Montana Cooperative Fishery Research Unit

2017 Briefing Booklet

MONTANA COOPERATIVE
FISHERY RESEARCH UNIT

Coordinating Committee Meeting
Bozeman, Montana
12 April 2017

Personnel and Cooperators

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Cooperative Unit Staff

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Cooperators and Collaborators

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- Leandra Cho-Ricketts

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- Graham Young

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- Jason Burckhardt
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- Travis Neebling
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Graduate Students Advised by Unit Faculty

Alex Anderson	M.S.
Sean Clancy	M.S.
Kyle Crapster	M.S.
Colleen Detjens	M.S.
Mike Duncan	Ph.D.
Adeline Dutton	M.S.
Jeffrey Glaid	M.S.
Luke Holmquist	M.S.
Daniel Kaus	M.S.
Michael Lance	M.S.
Jason Marsh	M.S.
Austin McCullough	M.S.
Lauren McGarvey	M.S.
Alex Poole	M.S.
Allison Stringer	M.S.
Nathan Thomas	M.S.
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Graduate Students Advised by Cooperating Faculty

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Brent Cascaddan	M.S.
Michael Forzley	M.S.
Shannon Hilty	M.S.

Megan Milligan	Ph.D.
Eric Scholl	Ph.D.
Skyler Vold	M.S.

Graduate Students Receiving Degrees

Jan Boyer graduated with a M.S. in Fish and Wildlife Management and is working for Arizona Game and Fish as a Fisheries Biologist.

Research Technicians

Kyla Bas	Tanner Cox	Amber Kornak
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Michelle Briggs	Jonathan Hashisaki	Yuka Tsutsui
Jeremy Brooks	Drew Howing	Anthony Veroline
Adrian Cain	Robert Jensen	Charles White

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.

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

Investigator
Alexander Zale
Unit Leader

Graduate Student
Michael Lance, M.S.

Collaborators
Grant Grisak, Jason Mullen
Montana Fish, Wildlife and Parks
Tom McMahon
Professor, MSU
Robert Al-Chokhachy USGS
Northern Rocky Mountain Science Center

Duration
January 2015 – December 2018

Funding
Montana Fish, Wildlife and Parks
MSU index 4W5241

Movement adds life history diversity to freshwater fish populations and can increase individual fitness and overall population resiliency. Movements by fish define the geographic boundaries of a population and delineate important management boundaries. The Smith River in central Montana is highly valued as a wild trout fishery. We studied movement patterns in the Smith River watershed by monitoring over 6,000 PIT-tagged fish. The average travel distance of tagged individuals monitored for one year or longer was 25.4 km (± 2.8 km, median = 6.8 km, max = 559 km); 25% of fish travelled more than 30 km. Mountain Whitefish travelled farther than other salmonids (mean = 35.1 km, ± 5.4 km, median = 9.8 km) followed by Brown Trout (mean = 17.8 km, ± 4.7 km, median = 6.9 km) and Rainbow Trout (mean = 16.4 km, ± 2.0 km, median = 5.4 km). Of fish tagged in the Smith River, 68% of Rainbow Trout, 57% of Mountain Whitefish, and 65% of Brown Trout moved into tributaries. Fish tagged in tributaries moved into the main stem Smith River at lower rates ($p < 0.001$). Fish tagged in the Great Plains geomorphic reach were most likely to move to another reach ($p = 0.009$). Fish tagged in tributaries were less likely to move among geomorphic reaches than fish tagged in the Smith River ($p < 0.001$). Mountain Whitefish and Longnose Suckers were the most likely species to move to another reach ($p < 0.043$). Nineteen percent of Mountain Whitefish, 20% of Longnose Suckers, 13% of Brown Trout, and 5% of Rainbow Trout moved among geomorphic reaches. Movement of fish in the Smith River is common and links distant habitats and sub-populations. Management of this and similar inland fisheries requires maintaining connectivity at the watershed scale.

Total Project Cost		$ 150,922.00
Beginning Balance – January 2016		106,133.14
Expenditures – January 2016 - December 2016		
Salaries and Benefits	24,168.65	
Contracted Services	1,094.91	
Supplies	8,650.21	
Communications	0	
Travel	2,584.05	
Rent	800.00	
Repairs and Maintenance	476.42	
Tuition	4,791.25	
Total Spent		42,565.49
Balance		63,567.65
Waived IDCs		18,728.82

Effect of water chemistry and pressure on lake trout embryos

Investigators
Alexander Zale
Unit Leader
Molly Webb
Bozeman Fish Technology Center
U.S. Fish and Wildlife Service

Graduate Student
Alex Poole, M.S.

Collaborator
Todd Koel
Yellowstone National Park

Funding
National Park Service, CESU
MSU index 4W5648

Duration
September 2015 – August 2019

Lake Trout *Salvelinus namaycush* have become widespread in the western United States due to intentional and illegal stockings and subsequent invasion events. Lake Trout typically inhabit a top-level predator niche in lake ecosystems where they are introduced and often prey on valued sport and native fishes. The illegal introduction of Lake Trout into Yellowstone Lake is the most publicized instance of this fishery resource issue. Yellowstone National Park initiated a gillnetting suppression program in 1995 to minimize the effect of non-native Lake Trout on native Yellowstone Cutthroat Trout *Oncorhynchus clarki bouvieri*. Beginning in 2009, the National Park Service (NPS) contracted with a commercial fishing company, Hickey Brothers, LLC, to aid in the gillnetting effort on Yellowstone Lake. This costly suppression method often results in the bycatch of native Yellowstone Cutthroat Trout. Development of alternative suppression methods that destroy Lake Trout embryos has been recommended to aid in ongoing Lake Trout suppression efforts on Yellowstone Lake. Previous research has demonstrated that Lake Trout populations are sensitive to changes in age-0 survival rates. However, current suppression techniques that target these early life stages are lacking. Chemical applications with the intent of inducing Lake Trout embryonic mortality were evaluated at the Bozeman Fish Technology Center (BFTC) in 2015 and 2016. Liquid and powder rotenone treatments at 4 mg/l for 12 hours caused the greatest amount of mortality in developing Lake Trout embryos at 96% (1.4 SE) and 99% (0.5 SE), respectively. Lake Trout embryonic mortality associated with exposure to fish carcass material at varying levels of water exchange was also evaluated in 2016 at the BFTC. Embryo mortality was 100% at 0.05 gpm, 100% at 0.l gpm, and 70% (2.5 SE) at 0.2 gpm; embryo mortality was a function of water exchange rates. Laboratory experiments will continue in 2017 to further evaluate the effects of carcass, carcass analog, and sediment deposition on Lake Trout embryonic mortality. The effect of sediment and Lake Trout carcass deposition will also be experimentally assessed *in situ* in Yellowstone Lake in 2017.

Total Project Cost		$ 90,017.00
Beginning Balance – January 2016		86,352.98
Expenditures – January 2016 - December 2016		
Salaries and Benefits	17,296.58	
Contracted Services	708.27	
Supplies	2,469.80	
Communications	0	
Travel	757.09	
Rent	20.00	
Repairs and Maintenance	0	
Tuition	3,923.05	
IDCs @ 17.5%	4,405.56	
Total Spent		29,580.35
Balance		56,772.63
Waived IDCs		6,671.32

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
Andrea Litt
Assistant Professor MSU
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 Yellowstone Cutthroat Trout in Yellowstone Lake tributaries. Repeated sampling of 6-7 tributaries will occur from April through October. 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 two smaller tributaries will also be used to compare to eDNA amounts.

Samples were collected from 6 tributaries in 2016 and are currently being analyzed at the Rocky Mountain Research Station in Missoula, MT. Seven tributaries will be sampled in 2017.

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

Investigator
Alexander Zale
Unit Leader

Graduate Student
Jason Marsh, M.S.

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

Duration
March 2015 – September 2018

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. The specific objectives of the study are: (1) document the movements and habitat use of Arctic Grayling and other fishes present in Elk Springs Creek and Picnic Creek, (2) determine abundance of Arctic Grayling and other fishes present in Elk Springs Creek and Picnic Creek, and (3) describe aquatic habitat conditions in Swan Lake, Elk Springs Creek and Picnic Creek. Variables outlined in each of the aforementioned objectives will be monitored before and after Swan Lake is bypassed. We will use passive integrated transponder (PIT) tags to determine movements of Arctic Grayling in Elk Springs Creek and Picnic Creek. Fish abundance in Elk Springs Creek and Picnic Creek will be determined using multiple-pass electrofishing depletion techniques. Aquatic habitat conditions in Swan Lake, Elk Springs Creek, and Picnic Creek will be assessed using dissolved oxygen concentration and temperature loggers.

Identifying the threats of smallmouth bass to Yellowstone cutthroat trout in the Yellowstone River

Investigators

Alexander Zale
Unit Leader
Adam Sepulveda, Robert Al-Chokhachy
USGS Northern Rocky Mountain Science Center

Graduate Student

Sean Clancy, M.S.

Duration

April 2016 – May 2019

Collaborators

Mike Ruggles, David Schmetterling, Scott Opitz, Jason Rhoten
Montana Fish, Wildlife and Parks

Funding

Northern Rocky Mountain Science Center, USGS RWO 72, MSU index 4W5971

Non-native smallmouth bass (*Micropterus dolomieu*) have demonstrated considerable range expansion from their initial introduction sites in the Yellowstone River downstream of Billings, MT, and adult smallmouth bass are now sympatric with wild and native trout near Livingston, MT. In other western waters, introduced smallmouth bass have demonstrated pronounced effects on juvenile salmonids. Information about their current and potential distribution and habitat associations are needed to identify the threat severity of smallmouth bass to other fishes in the Yellowstone River.

We used trap netting to describe the upstream extent and habitat associations of juvenile smallmouth bass, as presence of this life stage is representative of habitats that are suitable for establishment. We used trap nets to sample Yellowstone River side-channel habitats for juvenile smallmouth bass from the Clark's Fork River (river km 610) confluence to the Shield's River confluence (river km 785) in August and September 2016. We documented juvenile smallmouth bass only as far upstream as Big Timber (river km 732). Analyses relating their presence to habitat covariates are still pending. Next steps include repeating sampling from 2016 to test if juvenile smallmouth bass distributions expand with time and using radio telemetry and environmental DNA to characterize the upstream extent of adult smallmouth bass distributions.

Total Project Cost		$ 34,258.00
Beginning Balance – April 2016		34,258.00
Additional Funding – 2016		
Expenditures – April 2016 - December 2016		
Salaries and Benefits	6,624.30	
Contracted Services	20.00	
Supplies	1,606.18	
Communications		
Travel		
Rent		
Repairs and Maintenance		
Tuition	1,305.20	
IDCs @ 15%	1,433.35	
Total Spent		10,989.03
Balance		23,268.97
Waived IDCs		2,771.15

Evaluating sediment and nutrient contributions from unpaved forest roads to headwater streams

Investigators
Alexander Zale
Unit Leader
Robert Al-Chokhachy
USGS NOROCK

Graduate Student
Kyle Crapster, M.S.

Collaborators
Tom Black, Charles Luce
USDA Forest Service

Funding
USDA Forest Service , CESU
MSU index 4W6280

Duration
August 2016 – September 2019

Habitat degradation resulting from road networks and land use is considered one of the major impediments to fishes in montane ecosystems. Today, the US Forest Service road network exceeds over 600,000 kilometers and serves as a primary sediment contributor to streams and also alters peak flows. Restoring landscapes affected by roads represents an essential component for enhancing resiliency of salmonid assemblages. However, road network negative effects are unequally distributed across the landscape and strongly context dependent. Additional insight into relationships between roads, land use, and aquatic habitat can improve our understanding of anthropogenic influences on aquatic habitat and populations of sensitive species (e.g., Bull Trout *Salvelinus confluentus*), while helping to prioritize conservation and restoration efforts.

The goal of this research project is to understand the relative influence of roads and land use on aquatic habitat and the subsequent relationship to Bull Trout distribution and abundances in Northwest Montana. The project is focused on 1) the linkages between unpaved road sediment delivery and instream sediment transportation and retention; and 2) the relationships between management intensity, instream habitat, and the distribution and abundance of Bull Trout. The first objective will examine if model estimates of road sediment delivery are reflected in measures of instream suspended sediment delivered directly from road/stream connection points. The second objective will investigate the use of environmental DNA (eDNA) as a measure of Bull Trout abundance to aid in quantifying relationships between Bull Trout populations and instream habitat and land management.

Total Project Cost		$ 55,009.74
Beginning Balance – September 2016		55,009.74
Expenditures – September 2016 - December 2016		
Salaries and Benefits	4,610.19	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Tuition	2,516.75	
Repairs and Maintenance	0	
IDCs @ 17.5%	1,247.22	
Total Spent		8,374.16
Balance		46,635.58
Waived IDCs		1,888.63

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 – December 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 also lacking about nursery areas and general movements of walleye in the reservoir and its tributaries. To help improve our ability to distinguish hatchery-reared and wild walleye, we conducted a strontium supplementation experiment in several hatchery rearing tanks. Preliminary otolith microchemistry results indicate that adding strontium chloride for one to three days immediately after swim-up is sufficient to produce detectable increases in strontium concentrations in juvenile walleye otoliths. Such results indicate that future studies of walleye stocking efforts in Fort Peck could include assessments of hatchery-reared fry recruitment. Otolith microchemistry was also completed on an additional 647 otoliths from walleye captured during annual Fort Peck monitoring efforts. The results of those analyses, which will assess recruitment of hatchery-reared fingerlings and identify nursery areas and general movements, are not yet available, but the final report will be completed by the summer of 2017.

Total Project Cost		$ 47,200.00
Beginning Balance – January 2016		10,637.66
Additional Funding – 2016		18,400.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	12,570.29	
Contracted Services	8,900.00	
Supplies	796.96	
Communications	0	
Travel	2,587.39	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		24,854.64
Balance		4,183.02
Waived IDCs		10,936.04

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

Collaborators

Craig Hayes, Turneffe Atoll Trust
Leandra Cho-Ricketts, University of Belize
Kathi Irvine, Chris Peck USGS Northern Rocky Mountain Science Center

Graduate Student

Alex Anderson, M.S.

Duration

August 2012 – December 2016

Funding

Turneffe Atoll Trust
Student Support Project
MSU index 423192

We continue to assist the Turneffe Atoll Trust, the Turneffe Atoll Marine Reserve, and the Belize Fisheries Department to analyze and monitor the Queen Conch fishery at Turneffe Atoll, Belize. Fishery independent samples collected in summer 2016 indicated that the stock abundance was 70% of that observed in 2013 and included relatively few mature as well as age-1 and age-2 individuals, suggesting that recruitment may be limited by excessive harvest of mature adults.

Total Project Cost		$ 50,995.35
Beginning Balance – January 2016		2,507.05
STIP interest		25.58
Additional Funding – 2016		4,784.35
Expenditures – January 2016 - December 2016		
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		7,316.98
Waived IDCs		0

Annual evaluation and development of benchmarks for Lake Trout suppression in Yellowstone Lake

Investigators

Christopher Guy
Assistant Unit Leader
John Syslo, Ph.D.
Post Doc Research Associate

Collaborator

Todd Koel
Yellowstone National Park

Duration

July 2013 – June 2018

Funding

National Park Service, CESU
MSU index 4W4470

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 Yellowstone 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 824,000 (575,000-1,027,000; 95% CI) fish in 2012. Large increases in fishing effort from 2012 through 2016 resulted in high fishing mortality and likely prevented Lake Trout abundance from continuing to increase. From 2014 through 2016, fishing effort was about 76,000 100-m net nights, which exceeded the recommended target of 45,000 100-m net nights. The fishing effort from 2014 through 2016 resulted in an average instantaneous fishing mortality rate of 0.99 (0.59-1.41; 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 implemented from 2014 through 2016 is maintained.

Total Project Cost		$ 85,165.00
Beginning Balance – January 2016		44,774.38
Expenditures – January 2016 - December 2016		
Salaries and Benefits	11,462.60	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
IDCs @ 15%	2,005.94	
Total Spent		13,468.54
Balance		31,305.84
Waived IDCs		3,037.60

Novel methods 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

Non-native Lake Trout have been intentionally or inadvertently introduced into many lakes and reservoirs throughout the Intermountain West, and consequently the establishment of this apex predator has often caused declines in native species abundance. For example, introduced Lake Trout threaten to extirpate native Yellowstone Cutthroat Trout in Yellowstone Lake, Yellowstone National Park. Suppression of Lake Trout in Yellowstone Lake has been ongoing since 1995, primarily through the use of gill nets to capture juvenile and adult Lake Trout. Unfortunately, Lake Trout are not the only fish species collected in gill nets. 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. A mobile electrofishing grid, similar to the one used in Swan Lake, was was evaluated in 2015. Embryo (two days post-fertilization) mortality was 99% (0.64 SE) at the substrate surface, 51% (20.83 SE) for embryos buried 20 cm in the substrate, and 8% (4.30 SE) for embryos buried 40 cm in the substrate. Embryo mortality was a function of the depth, which was 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. The use of a suction dredge to collect Lake Trout embryos from spawning substrate and placing Lake Trout carcasses on spawning substrate to cause mortality in Lake Trout embryos were evaluated in 2016. Suction dredging collected 27% (4.00 SE) of embryos present in the substrate. Lake Trout carcasses covered with a gas impermeable tarp caused 100% (0.00 SE) mortality in embryos buried to 20 cm within the substrate. Uncovered Lake Trout carcasses placed on the substrate surface caused 100% (0.00 SE) mortality in embryos buried at 20 cm within the substrate and 98% (0.02 SE) mortality in embryos at the substrate surface. If implemented at a large scale, carcasses placed on Lake Trout spawning areas may be an effective alternative suppression method.

Total Project Cost		$ 128,852.00
Beginning Balance – January 2016		62,370.47
Expenditures – January 2016 - December 2016		
Salaries and Benefits	26,169.85	
Contracted Services	938.21	
Supplies	6,974.15	
Communications	136.72	
Travel	4,089.32	
Rent	3,000.00	
Repairs and Maintenance	695.91	
Tuition	3,569.15	
IDCs @ 17.5%	7,975.34	
Total Spent		53,548.65
Balance		8,821.82
Waived IDCs		12,076.92

Lake Trout suppression and the ecological consequences in Yellowstone Lake

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
Todd Koel
Yellowstone National Park

Graduate Student
Ph.D. student

Funding
National Park Service
MSU index 4W6204

Duration
September 2016 – August 2021

Novel methods to suppress Lake Trout are being developed in Yellowstone Lake, and one method that has promise is the use of Lake Trout carcasses on spawning areas (see project above titled: Novel methods to induce mortality of Lake Trout embryos in Yellowstone Lake). Lake Trout carcasses and other suppression techniques may affect ecological processes, such as increasing primary productivity or amphipod abundance. The objectives of this project are to continue to develop alternative suppression methods and assess the affects of alternative suppression methods on the ecology of Yellowstone Lake, with an emphasis on primary production and amphipods.

Total Project Cost		$ 183,300.00
Beginning Balance – September 2016		183,300.00
Expenditures – September 2016 - December 2016		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Total Spent		0
Balance		183,300.00
Waived IDCs		0

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. Gillnetting in Yellowstone Lake has removed over two million Lake Trout since suppression began in 1995. Targeting known spawning locations has resulted in the highest numbers of adult Lake Trout removed. Historically, it was believed that Lake Trout spawned at three locations in the West Thumb. Recently, nine more confirmed spawning sites have been discovered. The discovery of additional spawning areas has demonstrated the lack of our understanding regarding Lake Trout spawning locations. 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 seasonal aggregation patterns, and 3) identify spawning locations. A total of 312 (85 mature males) Lake Trout were surgically implanted with duel radio and acoustic transmitters in 2015 and 2016. Spawning season tracking resulted in 1,995 Lake Trout detections, relocating 254 (66 mature male) individual Lake Trout. Kernel-density-surface maps of Lake Trout locations identified nine putative spawning areas that warrant further investigation in 2017. One hundred additional transmitters will be implanted into adult male Lake Trout in 2017. Tracking will be conducted May through October to identify seasonal changes in Lake Trout aggregations as well as identify additional putative spawning locations.

Total Project Cost		$ 90,017.00
Beginning Balance – January 2016		87,948.35
Expenditures – January 2016 - December 2016		
Salaries and Benefits	17,347.04	
Contracted Services	0	
Supplies	127.95	
Communications	75.38	
Travel	2035.11	
Rent	0	
Repairs and Maintenance	0	
Tuition	3034.00	
IDCs @ 17.5%	3,958.40	
Total Spent		26,577.88
Balance		61,370.47
Waived IDCs		5,994.17

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

Investigator
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Assistant Unit Leader

Collaborator
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U.S. Bureau of Reclamation

Graduate Student
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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 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 a substantial decline such that only a few (< 50) wild fish remain in the population. To augment the declining population, stocking of age-1 hatchery-origin (HO) 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 HO Pallid Sturgeon at first sexual maturity, 2) determine the spawning periodicity of HO Pallid Sturgeon, 3) determine if reproductively active (RA) HO 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-use were recorded at each location. The youngest RA male HO Pallid Sturgeon captured was 14.5 years old and the youngest female was 18. Hatchery-origin males were observed having annual (N=3) and biennial (N=2) reproductive cycles. Mean total movement distances (± SE) during the spawning season were greater for both RA male classifications than for unconfirmed sex HO fish. Mean total movement distances were 104.5 km (18.9) for RA wild males, 116.0 km (18.1) for RA 1997-year class males, and 20.6 km (3.0) for unconfirmed sex 1997-year class fish. The timing of peak spring discharge was eight days earlier and 79 m^3/s less in 2016 compared to 2015, but total movement (km), maximum upstream location (rkm), median location (rkm), and home range size (km) during the presumed spawning season did not differ between the two years. In 2016, a RA HO female was

recaptured in the upper Missouri River ~15 km upstream of the confluence with the Marias River, representing the most upstream RA fish observed in this study. A successful spawning event at this location would provide the necessary distance from the reservoir transition zone to accommodate extended larval drift, but no such spawning event took place. Interestingly, all five females (two wild and three HO) tracked in this study from 2014 and 2016 have undergone follicular atresia. These preliminary results indicate that RA HO Pallid Sturgeon have similar behavior to wild Pallid Sturgeon in this reach of the Missouri River, but exhibit an alarmingly high incidence of follicular atresia.

Total Project Cost		$ 288,031.28
Beginning Balance – January 2016		55,839.11
Additional Funding – 2016		91,296.65
Expenditures – January 2016 - December 2016		
Salaries and Benefits	25,779.55	
Contracted Services	37,975.47	
Supplies	8,581.24	
Communications	4.34	
Travel	8,423.43	
Rent	12,000.00	
Repairs and Maintenance	1,523.68	
Tuition	5,016.95	
IDCs @ 17.5%	17,378.31	
Total Spent		116,682.97
Balance		30,452.79
Waived IDCs		26,315.74

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

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Graduate Students

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Collaborator

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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), 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.

Diet analysis between Pallid Sturgeon and Shovelnose Sturgeon indicate a higher degree of resource overlap in the regulated Missouri River compared to the Yellowstone River. Nineteen families of benthic macroinvertebrates were found in at least ten percent of sturgeon diets. Large Pallid Sturgeon (> 365 mm fork length) consumed five species of prey fish in proportion to their relative abundance. Most prey species in the Cyprinidae family were specialists feeding on less than five taxa; whereas, prey species in Ictaluridae and Hiodontidae families consumed fifteen taxa. Chironomidae and Hydropsychidae were common in ninety percent of all fish species. The food web of the upper Missouri River is complex, suggesting stability in the food web. Many of the prey items consumed by Pallid Sturgeon were relatively abundant in the environment, suggesting that Pallid Sturgeon may be more opportunistic than originally reported.

Macroinvertebrate assemblage structure, abundance, biomass, and secondary production differ throughout study reaches in the Missouri and Yellowstone rivers, with high estimates of assemblage abundance, biomass, and secondary production directly downstream of Fort Peck Dam. Furthermore, in reaches that are predominantly sand, small habitat patches (i.e., rock habitat, large woody debris, off-channel backwaters) support diverse communities of macroinvertebrates with high secondary production estimates, 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.

Total Project Cost		$ 487,126.00
Beginning Balance – January 2016		48,083.11
Additional Funding – 2016		117,399.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	80,724.96	
Contracted Services	1,083.82	
Supplies	2,724.85	
Communications	0	
Travel	9,646.60	
Rent	4,450.00	
Repairs and Maintenance	719.14	
Tuition	4,285.95	
Total Spent		103,635.32
Balance		61,846.79
Waived IDCs		45,599.54

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

Investigators

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U.S. Fish and Wildlife Service

Funding

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

Duration

June 2011 – July 2017
Completed

White Sturgeon farmers in California and Idaho, U.S.A. have observed that the variability in caviar quality and quantity can be attributed to accumulation of ovarian fat cells, or adipocytes. Although the accumulation of ovarian adipocytes has been documented in adult sturgeon, determining the age at which farmed sturgeon begin storing ovarian fat will potentially enable sturgeon farmers to adjust husbandry practices, like feeding different dietary energy levels, at an early age. We investigated the influence of dietary fat on the size of ovarian adipocytes in farmed age-2 and age-3 White Sturgeon. Samples of tissue at each age class were selected from three locations on the cross-sectioned ovary (anterior (the ovigerous folds and just behind), posterior (adipocytes furthest from the folds), and random (adipocytes in-between) from fish fed either a high energy (HE; 17% fat) diet or low energy (LE; 9% fat) diet for 18 months (age 2 fish) and 30 months (age 3 fish). Randomly chosen adipocytes from each location were measured histologically. Mean adipocyte size did not statistically differ among sample locations within fish of the same age fed the same diet. Fish fed the HE diet had significantly larger adipocytes than fish fed the LE diets at age-2 and age-3. Adipocyte size did increase significantly over time in both diets. Our results demonstrate that diet can influence the size of adipocytes found in juvenile White Sturgeon ovaries. Additional research is needed to determine whether the accumulation of large adipocytes as a juvenile carries over into adulthood and influences reproductive ability and caviar yield and quality.

Total Project Cost		$ 68,247.00
Beginning Balance – January 2016		20,975.81
Expenditures – January 2016 - December 2016		
Salaries and Benefits	18,225.69	
Contracted Services	0	
Supplies	158.09	
Communications	0	
Travel	2,592.03	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		20,975.81
Balance		0
Waived IDCs		9,229.36

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

Investigator
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Collaborator
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Montana Fish, Wildlife and Parks

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

Duration
August 2012 – May 2017

Climate change, habitat alterations, interactions with non-native species, and over-exploitation have been suggested to influence Arctic Grayling abundance and distribution, although sparse quantitative information exists to support these hypotheses. Arctic Grayling in Montana have experienced reductions in abundance and distribution over the last century and were resultantly 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 direct and relative influence of abiotic and biotic factors that were hypothesized to limit Arctic Grayling abundance and distribution. 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. Ordinary least squares and quantile regression analyses were used to evaluate the univariate relationships among stream discharge, stream temperature, habitat, non-native salmonids, and Arctic Grayling catch-per-unit-effort (*C/f*), which was partitioned into two demographics (i.e., ≥ age 1 and age 0). Global models were constructed using significantly related explanatory variables from the univariate analyses to evaluate the relative influence of abiotic and biotic factors on Arctic Grayling *C/f*; the amount of support for the global model and all nested models was ranked using an information-theoretic approach (AIC_c). The strongest univariate relationship was the positive correlation was between the *C/f* of Arctic Grayling ≥ age 1 and Brook Trout *C/f* (r=0.55, N=77). Multi-model inference suggested that increasing stream temperature and decreasing stream discharge have the greatest relative

influence on the *C/f* of Arctic Grayling ≥ age 1, and Brown Trout *C/f*, increasing stream temperature, and maximum discharge have the greatest relative influence on age-0 Arctic Grayling *C/f*.

Total Project Cost		$ 10,398.00
Beginning Balance – January 2016		1,238.36
STIP interest – 2016		3.96
Expenditures – January 2016 - December 2016		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	375.85	
Total Spent		375.85
Balance		866.47
Waived IDCs		165.37

Evaluation of juvenile Bull Trout outmigration in Thompson Falls Reservoir

Investigator
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Assistant Unit Leader

Collaborator
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Montana Fish, Wildlife and Parks

Graduate Student
Jeffrey Glaid, M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W4708

Duration
November 2013 – June 2017

Bull Trout populations in the Thompson River drainage have declined over the past century. Such declines have been attributed to impacts from habitat fragmentation, habitat degradation, and the introduction of non-native species. Temporal and spatial migration characteristics were evaluated to increase our understanding of local Bull Trout populations and better inform conservation efforts. Specifically, we assessed life-history heterogeneity, distribution, and movement of subadult Bull Trout (100 – 300 mm) throughout the Thompson River drainage. In autumn 2014, 53 subadult Bull Trout were injected with passive integrated transponder (PIT) tags, 29 of which were surgically implanted with acoustic transmitters. Minimal out-migration was observed in 2014. In summer 2015, 566 subadult Bull Trout were PIT-tagged within the Fishtrap Creek and West Fork Thompson River drainages (mainstem Thompson River tributaries). Stream-width PIT antennas were used to monitor fluvial out-migration at the confluences of the Thompson River tributaries and adfluvial out-migration at the mouth of the Thompson River. Actively out-migrating Bull Trout (N = 135) were sampled using directional weir traps at the tributary confluences, PIT-tagged, and implanted with acoustic- (N = 29) or radio-tags (N = 14) in autumn 2015. Between July and December 2015, 11% of the PIT-tagged Bull Trout were detected out-migrating from the Thompson River tributaries, with the peak of activity occurring in late October. Passive redetections for all tagged Bull Trout that entered the Thompson River (N=192) revealed that 13% entered Thompson Falls Reservoir, with a peak in adfluvial out-migration during December. Aabiotic cues of median temperature, minimum atmospheric pressure, and lunar illumination were associated with an increased number of out-migrants. Radio-tagged out-migrants exhibited a high degree of site fidelity between intermittent downstream movements within the Thompson River. Bull Trout originating from natal tributary drainages remained separate within the segments of the Thompson River that were downstream of their respective origins. Ripley K-function spatial analysis suggests that neither clustering nor dispersion existed at levels greater than would be expected by a random distribution. Our results demonstrate low out-migration rates in the Thompson River drainage and a prolonged inhabitance in the mainstem Thompson River, which was contrary to our *a priori* hypothesis of a clustered out-migration by subadult Bull Trout.

Total Project Cost		$ 117,106.00
Beginning Balance – January 2016		14,223.87
Additional Funding – 2016		26,758.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	19,755.97	
Contracted Services		
Supplies	131.88	
Communications	11.50	
Travel	1,859.02	
Rent	150.00	
Repairs and Maintenance	9.22	
Tuition	2,816.40	
Total Spent		24,733.99
Balance		16,247.88
Waived IDCs		10,882.96

Walleye suppression in Buffalo Bill Reservoir

Investigator
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Assistant Unit Leader

Graduate Student
Daniel Kaus, M.S.

Duration
July 2015 – June 2018

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

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		$ 110,127.00
Beginning Balance – January 2016		42,383.74
Additional Funding – 2016		55,301.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	23,006.75	
Contracted Services	133.25	
Supplies	1,686.72	
Communications	0	
Travel	5,940.06	
Rent	1,650.00	
Repairs and Maintenance	295.29	
Tuition	4,449.95	
IDCs @ 20%	7,432.40	
Total Spent		44,594.42
Balance		53,090.32
Waived IDCs		8,918.89

Lake Roosevelt Burbot maturation study

Investigators
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U. S. Fish Wildlife Service

Collaborators
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Graduate Student
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Funding
Confederated Tribes of the Colville Reservation
US Fish Wildlife Service , CESU
MSU index 4W6449

Duration
December 2016 – October 2018

Sexual dimorphism in Burbot can be difficult to discern as the species is seemingly monomorphic. Burbot spawn over a relatively short time frame indicating that the species has synchronous gonadal development. Reliable information regarding gametogenesis is required for population status assessment and harvest modeling. The objectives of this proposed work are to: 1) describe gametogenesis and the endocrine profile in adult Lake Roosevelt Burbot, 2) develop non-invasive (ultrasound) and less-invasive (plasma sex steroids) tools to determine sex and stage of maturity, and 3) develop non-invasive (egg diameter via ultrasound) and non-lethal invasive (collection of gametes through catheterization) tools to predict spawning readiness and successful spawning. Twelve burbot (n=6 females and n=6 males) have been sampled monthly since November 2016. To date, ultrasound can be used to definitively differentiate between females and males (100% accuracy).

Total Project Cost		$ 10,000.00
Beginning Balance – December 2016		10,000.00
Expenditures – December 2016 - December 2016		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Tuition	0	
Repairs and Maintenance	0	
Total Spent		0
Balance		0
Waived IDCs		0

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

Investigators

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

Collaborators

Scott Gangl, Patrick Isakson
North Dakota Game, Fish and Parks
Rob Holm, Steve Krentz
U.S. Fish and Wildlife Service

Duration

June 2015 – September 2017

Funding

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

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		$ 110,613.00
Beginning Balance – January 2016		61,303.00
Additional Funding – 2016		49,310.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	48,144.92	
Contracted Services	97.00	
Supplies	34.18	
Communications	0	
Travel	872.90	
Rent	0	
Tuition	0	
IDCs @ 15%	7,372.29	
Total Spent		56,521.29
Balance		54,091.71
Waived IDCs		14,253.27

Native prairie special status fish species inventory

Investigators
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Unit Leader

Graduate Student
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Collaborators
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Bureau of Land Management
Steve Leathe
NorthWestern Energy

Duration
July 2014 – June 2019

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

Pearl Dace *Margariscus margarita*, Northern Redbelly Dace *Chrosomus eos*, and Northern Redbelly × Finescale Dace hybrids *C. eos* × *C. neogaeus* (hereafter Hybrid Dace) are Montana species of concern. All three taxa appear to have undergone substantial range contractions and may be at risk of extirpation from Montana. A lack of information regarding their present distributions and status hinders their conservation and management. Our objectives are to (1) establish their current distributions relative to historic distributions, (2) determine the proportion of Northern Redbelly Dace populations that contain Hybrid Dace, and (3) evaluate the threat from non-native predators, which we hypothesize cause range contractions of dace in Montana prairie streams.

We sampled 94 sites in the inferred historic range for Pearl Dace, 85 of which had fish; Pearl Dace were present at 8 sites (9%) on 5 streams. Northern Pike were present at just one of these sites (Eagle Creek in Daniels County). However, when we resampled this site we did not capture any Pearl Dace, but again captured Northern Pike. Additionally, we sampled two nearby sites on Eagle Creek and found Northern Pike but no Pearl Dace. Thus we currently have no records of Pearl Dace and Northern Pike co-occurring. Northern Pike were captured at 16 sites (19%), and non-native trout (Brook Trout, Brown Trout, or Rainbow Trout) were captured at 17 sites (20%). We did not capture Pearl Dace in any streams with non-native trout present. Pearl Dace distribution has apparently declined in recent years. Pearl Dace may have been extirpated from 13 of 15 streams with historical collection records. This suggests a decline in occupied streams of 87%, likely due to the invasion of non-native Northern Pike or the presence of non-native trout.

We sampled 141 sites in the range of Northern Redbelly Dace and Hybrid Dace, 128 of which had fish; Northern Redbelly Dace were captured at 43 sites (34%), Northern Pike at 20 (16%), and nonnative trout at 27 sites (21%). Northern Redbelly Dace were present at only one of the sites where Northern Pike were captured and at 3 of the sites where non-native trout were captured. We captured Hybrid Dace at 14 sites (11%),

pending lab verification. Northern Redbelly Dace also appear to have declined in the parts of their range where Northern Pike have invaded, but appear to be secure in parts of their range where Northern Pike have not invaded. The status of Hybrid Dace is likely less secure than Northern Redbelly Dace because we suspect that all Northern Redbelly Dace populations do not also have Hybrid Dace.

Total Project Cost		$ 172,500.00
Beginning Balance – January 2016		89,903.33
Additional Funding – 2016		25,000.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	53,016.25	
Contracted Services	412.42	
Supplies	3,355.40	
Communications	115.58	
Travel	8,440.07	
Rent	0	
Repairs and Maintenance	65.19	
Tuition	1,064.20	
IDCs @ 17.5%	11,632.09	
Total Spent		78,101.20
Balance		36,802.13
Waived IDCs		17,614.32

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

Investigator
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Collaborator
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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 – June 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 2016		102,190.21
Expenditures – January 2016 - December 2016		
Salaries and Benefits	51,321.28	
Contracted Services	0	
Supplies	1,202.80	
Communications	12.10	
Travel	4,485.53	
Rent	500.00	
Repairs and Maintenance	494.18	
Tuition	0	
IDCs @ 15%	8,702.24	
Total Spent		66,718.13
Balance		35,472.08
Waived IDCs		16,824.75

Statistical analyses to direct conservation and restoration priorities for the Yellowstone cutthroat trout in the context of climate change

Investigator
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B.B. Shepard and Associates

Collaborator
Robert Al-Chokhachy
USGS NoRock

Duration
September 2016 – August 2017

Funding
National Park Service
MSU index 4W6272

Yellowstone Cutthroat Trout (*Oncorhynchus clarkii bouvieri*; hereafter YCT) is a native trout subspecies that has experienced a reduction in its distribution over the past century due to a multitude of human-related impacts. This study investigated the potential effects of non-native Brook Trout (*Salvelinus fontinalis*) and climate on the distribution of YCT over time. We used time-series data from the early 1970s to the present to investigate the effects of Brook Trout and climate, and their interaction, on the distribution of YCT. We compiled data on species composition, abundance, and size classes of these two species at fixed sites throughout the Shields River basin and compared these data to similar data from other sites throughout the range of YCT. These data have now been compiled and are currently being analyzed. We have augmented these data with growth data for YCT collected during the period 2011 to 2016. A manuscript will be prepared for publication based on these data.

Total Project Cost		$ 9,100.00
Beginning Balance – September 2016		9,100.00
Expenditures – September 2016 - December 2016		
Salaries and Benefits	7,183.89	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
IDCs @ 17.5%	1,257.18	
Total Spent		8,441.07
Balance		658.93
Waived IDCs		1,903.73

Carnivore management and elk recruitment in western Montana

Investigators
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Professor MSU
Jay Rotella
Professor MSU

Graduate Student
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Duration
February 2016 – June 2020

Collaborator
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Montana Fish, Wildlife and Parks

Funding
Montana Fish, Wildlife and Parks
MSU index 4W5906

Like other areas in Montana, the southern Bitterroot Valley experienced long periods of uninterrupted increase in elk abundance in the mid-20th century, followed by increases in large carnivore abundance starting in the late 20th century. These increases in large carnivore abundance coincided with decreases in elk calf recruitment and changes in area elk abundance. Thus, in 2011 researchers from Montana Fish, Wildlife and Parks and the University of Montana initiated the Bitterroot Elk Ecology Project to evaluate the factors driving changes in elk populations in the southern Bitterroot. After three years of evaluating the bottom-up and top-down effects on survival and recruitment of area elk populations, the research team determined that increasing elk calf survival in the southern Bitterroot may have positive effects on area elk abundance and recruitment. Thus, in 2012, area wildlife managers increased the harvest of large carnivores in the study area to increase elk calf survival. Our goal is to evaluate the effects of this increased carnivore harvest on elk calf recruitment in the East Fork and West Fork watersheds of the Bitterroot River. We will use ear-tag radio transmitters to monitor the survival of elk calves for the first year of their life. To date, we have radio-tagged 121 elk calves, which are monitored by field crews several times a week. Additionally, we plan to assess the relative impact of several factors on elk calf survival such as winter severity, forage availability, predation risk, and individual characteristics of elk calves such as birth mass and sex.

Total Project Cost		$ 530,000.00
Beginning Balance – January 2016		147,000.00
Additional Funding – 2016		383,000.00
Expenditures – March 2016 - December 2016		
Salaries and Benefits	39,260.58	
Contracted Services	40,499.79	
Supplies	90,403.32	
Communications	226.78	
Travel	0	
Rent	2,608.40	
Repairs and Maintenance	1,911.46	
Tuition	1,348.80	
Total Spent		176,259.13
Balance		353,740.87
Waived IDCs		77,554.02

Elk response to pine beetle outbreak and management responses to that outbreak in the Elkhorn Mountains

Investigator
Robert Garrott
Professor MSU

Collaborators
Kelly Proffitt
Montana Fish Wildlife and Parks
Denise Pengeroth
U.S. Forest Service

Graduate Student
Brent Cascaddan, M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W6318

Duration
October 2016 – June 2019

Montana Fish, Wildlife & Parks initiated a study to evaluate the effect of mountain pine beetle (MPB) infestation on elk habitat and elk movements in the Elkhorn Mountains in collaboration with the Elkhorn Working Group, Helena National Forest, Montana State University, and the Montana Department of Military Affairs. Beginning in 1996, a major epidemic of MPB began affecting pine forests in western North America. Currently, western US forests are experiencing a MPB epidemic that is unprecedented in the past 100 years in extent, severity, and duration. During the period from 2000 to 2013, MPB caused tree mortality over 17.5 million acres of pine forest across the western United States. The US Forest Service estimates that 6.1 million acres of beetle-killed trees are present in Montana, resulting in a major effect on the landscape. After the initial infestation, a decrease in canopy cover 2-4 years after infestation and an increase in soil nitrogen associated with downed woody debris may result in increases in understory shrub and herbaceous vegetation. These increases in understory vegetation may benefit wildlife species associated with early seral vegetation such as elk (*Cervus canadensis*) and deer (*Odocoileus* spp.). As infestation progresses, beetle-killed pine trees will begin to fall 3-5 years after tree death, with 25-50% of the trees falling within 10 years. These downed trees have the potential to adversely affect movement of elk and deer.

To better understand effects of the beetle epidemic on elk habitat, we will directly evaluate elk nutritional resources across their summer range, with a goal of quantifying the effects of beetle infestation on elk nutritional resources. This project will also serve to fill the gap in knowledge of how mountain pine beetle affects forest habitat and wild ungulates such as elk, and what potential management actions can be taken to produce a desired result. This knowledge is necessary for the decisions wildlife and forest managers need to make for maintaining healthy wildlife populations and habitat.

Total Project Cost		$ 37,038.00
Beginning Balance – October 2016		37,038.00
Expenditures – October 2016 - December 2016		
Salaries and Benefits	5,423.76	
Contracted Services	0	
Supplies	227.16	
Communications	0	
Travel	0	
Tuition	1,889.00	
Repairs and Maintenance	0	
Total Spent		7,539.91
Balance		29,498.09
Waived IDCs		3,317.56

Characterizing foraging areas and maternity roost sites of bat species and evaluating the effects of forest disturbance

Investigator
Andrea Litt
Assistant Professor, MSU

Collaborator
Claire Gower
Montana Fish, Wildlife and Parks

Graduate Student
Shannon Hilty, M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W6331

Duration
September 2016 – June 2020

Bats are fundamental components of ecosystems but face a wide array of conservation issues including elimination of prey species, mortalities due to wind energy development and white nose-syndrome, and loss of roosting and foraging habitat. Bats require both adequate maternity roosts and foraging sites to complete their life history. The availability of these sites may limit the distribution and abundance of bats, making these sites key for conservation. We know little about natural maternity roosts and foraging sites within Montana's forests. Understanding what specific characteristics of these habitat features are important for selection and use by bats is essential to develop useful conservation and management strategies.

Mountain pine beetles (MPB) alter the composition and function of ecosystems, and have resulted in large-scale changes in forest structure throughout the western United States. Accordingly, Montana's state agencies are asked to comment on forest management plans for both public and private land with regards to wildlife species, which requires drawing on existing research and knowledge for insights. Numerous research projects have examined the effects of extensive logging operations and fire on bats in forests throughout the western US; in contrast, we know little about the effects of MPB on bats.

We intend to address some of these knowledge gaps by quantifying characteristics of maternity roosts and foraging sites for tree-roosting bats during the summer, with a specific focus on how the use and availability of these habitat features are affected by MPB. In particular, we hope to answer two overarching questions: (1) When selecting roost sites (particularly maternity colonies) and foraging sites in forests during the active season, what characteristics do bats prefer? (2) How do MPB disturbances affect the availability (and use) of these preferred characteristics? To examine maternity roosts, we will capture and fit transmitters to lactating female bats across a gradient of MPB severity. We will track bats to individual roosts daily for roughly seven days and measure a suite of vegetative characteristics at both the tree-roost and stand levels. We

will deploy an array of acoustic detectors across the MPB gradient to address the foraging component of this study. This work will allow us to build resource selection models to better inform management decisions pertaining to Montana's bats and forests.

Total Project Cost		$ 25,000.00
Beginning Balance – September 2016		25,000.00
Expenditures – September 2016 - December 2016		
Salaries and Benefits	789.86	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Tuition	0	
Repairs and Maintenance	0	
Total Spent		789.86
Balance		24,210.14
Waived IDCs		347.54

Effects of livestock grazing management on the ecology of sharp-tailed grouse, grassland birds, and their predators in mixed grass prairie habitats of Montana

Investigator
Lance McNew
Assistant Professor

Collaborator
Lorelle Berkeley
Montana Fish, Wildlife and Parks

Graduate Students
Megan Milligan, Ph.D.
Skyler Vold, M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W5907

Duration
February 2016 – June 2020

Rangelands used for domestic cattle grazing consist of the largest remaining tracts of native grassland that have not otherwise been fragmented by agricultural use or other human development. Grazing is the predominant land use across western North America and livestock grazing directly affects the structure, composition, and productivity of native grasslands. Thus, grazing management within these rangelands has a significant effect on the quality and extent of wildlife habitat. This project aims to evaluate the effects of various grazing systems on the ecology of sharp-tailed grouse (*Tympanuchus phasianellus*), grassland birds, and their predators, by examining the effects of rangeland management practices prescribed by the Montana Upland Game Bird Enhancement Program on private lands in relation to the management systems employed on surrounding lands not enrolled in conservation easements. Specifically, this project will look at the effects of different grazing systems on sharp-tailed grouse nesting ecology, survival, and space use to determine if the management guidelines recommended by Montana Fish, Wildlife and Parks (FWP) are having an effect on grouse populations. This project will examine the ecological effects of various grazing treatments by examining abundance and space use of the grassland bird and meso-predator assemblages within the study site. WE will thereby evaluate whether Montana FWP management guidelines are recommending the grazing system with the greatest benefit to grassland wildlife.

Total Project Cost		$ 274,625.00
Beginning Balance – January 2016		140,375.00
Additional Funding – 2016		134,250.00
Expenditures – February 2016 - December 2016		
Salaries and Benefits	63,175.34	
Contracted Services	525.37	
Supplies	43,018.37	
Communications	162.15	
Travel	975.07	
Rent	4,500.00	
Repairs and Maintenance	6,301.06	
Tuition		
Total Spent		118,657.36
Balance		155,967.64
Waived IDCs		52,209.24

Grouse food insect, pollinator, and dung beetle ecology - grazing

Investigator
Hayes Goosey
Assistant Research Professor

Collaborators
Lorelle Berkeley, John Ensign
Melissa Foster
Montana Fish, Wildlife and Parks
Marni Rolston, MSU Animal and Range Sciences

Duration
May 2016 – June 2021

Funding
Montana Fish, Wildlife and Parks
MSU index 4W6068

Our study sites are in central and eastern Montana. At each location, we are examining the effects of livestock grazing on the arthropod assemblage as it relates to sage-grouse and sharp-tailed grouse management; however, our primary research objective is investigating, in the larger context, if arthropod assemblage structure is associated with rangeland management. We are investigating two grazing programs: the NRCS Sage-Grouse Initiative (SGI) rest-rotational program in central Montana and the Montana Department of Fish, Wildlife and Parks three-pasture rest-rotation program on the Buxbaum ranch in eastern Montana. Our field efforts this year consisted of collecting arthropod samples focusing on 1) ground dwelling grouse food items, 2) vegetation dwelling food items, 3) rangeland pollinators, and 4) dung beetles. We collected 4 sets of arthropod samples at 21 locations over 10-week period resulting in 840 samples. These samples will yield about 20,000 specimens for identification. We have completed processing a portion of our samples and here present preliminary results.

In general, our results suggest grazing management may have large effects on vegetation structure and arthropods. Lands enrolled in SGI grazing systems are managed for cow/calf production and are comprised primarily of sage-brush steppe habitats. The LMWR comprises three units, and livestock grazing was removed from the largest unit over a decade ago. During 2012-2015, vegetation and food arthropod sampling occurred in SGI grazed and deferred pastures and on the Lake Mason National Wildlife Refuge (LMWR). Analysis of vegetation data revealed that LMWR lands were characterized by more litter cover, less bare ground, and higher vegetation than surrounding grazed land. A detrended correspondence analysis of family level diversity of arthropods between pastures in SGI grazing systems and LMWR lands also indicated that differences exist between these land use strategies.

Our results are also suggesting differences in arthropod functional groups as a function of livestock grazing. More specifically, lands that are idle from grazing contain higher relative abundances of predatory spiders and detritivores. Greater levels of plant detritus explain these differences in that with the removal of grazing, more plant thatch (dried growth from previous growing season) predominates the landscape. This

provides a food source for detritus consuming insects but also provides ambush sites for predatory Lycosid spiders. In areas with less plant detritus (i.e., livestock grazed areas), Gnaphosid spiders dominate the predatory guild. Furthermore, our results suggest that dung feeding beetles are more abundant in livestock idle areas. At first this seems counter-intuitive in that dung-feeding insects should be greatest in number in areas with abundant cattle dung. However, this is not the case, and we are interested in the cause of this as it may be due to pesticide residues in the cattle dung that cause dung feeding insect mortality and morbidity. Thus far, food arthropod abundance tends to be greater in livestock grazed pastures when compared to long-time idle pastures. We speculate this increase could be greater if dung beetle populations were more representative on agricultural lands because dung beetles are a major food source of grouse chicks.

Total Project Cost		$ 72,953.00
Beginning Balance – May 2016		72,953.00
Additional Funding – 2016		
Expenditures – May 2016 - December 2016		
Salaries and Benefits	54,393.62	
Contracted Services	180.88	
Supplies	3,362.91	
Communications		
Travel	3,327.72	
Rent		
Repairs and Maintenance	361.33	
Total Spent		61,626.46
Balance		11,326.54
Waived IDCs		27,115.64

Wolverine connectivity in Wyoming, Idaho, and Washington

Investigator
Andrew Hansen
Professor

Collaborators
Justin Gude, Robert Inman
Montana Fish, Wildlife and Parks

Graduate Student
Kathleen Carroll, Ph. D.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W6410

Duration
November 2016 – June 2018

Wolverines (*Gulo gulo*) occupy semi-isolated patches of high elevation public lands in low densities in the conterminous United States. Connectivity between these semi-isolated populations is essential to the persistence of this species for demographic and genetic purposes. Maintaining connectivity between wolverines presents several challenges: the scale that the wolverine metapopulation functions over is large (300 individuals in 4 states), connective habitat in valley bottoms is often privately owned land, core and connective wolverine habitats may shift in the future due to climate change and land-use change, and current models of wolverine connectivity do not account for climate change and land-use change. We will model changes in wolverine habitat suitability and connectivity under scenarios of climate and land-use change at three time intervals (present, 2030, 2050) to evaluate opportunities for conservation action across Montana, Idaho, Washington, and Wyoming. The project will develop the first integrated models capable of projecting snow dynamics, forest cover, and wolverine habitat suitability under IPCC future scenarios and forecasts of human land-use change. We will develop GIS layers representing natural and human features significant in predicting wolverine habitat, suitability, and connectivity and, at the conclusion of this effort, we will provide the data layers to land trusts, and government entities to help them achieve regional-level connectivity.

Total Project Cost		$ 112,984.00
Beginning Balance – November 2016		112,984.00
Expenditures – November 2016 - December 2016		
Salaries and Benefits	1,731.84	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Tuition	0	
Repairs and Maintenance	0	
Total Spent		1,731.84
Balance		111,252.16
Waived IDCs		762.01

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 2016		10,613.19
Additional Funding – 2016		0
Expenditures – January 2016 - December 2016		
Salaries and Benefits	0	
Contracted Services	0	
Supplies	0	
Communications	0	
Travel	0	
Rent	0	
Repairs and Maintenance	0	
Tuition	0	
Administrative Fee @ 6%	0	
Total Spent		0
Balance		10,613.19

MTCFRU service project account

Investigators

Alexander Zale
Unit Leader
Michael Lance
Graduate Student M.S.

Collaborators

Bradley B. Shepard
B. B. Shepard and Associates
Grant Grisak
Montana Fish, Wildlife and Parks

Duration

Ongoing

Funding

MT Fish, Wildlife and Parks
MSU Index 433309

This account manages non-grant work including consulting for data base development and student internships that the Montana Cooperative Fishery Research Unit performs in association with cooperators and collaborators.

Beginning Balance – January 2016		$ 5,524.17
Additional Funding – 2016 Montana Fish, Wildlife and Parks		4,950.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	0	
Contracted Services	800.00	
Supplies	3,245.61	
Communications	0	
Travel	3,237.84	
Rent	250.00	
Repairs and Maintenance	0	
Tuition	0	
Administrative Fee @ 6%	452.01	
Total Spent		7,985.46
Balance		2,488.71

MTCFRU Gift Account

Investigators

Alexander Zale
Unit Leader
Jason Marsh
Graduate Student M.S.

Funding

Eccles Foundation
$10,000
MSU Index 423077

Duration

Ongoing

This account manages support from foundations and NGOs for graduate students in the Cooperative Fishery Research Unit program.

Beginning Balance – January 2016		0
Additional Funding – 2016 Eccles Foundation		10,000.00
STIP Interest 2016		1.34
Expenditures – January 2016 - December 2016		
Salaries and Benefits	0	
Supplies	929.14	
Travel	0	
Repairs and Maintenance	0	
Tuition	0	
Total Spent		929.14
Balance		9,072.20

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 2016		$ 51,275.35
Expenditures – January 2016 - December 2016		
Repairs and Maintenance	15,516.17	
Fuel	12,035.93	
Insurance	3,286.13	
Supplies	427.64	
Administrative Assessment Fee @ 6%	1,875.94	
Total Spent		33,141.81
Total Revenue Reimbursed		43,574.56
Balance		61,708.10

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 2016		$ 47,111.93
Expenditures – January 2016 - December 2016		
Repairs and Maintenance	2,758.20	
Supplies	0	
Engine,transom,stern drive SeaArk	17,800.01	
Administrative Assessment Fee @ 6%	1,233.49	
Total Spent		21,791.70
Total Revenue Reimbursed		20,150.00
Balance		45,720.23

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 2016		$ 3,325.02
Expenditures – January 2016 - December 2016		
Salaries and Benefits	0	
Contracted Services	3,477.25	
Supplies	147.76	
Communications	935.38	
Travel (training)	0	
Rent (storage unit)	7,633.04	
Repairs and Maintenance	0	
Administrative Assessment Fee @ 6%	797.54	
Total Spent		12,990.97
Total Revenue from VPR		13,000.00
Balance		3,334.05

Monetary Equivalence for MSU Services and Facilities
January 2016 - December 2016

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 ($1,219,742)	9,757.94
Utilities - General @ 12% of total expenditures ($1,219,742)	146,369.04
Unit Operations Account	13,000.00
Waived IDCs	375,118.59
Total	**618,597.77**

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 2016		$ 57,896.31
Additional Funding – 2016		30,000.00
Expenditures – January 2016 - December 2016		
Salaries and Benefits	10,618.37	
Contracted Services	5,033.11	
Supplies	7,605.65	
Communications	392.03	
Travel	5,139.90	
Rent	0	
Repairs and Maintenance	8,105.41	
Tuition	395.85	
Equipment	8,269.43	
Total Spent		45,559.75
Balance		42,336.56

Federal Budget
January 2015 - December 2015

Salaries and Benefits	$ 352,841.20
Supplies	0
Total	$ 352,841.20

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

USGS

2016 Chevrolet Silverado 2500, 4x4 crew cab (white)
Property No. 434174 – Serial No.1GC1KUE80GF252052
Acquisition value $35,644
Mileage 20

2011 Ford F250 4×4 crew cab (green)
Property No. 433429 – Serial No 1FT7W2BTOBEA70586
Acquisition value $31,697.00
Mileage 51,426

2009 Chevrolet HHR (red)
Property No. 433291 – Serial No. 3GNBAADB4AS513678
Acquisition value $18,720.00
Mileage 28,944

2005 Chevrolet Silverado 2500, 4×4 crew cab (green)
Property No. 430750 - Serial No. 1GCHK23G15F926039 (2005)
Acquisition value $22,948.21
Mileage 110,762

2002 Chevrolet 4×4 Suburban (white)
Property No. 261052 - Serial No. 3GNGK26U52G249012
Acquisition value $31,988
Mileage 123,427

1999 Chevrolet 3/4-ton 4×4 pickup truck (white)
Property No. 252537 -- Serial No. 1GCGK24R9XF049122
Acquisition value $21,009
Mileage 163,909

1989 Chevrolet 4×4 Suburban (tan)
Property No. 261114 - Serial No. 1GNGV26K2KF176088

Acquisition value $15,766
Mileage 159,293

Leica S8APO Microscope
Serial No. B1407890
Acquisition value $6014 (2016)

2016 Honda BF-225 Outboard Motor
Serial No. BAGJ-1800419
Acquisition value $14,860 (2016)
For 2004 Wooldridge boat

Halltech Backpack Electrofisher
Serial No. B433MK5
Acquisition value $7,694 (2016)

Leica M165 C Stereomicroscope System
Serial No. 5766180
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 replaced 2016
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 32,239

2008 Ford Escape Hybrid 4WD (grey)
Property No. 132775
Serial No. 1FMCU59H78KA13346
Acquisition Value $26,553.65 (2007)
Mileage 41,743

2005 GMC Sierra 2500 crew cab truck (green)
Property No. 132353
Serial No. 1GTHK23G65F944780
Acquisition Value $24,463.00 (2005)
Mileage 139,071

2001 GMC 1/2 ton 4×4 extended cab truck (green)
Property No. 132228
Serial No. 2GTEK19T911227311
Acquisition Value $15,255.00 (2005)
Mileage 178,159

1999 Ford F250 4×4 crew cab (blue)
Property No. 125014

Serial No. 1FTNW21S8XEA98840
Acquisition Value $11,002 (2005)
Mileage 179,592

1999 Chevrolet 1/2 ton 4×4 extended cab truck (white)
Property No. 132229
Serial No. 2GCEK19T8X1144560
Acquisition Value $12,459.00 (2005)
Mileage 214,541

Smith-Root Backpack Electrofisher
Serial No. F01157
Acquisition value $8269 (2016)

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)