers passed Intake, Cartersville, and Myers diversions and were rarely blocked at these structures. Conversely, Shovelnose Sturgeon rarely passed upstream at Intake Diversion and never passed upstream at Cartersville Diversion. Burbot, Channel Catfish, and Spiny Softshells encountered diversion dams less often because of their smaller home ranges, but were able to pass Intake and Cartersville diversions on some occasions, and were blocked on other occasions. We collected little information on passage at diversion dams upstream of Carterville Diversion because there were few observations of telemetered animals encountering these structures. Most passage events at Intake Diversion were via the main channel, rather than via the side channel. However, non-telemetered animals may have used the side channel for passage and these side channels may provide nursery and backwater refugia for several species. Passage irrespective of species was lower at Cartersville Diversion than at Intake Diversion. There was little evidence that discharge was the primary factor that influenced passage success at diversion dams. Passage at diversion dams is probably also influenced by animal morphology, animal motivation, diversion configuration, hydraulic conditions, or a combination thereof. Habitat used varied among species.

Blue Suckers and Shovelnose Sturgeon largely avoided unconfined reach types and used main channel habitats. Burbot and Channel Catfish largely avoided confined reaches and also used main channel habitats. Spiny Softshells preferred secondary channels in all seasons but winter, when they preferred bluff pools. We observed little use of tributaries by all species. Aggregations during spawning and nesting seasons were observed, but they were widely dispersed, suggesting that suitable spawning and nesting habitats occur at multiple locations along the river.

Total Project Cost		19,868.00
Beginning Balance - January 2015		4,509.66
Expenditures – January 2015 - December 2015		
Salaries and Benefits	4,509.66	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		4,509.66
Balance		0
Waived IDCs		1,984.25

Native prairie special status fish species inventory

Investigator
Robert Bramblett
Assistant Research Professor
Alexander Zale
Unit Ledaer

Collaborators
Jake Chaffin
Bureau of Land Management
Steve Leathe
NorthWestern Energy

Graduate Student
Allison Stringer

Duration
July 2014 – June 2019

Funding
Bureau of Land Management,
CESU MSU index 4W5002
NorthWestern Energy
MSU index 433295

Pearl Dace *Margariscus margarita* and Northern Redbelly × Finescale Dace hybrids *Chrosomus eos* × *C. neogaeus* (hereafter Hybrid Dace) are Montana species of special concern. Both taxa appear to have undergone substantial range contractions and are at risk of extirpation from Montana. A lack of information regarding their present distributions and status hinders their conservation and management. We are identifying and ranking conservation areas for both taxa by (1) conducting targeted surveys to establish their current distributions relative to historic distributions, (2) determining the locations and proportion of Northern Redbelly Dace populations that contain Hybrid Dace, and (3) evaluating the threat from non-native Northern Pike *Esox lucius*, which we hypothesize cause range contractions of dace in Montana prairie streams. We visited 37 sites on 29 streams across the Missouri River drainage in 2015, 7 of which had historic occurrence records of Pearl Dace. Northern Redbelly Dace were present at 15 sites, Hybrid Dace were probably present (pending laboratory verification) at 7 sites, Pearl Dace were present at 1 site, and Northern Pike were present at 9 sites. Pearl Dace occurred historically in 6 of the streams with Northern Pike, but we found Pearl Dace in only one of them. We sampled three year classes of Northern Pike in one stream, suggesting that Northern Pike reproduce and survive in some prairie streams. A case study of two adjacent streams indicated that Northern Redbelly Dace were present in the stream without Northern Pike and absent in the stream without Northern Pike. We will continue field sampling in 2016.

Total Project Cost		$ 147,500.00
Beginning Balance - January 2015		25,000.00
Additional Funding – 2015		122,500.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	35,922.38	
Contracted Services	0	
Supplies	4,143.09	
Communications	152.46	
Travel	5,717.41	
Rent	0	
Repairs and Maintenance	0	
Tuition	3,083.10	
IDCs @ 17.5%	8,578.23	
Total Spent		57,596.67
Balance		89,903.33
Waived IDCs		12,989.88

The spatial and temporal extent of the hypoxic zone in the headwaters of Lake Sakakawea

Investigator
Robert Bramblett
Assistant Research Professor

Collaborator
Joseph Bonneau
U.S. Army Corps of Engineers

Graduate Student
Eric Scholl, Ph.D.

Funding
U.S. Army Corps of Engineers
USGS RWO 71
MSU index 4W5226

Duration
November 2014 – March 2017

The leading hypothesis for lack of recruitment of Pallid Sturgeon in the Yellowstone and Missouri rivers upstream of Lake Sakakawea Reservoir is that insufficient larval drift distance results in larvae settling in hypoxic sediments in the headwaters of Lake Sakakawea where larvae succumb to asphyxiation. We documented hypoxic sediments in the headwaters of Lake Sakakawea. Hypoxic sediment existed from the transition zone between the Missouri River and the reservoir and extended down reservoir for at least 45 km. Hypoxic sediments were associated with declines in current velocity and sediment particle size, and increases in sediment organic matter. We did not observe a strongly stratified or hypoxic hypolimnion, probably because the headwaters area was too shallow and wind-mixed to stratify thermally. We speculate that larval Pallid Sturgeon arriving in the headwaters lack the swimming ability to remain in the water column or to avoid hypoxia and succumb to asphyxiation in or on the hypoxic sediments.

Total Project Cost		$ 186,405.66
Beginning Balance - January 2015		186,405.66
Expenditures – January 2015 - December 2015		
Salaries and Benefits	56,678.65	
Contracted Services	135.50	
Supplies	8,942.43	
Communications	36.61	
Travel	5,307.62	
Rent	654.92	
Repairs and Maintenance	1,474.96	
Tuition	0	
IDCs @ 15%		10,984.76
Total Spent		84,215.45
Balance		102,190.21
Waived IDCs		21,236.74

Taxonomic and ecological service project account

Investigator
Robert Bramblett
Assistant Research Professor

Funding
USGS Water Science Center
MSU Index 433295

Duration
Ongoing

Dr. Bramblett provides prairie fish identification services and workshops periodically.

Beginning Balance - January 2015		11,089.45
Additional Funding 2015		10,000.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	9,883.26	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Administrative Fee @ 4%	593.00	
Total Spent		10,476.26
Balance		11,089.45

MTCFRU service project account

Investigators

Alexander Zale
Unit Leader
Robert Bramblett
Assistant Research Professor
Michael Duncan
Research Scientist

Duration

Ongoing

Collaborator

Travis Lohrenz
Montana Fish, Wildlife and Parks
Bradley B. Shepard
B. B. Shepard and Associates

Funding

Madison River Foundation
$ 7,099
Park County Conservation District
$ 6,179
MSU Index 433309

This account manages non-grant work including otolith microchemistry analytical services and student internships that the Montana Cooperative Fishery Research Unit performs in association with cooperators and collaborators

Beginning Balance - January 2015		$ 3,093.71
Additional Funding – 2015 Park County Conservation District		6,179.20
Expenditures – January 2015 - December 2015		
Salaries and Benefits	2,945.32	
Contracted Services	0	
Supplies	0	
Communications	5.95	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Returned to Madison River Foundation	620.40	
Administrative Fee @ 6%	177.07	
Total Spent		3,748.74
Balance		5,524.17

Montana Cooperative Fishery Research Unit Vehicle Account

Administrator

Alexander Zale
Unit Leader

Funding

Designated Account - projects are charged mileage based on project use
MSU index 433099

The purpose of the Unit vehicle account is to cover all expenses related to Unit vehicles, which includes replacement, repairs and maintenance, insurance, and fuel.

Beginning Balance - January 2015		$ 65,851.96
Expenditures – January 2015 - December 2015		
Repairs and Maintenance	15,121.72	
Fuel	16,859.29	
Insurance	2,776.40	
Equipment: 2014 Dodge Ram	29,197.00	
Administrative Assessment Fee @ 4%	3,837.25	
Total Spent		67,791.66
Total Revenue Reimbursed		53,215.05
Balance		51,275.35

Montana Cooperative Fishery Research Unit Watercraft Account

Administrator

Alexander Zale
Unit Leader

Funding

Designated Account - projects are charged a daily fee when using boats
MSU index 433301

The purpose of the Unit watercraft account is to cover expenses related to Unit research vessels, including replacement, repairs, and maintenance.

Beginning Balance - January 2015		$ 36,707.83
Expenditures – January 2015 - December 2015		
Repairs and Maintenance	0	
Supplies	7,283.87	
Equipment	0	
Administrative Assessment Fee @ 4%	437.03	
Total Spent		7,720.90
Total Revenue Reimbursed		18,125.00
Balance		47,111.93

Montana Cooperative Fishery Research Unit Operations Account

Administrator
Alexander Zale
Unit Leader

Funding
$1,000 monthly from MSU VP for Research and Economic Development
MSU index 436899

Beginning Balance - January 2015		$ 11,747.28
Expenditures – January 2015 - December 2015		
Salaries and Benefits	0	
Contracted Services	3,596.33	
Supplies	51.99	
Communications	1,367.00	
Travel (training)	250.00	
Rent (storage unit)	7,633.04	
Repairs and Maintenance	0	
Administrative Assessment Fee @ 6%	773.90	
Total Spent		13,672.26
Total Revenue from VPR		5,250.00
Balance		3,325.02

Monetary Equivalence for MSU Services and Facilities
January 2015 - December 2015

Program Coordinator salary and benefits	$ 49,878.74
Office space	
Staff - 515 sq. ft. @ $13/sq. ft.	6,695.00
Students - 742 sq. ft. @ $13/sq. ft.	9,646.00
Laboratory space - 40% of 942 sq. ft. @ $16/sq. ft.	6,028.80
Storage space - AJMJ cages (2) - 71.5 sq. ft. @ $3.24/ sq. ft.	231.66
Museum facilities - 12.5% of 936 sq. ft. @ $16/ sq. ft.	1,872.00
Library @ 0.8% of total expenditures ($656,400)	5,251.20
Utilities - General @ 12% of total expenditures ($656,400)	78,768.00
Unit Operations Account	5,250.00
Waived IDCs	193,965.57
Total	**357,586.97**

Montana Fish, Wildlife and Parks Annual Contribution
Montana Cooperative Fishery Research Unit Operations

Administrator	**Funding**
Alexander Zale	Montana Fish, Wildlife and Parks
Unit Leader	MSU index 4W5335

Beginning Balance - January 2015		$ 49,616.79
Additional Funding – 2015		30,000.00
Expenditures – January 2015 - December 2015		
Salaries and Benefits	11,040.06	
Contracted Services	5,880.71	
Supplies	1,565.00	
Communications	110.93	
Travel	3,123.78	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		21,720.48
Balance		57,896.31

Federal Budget
January 2015 - December 2015

Salaries and Benefits	$ 338,378.06
Supplies	0
Total	$ 338,378.06

Unit Equipment Inventory (items with acquisition values greater than $5,000)

USGS

2011 Ford F250 4×4 crew cab (green)
Property No. 433429 – Serial No 1FT7W2BTOBEA70586
Acquisition value $31,697.00
Mileage 45,141

2009 Chevrolet HHR (red)
Property No. 433291 – Serial No. 3GNBAADB4AS513678
Acquisition value $18,720.00
Mileage 22,470

2005 Chevrolet Silverado 2500, 4×4 crew cab (green)
Property No. 430750 - Serial No. 1GCHK23G15F926039 (2005)
Acquisition value $22,948.21
Mileage 100,257

2002 Chevrolet 4×4 Suburban (white)
Property No. 261052 - Serial No. 3GNGK26U52G249012
Acquisition value $31,988
Mileage 117,628

1999 Chevrolet 3/4-ton 4×4 pickup truck (white)
Property No. 252537 -- Serial No. 1GCGK24R9XF049122
Acquisition value $21,009
Mileage 163,849

1989 Chevrolet 4×4 Suburban (tan)
Property No. 261114 - Serial No. 1GNGV26K2KF176088
Acquisition value $15,766
Mileage 158,530

Leica M165 C Stereomicroscope System
Serial No. 10450035
Leica DFC450 Digital Camera
Serial No. 12730411
Acquisition value $20,936

Wooldridge 20' Custom Boat and Trailer with a Honda 200 Four Stroke Motor and Electrofishing combo.
Property No. Boat 4005308 - Serial No. WLG20635I405
Property No. Trailer 430697 - Serial No. 47AVA221250061126
Property No. Motor 4005305 - Serial No. BAEJ-1300065
Property No. Electrofisher Combo 4005309
Acquisition value $50,871.57 (2004)

1990 23' Sea Ark Marine Boat and EZ-Load Trailer with a Zodiac life raft, Mobile Radio, Binoculars, Ross Depthfinder and Hummingbird Fish Finder.
Property No. Boat 632069 - Serial No. SAMA0093J989/FSC 1940
Property No. Trailer 632068 - Serial No. 12EIGN224LLW19678/FSC 2330
Property No. Mobile Radio 632015 - Serial No. 1391568/FSC 5820
Property No. Depthfinder 632014 - Serial No. 1975-201/FSC 6605
Property No. Life Raft 632007 - Serial No. 2845 or 2860/FSC 4220
Property No. Fish Finder 618216 - Serial No. 4765325
Property No. Binoculars 237807 - Serial No. 308594
Acquisition value $42,845.99 (Transferred from USFWS Creston Fish and Wildlife Center June 2006)

Hyde Aluminum Drift Boat
Property No. 3800001 - Serial No. TAD00230D696
Acquisition value $5,262 (1996)

VideoRay Pro3-XE-N ROV System
Property No. 4005775 - Serial No. G09028
Acquisition value $25,424.00 (2009)

Electrofisher SRI Backpack Combo
Serial No. BC-170057
Acquisition value $7,467.59 (2004)

Olympus BX40 microscope
Property No. 6001157 - Serial No. 9810089
Acquisition value $5,601 (1999)

U.S. Army Corps of Engineers

Wooldridge Jet Boat
Serial No. WLG18428K596
Acquisition value $19,447 (1996)

Montana State University

2014 Dodge Ram 2500 (white)
Property No. 135050
Serial No. 3C6TR5DT0EG281683
Acquisition Value $29,197.00
Mileage 14,974

2008 Ford Escape Hybrid 4WD (grey)
Property No. 132775
Serial No. 1FMCU59H78KA13346

Acquisition Value $26,553.65 (2007)
Mileage 40,269

2005 GMC Sierra 2500 crew cab truck (green)
Property No. 132353
Serial No. 1GTHK23G65F944780
Acquisition Value $24,463.00 (2005)
Mileage 125,973

2001 GMC 1/2 ton 4×4 extended cab truck (green)
Property No. 132228
Serial No. 2GTEK19T911227311
Acquisition Value $15,255.00 (2005)
Mileage 170,699

1999 Ford F250 4×4 crew cab (blue)
Property No. 125014
Serial No. 1FTNW21S8XEA98840
Acquisition Value $11,002 (2005)
Mileage 179,185

1999 Chevrolet 1/2 ton 4×4 extended cab truck (white)
Property No. 132229
Serial No. 2GCEK19T8X1144560
Acquisition Value $12,459.00 (2005)
Mileage 212,780

2012 Wooldridge 18’ Custom Boat with a Mercury 150 Optimax motor
Serial No. WLG18379H112
Mercury Serial No. 1B881822
EZ Loader trailer Serial No. 1ZEAAAMC5CA001832
Acquisition Value $36,080.50 (2011)

BRP Evinrude 200 hp (for 1996 Wooldridge boat)
Serial No. 05257091
Acquisition value $10,444.00 (2009)

2008 Crestliner 18’ Boat
Serial No. CRC36198J708
90 hp Evinrude engine, Serial No. 05265364
19’ Shorelander trailer VIN No. IMDAPLP188A402650
Acquisition value $16,107.00 (2009)

2008 18’ Wooldridge Custom Boat
Serial No. WLG18099B808
150 hp Yamaha engine Serial No. 63PL1070949
EZ Loader Trailer Serial No. 1ZEADAMB08A152874

Acquisition value $32,182 (2008)

Smith-Root Electrofisher
Serial No. 11363T
Acquisition value $14,074 (2007)

2008 Workskiff Custom Boat
Serial No. MGN19S06D808
135 hp Honda engine Serial No. BARJ-1301242
EZ Loader Trailer Serial No. 1ZEADMPK28A158379
Acquisition value $36,615 (2008)

2013 Jayco Jay Flight 26BH Travel Trailer
Serial No. 1UJBJ0BP4D77R0223
Acquisition value $19,600 (2013)

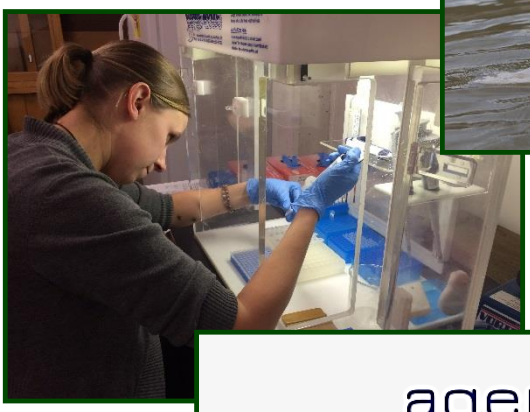
HT 2000 Backpack Electrofisher
Serial No. B068MK4
Acquisition value $6,162 (2006)

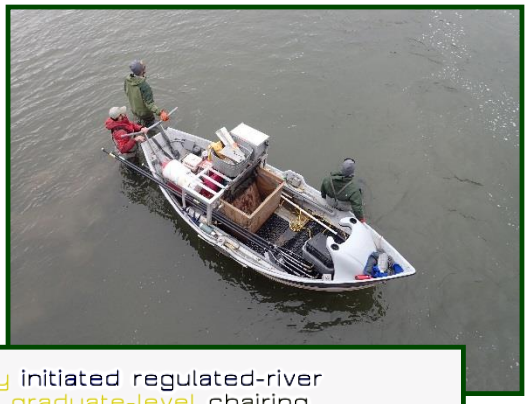
Electrofisher Backpack
Property No. 131644
Serial No. C00162
Acquisition value $5,792 (2003)

Acoustic Doppler Current Profiler
Property No. 133442
Serial No. StreamPro930
Acquisition value $16,975 (2009)

YSI Water Quality Monitor
Serial No. 08F100275, 08F100274, 08E100745
Acquisition value $15,923 (2008)

SRX 400A Datalogging Coded Series Receivers with W31 CT Firmware (2)
Property No. 132057
Serial No. 11826A
Acquisition value $7,950 (2004)
Property No. 132058
Serial No. 11827A
Acquisition value $7,950 (2004)





community initiated regulated-river
education graduate-level chairing
agencies exemplified keeping assistance
course appropriate requirements
aquatic
expertise
advance faculty
year per State
Cooperators
need
information
large-river
exotic meet outside fish problems science best exists
applied
improving
needed
flexible Program's assemblages
habitat Cooperator's directly useful non-Unit mission
remaining Fishery
addressed current response studies special
issues
prairie new
open
species
designed
serving provided Technical
areas
inquiry reservoir
focus
recruit one
topics
staff continue
occur
In-service effects
streams provide teaching
include
Unit
fisheries-management
resources
fisheries
needs
associations restoration
Montana
WordItOut