Montana Cooperative Fishery Research Unit

2015 Briefing Booklet

MONTANA COOPERATIVE
FISHERY RESEARCH UNIT

Coordinating Committee Meeting
Helena, Montana
15 April 2015

Personnel and Cooperators

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    Post-Doctoral Researcher
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    Research Scientist

Cooperators and Collaborators

Montana Fish, Wildlife and Parks
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    Mike Backes
    Caleb Bollman
    Grant Grisak
    Lauri Hanauska-Brown
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    Matt Jaeger
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Wildlife Conservation Society
Brad Shepard

Wyoming Game and Fish Department
Paul Gerrity
Rob Gipson
Mark Smith

Current Graduate Students Advised by Unit Faculty

Alex Anderson	M.S.
Jan Boyer	M.S.
Mike Duncan	Ph.D.
Carter Fredenberg	M.S.
Andrew Gilham	M.S.
Jeffrey Glaid	M.S.
Luke Holmquist	M.S.
Sean Lewandoski	M.S.
Austin McCullough	M.S.
Ann Marie Reinhold	Ph.D.
David Ritter	M.S.
John Syslo	Ph.D.
Nathan Thomas	M.S.
Brian Tornabene	M.S.
Brittany Trushel	Ph.D.
Patrick Uthe	M.S.

Current Graduate Students Advised by Cooperating Faculty

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

Research Technicians 2014

Jeff Eshelman	Patrick Luckenbill	Karin Neff
Lillie Giono	Paige Maskill	Janette Rounds
Leif Halvorson	Ryan McClure	Yuka Tsutsui
Nate Higginson	Aaron McGuire	Jonathan Wester
Blaine Leonard	Isaac Miller	Iain Nolen-Wethington

Graduate Students Receiving Degrees in 2014

Carter Fredenberg graduated with a M.S. in Fish and Wildlife Management and is working for the National Park Service in Glacier National Park as a Fisheries Biologist.

Brian Tornabene graduated with a M.S. in Fish and Wildlife Management and is currently working for Purdue University, Department of Forestry and Natural Resources, as an Extension Outreach Coordinator for state-endangered hellbender conservation.

Patrick Uthe graduated with a M.S. in Fish and Wildlife Management and is preparing manuscripts of his thesis chapters and applying for positions.

Ann Marie Reinhold graduated with a Ph.D. in Ecology and Environmental Sciences and is working for the Montana State University Department of Land Resources and Environmental Science as a post-doctoral research associate in the Montana State Fluvial Landscape Laboratory.

2014 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.

Phytoremediation and revegetation of highly salinized, emerging shorelines of Hailstone Basin National Wildlife Refuge consequent to reservoir dewatering by upslope water spreading and evaporation

Investigators

James W. Bauder, Professor
MSU Land Resources and
Environmental Sciences

Collaborators

Robert Dunn, Laura Smith
Westscape Native Plants
Nursery

Graduate Student

Russell Smith, M.S.

Project Duration

December 2009 – August 2014
Completed

Funding

U.S. Fish and Wildlife Service
USGS RWO 62
MSU index 4W2934

Hailstone National Wildlife Refuge, located about 3.5 miles northeast of Rapelje, Montana, is part of the Big Lake Complex, a large drainage area beginning with Hailstone Basin to the north and ending at the state-owned and managed Big Lake to the south. This complex is one of the most productive breeding grounds for migratory birds and waterfowl in central Montana. The refuge has also served in the past as a principal stop-over for migratory birds of the Intermountain and Central Flyways. Hailstone Refuge is in open shortgrass prairie country dominated by rocky outcroppings, small grassy hills, and a large alkaline playa, a remnant of dewatering the Refuge impoundment in 2011-2012. From about 1935 until 2008, an impoundment formed by a CCC-constructed rock × earthen dam, sporadically filled with rainfall, runoff, and snowmelt laden with geologically sourced dissolved salts—mostly sodium bicarbonate, sulfate and chloride. Dewatering left behind a salt-encrusted basin, devoid of much vegetation. Not only was the impoundment a hazardous environment for waterfowl, but in addition, the basin became a source of significant blowing salt dust and fine soil particles and air quality deterioration following dewatering.

In concert with the dewatering effort, the project reported here completed three objectives: 1) provide educational opportunities and training experience for collegiate students, 2) evaluate and implement various methods, mechanisms and plant communities for sustainable revegetation and reclamation of the perimeter areas, shoreline, and exposed lake-bottom sediments of Hailstone Basin National Wildlife Refuge, and 3) develop guidelines and recommendations for cost-efficient, sustainable revegetation and reclamation of salt and sodium affected basin sites. Several approaches to revegetation were attempted, ultimately leading to positive success in establishing both sustainable and colonizing plant communities along the eastern and western shorelines of the previously saltwater filled basin. The following summarizes the outcomes, guidelines, and recommendations for cost-efficient, sustainable revegetation.

Successful revegetation and reclamation is highly dependent on providing an abundant seed supply of locally adapted plant species; the species readily established and self-sustaining were Nuttall's alkali grass, Prush seepweed, red swampfire, inland saltgrass, tall and slender wheatgrass, foxtail barley, kochia, and squirrel tail.

Although not all of these species are considered desirable components of sustainable plant communities, each of these species played a valuable role in revegetation of this extremely saline environment; additionally, foxtail barley, kochia, squirrel tail, and puccinellia seed was naturally supplied and dispersed from existing plant communities along the lakebed shoreline.

Land surface manipulation, i.e., shallow furrowing or ridging, proved to be highly effective and strongly contributory to seedling establishment; congruent to the ridging is a quickly germinating species such as Suaeda, which effectively served as a 'nurse crop' for other newly germinated seedlings.

Installation of straw waddles, woven debris barriers, and snowfence for microclimate modification initially contributed to seedling establishment but served little beneficial purpose after plant communities had become established.

Timing of 'seeding' to capitalize on cool temperatures and adequate moisture to facilitate seed germination is critical; seed of desirable species must be applied in late autumn—l ate October and early November—during furrowing and ridging operations; surface seeded species, particularly Suaeda and puccinellia, must be seeded between early November and late March.

Large, conventional farm equipment or heavy land reclamation equipment or both proved to be of limited functionality with minimal contribution to successful surface manipulation and revegetation; smaller, shallow shovel or duckfoot-type ripping equipment, pulled with either a 4-wheel drive ATV or small 'hobby' tractor, equipped with floatation tires, provided ideal surface conditions for debris and snow trapping, seed placement, and seedling survival.

Much of the lakeshore and exposed lake-bottom sediments will naturally become revegetated with time, the dominant plant species being Suaeda, puccinellia, kochia, and inland salt grass. This natural revegetation will probably take 10 years or more. With adequate additional funding, revegetation of about 90% of the exposed lake-bottom sediments could be sustainably revegetated in 3-4 years.

Total Project Cost		$411,484.40
Beginning Balance – January 2014		$ 49,743.93
Expenditures – January 2014 - July 2014		
Salaries and Benefits	$ 22,179.02	
Contracted Services	$ 14,989.99	
Supplies	$ 1,296.76	
Communications	$ 145.73	
Travel	$ 330.76	
IDCs @ 15%	$ 5,841.40	
Total Spent		$ 44,783.66
Balance deobligated		$ 4,960.27
Waived IDCs		$ 11,293.19

A proposal to conduct an integrated analysis of Red Rock Creek and Upper Red Rock Lake historical Arctic grayling data

Investigator
Megan Higgs
Assistant Professor, MSU

Graduate Student
Terrill Paterson, M.S.

Collaborators
Matt Jaeger, Montana Fish, Wildlife and Parks
Kyle Cutting, Jeff Warren
Red Rock Lakes National Wildlife Refuge, U.S. Fish and Wildlife Service
Glenn Boltz, retired
U.S. Fish and Wildlife Service

Project Duration
June 2013 – July 2014

Funding
USGS RWO 69, MSU index 4W4448
Completed

Concerns about potential population declines and low survival of the last remaining native population of adfluvial Arctic grayling in contiguous U.S. at Red Rock Lakes National Wildlife Refuge motivated a long-term monitoring effort (1975 to present). The species is under review for potential listing under the Endangered Species Act. That decision requires estimates of abundance and survival. The 38-year legacy data set from the monitoring effort was used to estimate minimum abundances based on fish counts, along with estimates of both abundance and apparent survival based on mark-recapture methods intermittently applied over the years. The sampling design of the monitoring effort necessitated a simulation study to partially understand the degree of bias in abundance estimates resulting from spatially restricted sampling during electrofishing. Estimated abundances in the system range from a few hundred individuals (1995: 122, 95% confidence interval 101-154) to over 2,000 (2012: 2,535, 95% CI 2509-2545). Estimated annual apparent survival ranged from 0.15 in 1993-1994 (95% CI 0.05-0.28) to 0.82 in 1994-1995 (95% CI 0.49-0.99). Simulations suggest that abundance estimates are biased high and variable with low detection and spatially restricted sampling.

Total Project Cost		$ 17,248.00
Beginning Balance – January 2014		$ 1,188.56
Expenditures – January 2014 - July 2014		
Salaries and Benefits	$ -0-	
Supplies	$ -0-	
Travel	$ 255.30	
IDCs @ 15%	$ 38.26	
Total Spent		$ 293.56
Balance deobligated		$ 895.00
Waived IDCs		$ 74.07

Limiting factors, thermal refuges, and connectivity in the Smith River system
(aka Tenderfoot Creek—Bair Ranch Foundation Fisheries Research)

Investigators
Alexander Zale
Unit Leader, MTCFRU

Graduate Student
T. David Ritter, M.S.

Project Duration
July 2009 – December 2015

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

Funding
Montana Fish, Wildlife and Parks
MSU index 4W2688, 4W4785

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 mainstem river and its tributaries would be beneficial to the fishery. 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 evaluate the importance of pristine, coldwater tributaries to salmonid populations of montane river basins. 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 moving into Tenderfoot Creek proper to use it as a temporary thermal refuge. However, such use probably occurred in the Smith River in the thermal plume of Tenderfoot Creek below the confluence. Large, presumably dominant Brown Trout established permanent territories within Tenderfoot Creek and may have dissuaded habitation by conspecifics during thermally stressful periods. 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. Spawning effort by Mountain Whitefish and rainbow × cutthroat hybrid trout was high; about 7,500 Mountain Whitefish were observed in spawning aggregations in autumn and over 25,000 juvenile rainbow × cutthroat hybrid trout used the tributary as a nursery area. 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 migratory Smith River fishes for spawning; maintaining its connectivity, and that of other tributaries, may therefore be vital to successful recruitment.

Total Project Cost		$212,322.74
Beginning Balance - January 2014		$ 29,053.31
Additional funding – 2014		$ 67,319.74
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 38,802.39	
Contracted Services	$ 161.99	
Supplies	$ 12,861.03	
Communications	$ -0-	
Travel	$ 3,091.80	
Rent	$ 9,480.48	
Repairs Maintenance	$ 1,098.06	
Tuition	$ 2,842.55	
Total Spent		$ 68,338.30
Balance		$ 28,034.75
Waived IDCs		$ 30,068.85

Effects of abiotic and biotic factors on life history characteristics and vital rates of Yellowstone cutthroat trout in a headwater basin

Investigators

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

Collaborators

Jeffrey Kershner, USGS, Northern Rocky Mountain Science Center
Rob Gipson, Wyoming Game and Fish Department

Graduate Student

Patrick Uthe, M.S.

Project Duration

March 2012 - June 2014
Completed

Funding

U.S. Geological Survey, Priority Ecosystems Science Program, RWO 67**,** MSU indexes 4W3919, 4W4253 4W4532

The Yellowstone Cutthroat Trout was historically distributed throughout the Upper Yellowstone and Upper Snake River drainages, but now occupies only 42% of its original range because of habitat degradation and introduced salmonid species. Many of the current strongholds are located on public land in mountainous watersheds with low human disturbance. However, knowledge of life history characteristics of headwater populations is limited. Moreover, streams throughout the Rocky Mountains have already exhibited symptoms of climate change through alterations in thermal and hydrologic regimes, but it is unknown how these changes will affect fish populations. To address these needs, we implemented a mark-recapture study on five populations of trout from Spread Creek, Wyoming, and Shields River, Montana, to estimate annual growth, survival rates, and movement patterns, and document the effects of discharge, temperature, and food availability on summer growth patterns. Survival rates were high compared to survival rates of other Cutthroat Trout subspecies and large trout generally had lower survival rates than small trout. Downstream movements out of streams by tagged trout were substantial. Annual growth rates varied among streams and size classes, but were relatively low compared to populations of Yellowstone Cutthroat Trout from large, low elevation streams. Trout grew more in length than weight in summer, suggesting an investment in structural growth rather than accumulation of reserve tissues. Temperature and discharge had strong effects on summer growth, but the effect of discharge was greater for growth in weight than in length, probably resulting from increased prey availability at high discharges. Temperature interacted with fish length such that small trout responded favorably to increased average daily temperatures near physiological optima and increased growing season length, whereas large trout responded negatively to warming temperatures. These estimates of key demographic parameters are useful in developing management and conservation strategies. Additionally, we documented that even under thermally suitable conditions, discharge can have significant effects on growth, making it important to consider multiple factors affected by climate change when devising climate adaptation strategies for coldwater fishes.

Total Project Cost		$ 83,034.00
Beginning Balance – January 2014		$ 11,408.74
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 9,302.93	
Supplies	$ 472.00	
Communications	$ -0-	
Travel	$ 129.47	
Tuition	$ -0-	
IDCs @ 15%	$ 1,504.34	
Total Spent		$ 11,408.74
Balance		$ -0-
Waived IDCs		$ 2,853.60

Grazing effects on stream fish assemblages on Blackfeet Nation lands

Investigators

Alexander Zale
Unit Leader, MTCFRU
Bradley Shepard
Wildlife Conservation Society

Collaborators

Robert Bramblett, MSU
Andrea Litt, MSU
Keith Tatsey, Blackfeet Community College

Graduate Student

Andrew Gilham, M.S.

Funding

Wildlife Conservation Society
MSU index 423187

Project Duration

June 2012 – December 2014

Livestock grazing is the most common land-use practice in the western United States. However, riparian and stream habitats are particularly susceptible to degradation from 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 predated assessments of fish populations and stream habitats, before and after comparisons are impossible. Moreover, the spatial and temporal complexity of livestock grazing make it difficult to isolate its effects on instream habitat and channel morphology characteristics, which are also influenced by inherent watershed characteristics (basin area, gradient, discharge). We assessed the effects of livestock grazing on 10 headwater streams (1400 to 1585 m in elevation) 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, and instream cover as well as trout biomass before and after accounting for inherent watershed and habitat variation. A significant positive relationship existed between scat counts and proportion fine sediment ($P < 0.001$). A linear mixed-effect model with random effects of stream and sampling year detected a negative relationship between scat count and estimated trout biomass ($P = 0.01$) as did an additive linear mixed model ($P = 0.008$). Our results corroborate previous findings of livestock grazing suppressing trout biomasses but the primary mechanism driving observed trout biomasses remains unclear.

Total Project Cost		$ 43,646.76
Beginning Balance – January 2014		$ 17,623.85
STIP interest 2014		$ 11.69
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 10,757.70	
Supplies	$ 525.27	
Travel	$ -0-	
Tuition	$ 2,665.00	
Total Spent		$ 13,947.97
Balance		$ 3,687.57

Spatial and temporal dynamics of the queen conch stock at Turneffe Atoll, Belize

(aka Turneffe Atoll Trust student support)

Investigators

Alexander Zale
Unit Leader, MTCFRU
Robert Bramblett
Assistant Research Professor

Collaborators

Leandra Cho-Ricketts,
Environmental Research Institute
University of Belize
Craig Hayes, Turneffe Atoll Trust

Graduate Student

Alex Anderson, M.S.

Funding

Turneffe Atoll Trust
MSU index 423192

Project Duration

August 2012 – December 2014

In support of sustainable management of the Turneffe Atoll Marine Reserve (TAMR), we are assessing the current status of the atoll's queen conch population and developing analytical techniques for monitoring its response to management. Our specific objectives are to 1) produce a baseline assessment of current conch distribution, abundance, and size structure at TAMR, and 2) develop a monitoring plan to detect specified levels of change in conch stock abundance. Quantification of the spatial variability in conch abundances will allow completion of a statistical power analysis to determine the location and number of transect samples needed to monitor future conch population dynamics at TAMR. Conch were sampled from May through August and in December 2013 and January 2014 at sites selected using a stratified-random design.

Conch were counted along four parallel 50 m long × 4 m wide transects at each site by two scuba divers following the Long-term Atoll Monitoring Program (LAMP) protocol. A total of 213 sites was sampled among the five geozones: North 81, Northeast 30, Southeast 25, Southwest 44, and Northwest 33. The distribution among habitat types was bare sand 6, sand and sparse algae 22, sparse seagrass 31, medium seagrass 52, dense seagrass 49, sparse patch reef 8, sparse massive coral 9, dense massive coral 23, and spur and groove 13. A total of 2,383 conch of various sizes was sampled. Densities varied greatly within and among habitat types and geozones; highest densities were in the North, followed by the Southwest, Northeast, Southeast and Northwest. The most conch found at a site was 383, but many sites (87) had no conch. Conch were sampled at depths of 0 to 23.5 m (0 to 77 feet). The largest conch was 10.4 inches long. The greatest lip thickness was 28.3 mm. Although sample sites were stratified among habitat types based on existing GIS shapefiles, significant discrepancies existed between expected and observed habitat types. Video imagery collected during the transects was examined to correct discrepancies. Analyses are ongoing.

Total Project Cost		$ 46,211.00
Beginning Balance – January 2014		$ 17,954.67
STIP interest - 2014		$ 9.36
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 15,324.15	
Supplies	$ 136.64	
Travel	$ -0-	
Tuition	$ -0-	
Total Spent		$ 15,460.79
Balance		$ 2,503.24

Suppression of lake trout in Quartz Lake, Glacier National Park

Investigators

Christopher Guy
Assistant Unit Leader, MTCFRU
Clint Muhlfeld
USGS Northern Rocky Mountain Science Center

Graduate Student

Carter Fredenberg, M.S.
Completed

Collaborator

Chris Downs
National Park Service

Funding

USGS Northern Rocky Mountain Science Center

Project Duration

January 2011- December 2013

Prior to the recent invasion of non-native lake trout *Salvelinus namaycush*, Glacier National Park (GNP) supported about one-third of the remaining natural lake habitat supporting threatened bull trout *Salvelinus confluentus*. However, bull trout populations have recently declined and are at high risk of extirpation in several lakes in western GNP because of the establishment of lake trout. In 2009, the U.S. Geological Survey and the National Park Service began suppressing lake trout in Quartz Lake (352 ha) to reduce effects on native bull trout. The objectives of this study were to 1) describe the demography of the lake trout population during the suppression program (2009-2013), 2) identify the timing and location of lake trout spawning, 3) determine the most efficient combination of gill net mesh color and twine diameter to capture juvenile lake trout (age 2 to age 4), 4) assess the effects of suppression on the growth rate of the lake trout population and use this information to model harvest scenarios, and 5) determine whether suppression negatively affected bull trout. Lake trout exhibited slower growth, lower condition, and lower fecundity relative to other populations. Spawning locations were identified on cobble and boulder substrates (depths 2-20 m) near the base of two avalanche chutes where adults began aggregating between 1 and 9 October prior to thermal destratification (11-12 C°). Catch rates of spawning (ripe) adults were highest from 12 October through 25 October when temperatures declined to below 10 C°. Gill nets with 0.1 mm twine thickness and green color increased catchability of juvenile lake trout. Although density dependent parameters were not included, population simulation models indicated the population was growing exponentially and would probably reach carrying capacity within ten years without suppression. Suppression resulted in declining population growth rates (λ) from 1.23 prior to suppression to 0.61-0.79 during suppression. Bull trout redd abundances remained stable throughout the suppression period. Targeted suppression successfully reduced lake trout abundance and continued suppression at or above observed exploitation levels is needed to ensure continued population declines and to avoid effects on the bull trout population.

Lake trout suppression in Yellowstone Lake: developing benchmarks for harvest and a sampling design to measure efficacy

Investigator
Christopher Guy
Assistant Unit Leader, MTCFRU

Collaborators
Todd Koel and Patricia Bigelow
National Park Service

Graduate Student
John Syslo, Ph.D.

Funding
USGS RWO 63
National Park Service
MSU index 4W2997

Project Duration
February 2010 - June 2014
Continuing into next project

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 were used to assess the efficacy of the lake trout suppression program and quantify targets for exploitation and fishing effort. A large increase in fishing effort in 2014 resulted in high lake trout mortality and probably suppressed lake trout population growth. In 2014, fishing effort was 74,500 100-m net nights, which exceed the recommended target of 45,000 100-m net nights. The fishing effort in 2014 resulted in an instantaneous fishing mortality of 1.12 (0.98-1.26; 95% CI) and a population growth rate of 0.63 (0.44-0.82). Thus, lake trout abundance is predicted to decline if the amount of fishing effort in 2014 is maintained.

Total Project Cost		$102,770.00
Beginning Balance – January 2014		$ 8,372.35
Expenditures – January 2014 - June 2014		
Salaries and Benefits	$ 6,505.20	
Supplies	$ -0-	
Travel	$ -0-	
Tuition	$ 775.10	
IDCs @ 15%	$ 1,092.05	
Total Spent		$ 8,372.35
Balance		$ -0-
Waived IDCs		$ 2,111.28

Annual evaluation and development of benchmarks for lake trout suppression in Yellowstone Lake (continuation of previous project)

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

Project 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. A large increase in fishing effort in 2014 resulted in high lake trout mortality and probably suppressed lake trout population growth. In 2014, fishing effort was 74,500 100-m net nights, which exceed the recommended target of 45,000 100-m net nights. The fishing effort in 2014 resulted in an instantaneous fishing mortality of 1.12 (0.98-1.26; 95% CI) and a population growth rate of 0.63 (0.44-0.82). Thus, lake trout abundance is predicted to decline if the amount of fishing effort in 2014 is maintained.

Total Project Cost		$ 85,165.00
Beginning Balance – January 2014		$ 85,165.00
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 13,361.01	
Contracted Services	$ 592.00	
Supplies	$ 275.48	
Travel	$ -0-	
Tuition	$ 2,653.41	
IDCs @ 15%	$ 2,954.32	
Total Spent		$ 19,836.22
Balance		$ 65,328.78
Waived IDCs		$ 4,473.72

Estimate density of lake trout vulnerable to capture in trap nets using mark-recapture methods appropriate to sampling design

Investigators

Jay Rotella
MSU Professor
Christopher Guy
Assistant Unit Leader, MTCFRU

Collaborators

Todd Koel, National Park Service
Pat Bigelow, National Park Service

Project Duration

June 2012 – December 2015

Funding

National Park Service, CESU
MSU index 4W4058

From June 3, 2013 through October 17, 2013, lake trout ≥ 210 mm were captured in Yellowstone Lake in gill nets and trap nets. Data from these fish were used in a mark-recapture analysis to estimate abundance using closed mark-recapture models. Abundance estimation was conducted for fish in four length classes: (1) 210-450 mm, (2) 451-540 mm, (3) 541-610 mm, and (4) > 610 mm. Abundance was estimated by using capture-recapture and removal data to estimate capture probability of fish in each length class by day. A set of competing models of capture probability was evaluated, and the model(s) that were best supported by the data were used to provide estimates of abundance for the population. Model-selection results provided strong evidence that daily capture probability varied by length class of fish, effort expended by gear type, and the previous capture history of a fish. The best-supported model included interactions between effort by each gear type and length class, which allowed effort for each of the different gear types to have different relationships with capture probability for different length classes. Evaluation of goodness-of-fit by examination of residual errors between the observed number of daily captures in each length class and the expected number based on the best-supported model did not indicate any serious problems with lack of fit. Resulting estimates of abundance and accompanying standard errors were as follows: 303,484 (SE = 22,350) fish in the 210-450 mm length class; 41,288 (SE = 4,456) fish in the 451-540 mm length class; 17,278 (SE = 4,456) fish in the 541-610 mm length class; and 5,601 (SE = 812) fish in the > 610 mm length class. Based on these estimates and the number of individual fish caught in each length class, estimated exploitation rates along with accompanying 95% confidence intervals were as follows: 0.72 (0.63-0.84) for fish in the 451-540 mm length class; 0.56 (0.46-0.71) for fish in the 451-540 mm length class; 0.48 (0.38-0.66) for fish in the 541-610 mm length class, and 0.45 (0.35-0.63) for fish in the > 610 mm length class. The estimate for fish 210-451 mm in length may not fully represent all fish in the length class. The extent to which the estimates may underestimate abundance and overestimate exploitation rate depends on gear selectivity for the smallest length class.

Use of mobile electrofishing to induce mortality in lake trout embryos in Swan Lake

Investigator
Christopher Guy
Assistant Unit Leader, MTCFRU

Post-Doctoral Researcher
Peter Brown

Collaborators
Leo Rosenthal
Joel Tohtz
Montana Fish, Wildlife and Parks

Project Duration
July 2011 – June 2014
Completed

Funding
Montana Fish, Wildlife and Parks
MSU index 4W3625, 4W4157
4W4530

An apparent rapid increase in the abundance of nonnative lake trout has occurred in Swan Lake, which is of concern to state, federal, tribal, and private entities because Swan Lake contains one of the most stable bull trout populations in Montana. Consequently, an experimental lake trout suppression program has been initiated in Swan Lake that targets juvenile and adult lake trout. Targeting lake trout embryos may be a complementary and effective method for suppressing lake trout. Exposure of fish embryos to voltage gradients in the upper range of those produced by electrofishing equipment has been shown to result in mortality. However equipment does not exist to increase mortality of embryos. We tested a grid of electrodes electrified for 60 s with 15 amps of direct current at 1000 V. Embryos were pre-positioned in spawning areas, electrodes were lowered from a pontoon boat and electrified using standard electrofishing equipment. Embryo mortality was 100.00% (± 0.00%) at the surface of the substrate, 99% (± 2%) in embryos buried 5 cm deep, 99% (± 1%) in embryos buried 10 cm deep, and 98% (±3 %) in embryos buried 20 cm deep. Average mortality in the controls (embryos placed in spawning areas but not exposed to electricity) was 8% (± 5%). Mortality in treatment groups differed significantly from the control (Kruskal–Wallis statistic, $H = 63.6$, df = 4, $P \leq 0.001$). The portable grid of electrodes was effective in causing high mortality of lake trout embryos. The equipment should be used to supplement ongoing gillnetting operations for overall population suppression, and could be used thereafter for continued population suppression. Modifications to the electrode array, or to the electric waveforms used, could make the array effective in causing high mortality of larval and juvenile life stages.

Total Project Cost		$255,046.00
Beginning Balance – January 2014		$ 40,706.74
Expenditures – January 2014 - June 2014		
Salaries and Benefits	$ 28,914.33	
Contracted Services	$ -0-	
Supplies	$ 10,261.68	
Travel	$ 1,530.73	
Repair and Maintenance	$ -0-	
IDCs @ 0%	$ -0-	
Total Spent		$ 40,706.74
Balance		$ -0-
Waived IDCs		$ 17,910.97

Electroshocking to induce mortality of lake trout embryos in Yellowstone Lake

Investigator
Christopher Guy
Assistant Unit Leader

Collaborator
Todd Koel
Yellowstone National Park

Post-Doctoral Researcher
Peter Brown

Funding
National Park Service, CESU
MSU index 4W4471

Project Duration
July 2013 – June 2015
Completed

This research project was initiated because of preliminary findings from research conducted in Swan Lake, Montana (see above). The research in Swan Lake (2011-2012) suggested that an electrode array could induce high mortality in lake trout embryos. In 2013, two electrode arrays ware developed, one for Swan Lake, Montana, and another for Yellowstone Lake, Yellowstone National Park. Unfortunately, evaluation of the efficacy of the electrode array at Carrington Island in Yellowstone Lake could not be accomplished because of the Federal Government shutdown in the autumn of 2013. Thus, the research targeted for Yellowstone Lake was conducted in Swan Lake and the results are presented in the abstract above.

Total Project Cost		$ 39,147.00
Beginning Balance – January 2014		$ 21,094.13
Expenditures – January 2014 - November 2014		
Salaries and Benefits	$ 14,596.78	
Contracted Services	$ -0-	
Supplies	$ 936.98	
Travel	$ 1,431.45	
Rent	$ 999.65	
Repair & Maintenance	$ -0-	
IDCs @ 17.5%	$ 3,129.27	
Total Spent		$ 21,094.13
Balance		$ -0-
Waived IDCs		$ 4,775.27

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

Project 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. The electrofishing grid was also developed for the National Park Service, Yellowstone Lake, but never implemented because of the Federal Government shutdown in autumn 2013. Part of this project will be to experimentally evaluate the efficacy of the electrofishing grid in Yellowstone Lake. In addition, suction dredging and tarping spawning areas will be evaluated as novel methods for inducing mortality in lake trout embryos.

Total Project Cost		$128,852.00
Beginning Balance – July 2014		$128,852.00
Expenditures – July 2014 - December 2014		
Salaries and Benefits	$ 5,429.72	
Contracted Services	$ 465.00	
Supplies	$ 2,463.78	
Travel	$ 495.04	
Repair & Maintenance	$ -0-	
Tuition	$ 3,681.55	
IDCs @ 17.5%	$ 2,193.64	
Total Spent		$ 14,728.73
Balance		$114,123.27
Waived IDCs		$ 3,321.80

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
David Trimpe
Bureau of Reclamation

Graduate Student
Luke Holmquist

Funding
Bureau of Reclamtion
MSU index 4W4723

Project Duration
January 2014 – June 2017

Pallid sturgeon *Scaphirhynchus albus* 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. Whether stocked pallid sturgeon will reproduce or have similar behavior as wild-born pallid sturgeon during spawning migrations is unknown. The wild hatchery-reared (WHR) pallid sturgeon are reaching sexually maturity, which provides the opportunity to study how the reproductive behavior of mature WHR pallid sturgeon compares to wild born pallid sturgeon.

The objectives of this study are to 1) determine age and size of WHR pallid sturgeon at first sexual maturity, 2) determine the spawning periodicity of WHR pallid sturgeon, 3) determine if mature WHR pallid sturgeon use habitat and move similarly to wild-born adult pallid sturgeon, 4) determine if experimental discharge releases from upstream reservoirs provide a cue for pallid sturgeon to migrate further upstream during spawning migrations, and 5) locate spawning sites. To accomplish these objectives, six wild-born adults and 28 WHR pallid sturgeon have been implanted with radio transmitters and sampled for blood plasma sex steroid concentrations. Blood plasma sex steroid analysis shows that five of the 28 WHR pallid sturgeon have been identified as mature males. In 2014, a wild born reproductively active female was intensively followed in an attempt to locate a spawning site. The female moved a minimum of 552 km between peak discharge and when water temperature reached 24°C (5 June to 5 July), but when the female was recaptured she still contained her eggs. Histological analysis of eggs and sex steroid analysis did not reveal that the fish had undergone atresia prior to 4 July. The female will be recaptured in spring 2015 to determine if she underwent follicular atresia or spawned after the tracking period. Additional fish will be implanted with radio transmitters and tracked along with previously tagged fish in the spring and early summer of 2015 and 2016.

Total Project Cost		$101,678.63
Beginning Balance – January 2014		$101,678.63
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 22,393.49	
Contracted Services	$ 109.99	
Supplies	$ 14,547.03	
Travel	$ 5,647.05	
Rent	$ 12,000.00	
Maintenance	$ 938.74	
Tuition	$ 5,067.35	
IDCs @ 17.5%	$ 10,623.18	
Total Spent		$ 71,326.83
Balance		$ 30,351.80
Waived IDCs		$ 16,086.43

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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Assistant Unit Leader, MTCFRU
Wyatt Cross
Assistant Professor, Ecology
Jay Rotella
Professor, Ecology

Graduate Students

Eric Scholl, Ph.D.
Brittany Trushel, Ph.D.

Collaborators

Lee Nelson
Montana Fish, Wildlife and Parks

Funding

Montana Fish, Wildlife and Parks
MSU index 4W4311

Project 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, growing concern exists among biologist that they have stocked too many pallid sturgeon, thereby 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 to 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. Capture-recapture models will be used to estimate abundance of pallid sturgeon. Habitat specific estimates of macroinvertebrate and small fish production will be combined with large-scale habitat quantification to estimate the amount of macroinvertebrate and small fish production that is potentially available for fish consumers over large reaches. Additionally, quantitative diets of the most abundant fish species in each trophic guild will be used to estimate the energetic demand of the fish assemblage. Combining supply and demand approaches will allow us to create quantitative food-webs to assess the amount of energy available to the current pallid sturgeon population after accounting for major consumers in the ecosystem. These results will be used to better manage pallid sturgeon by informing future stocking recommendations.

Total Project Cost		$ 252,157.00
Beginning Balance - January 2014		$ 19,009.66
Additional Funding 2014		$ 136,167.00
Expenditures - January 2014 - December 2014		
Salaries and Benefits	$ 62,528.13	
Contracted Services	$ -0-	
Supplies	$ 10,320.75	
Communications	$ 21.96	
Travel	$ 16,072.90	
Rent	$ 8,482.00	
Maintenance	$ 2,509.37	
Tuition	$ 11,768.25	
IDCs @ 0%	$ -0-	
Total Spent		$ 111,703.36
Balance		$ 43,473.30
Waived IDCs		$ 49,149.48

Spawning of pallid sturgeon and shovelnose sturgeon in an artificial stream

Investigator
Christopher Guy
Assistant Unit Leader, MTCFRU
Kevin Kappenman, Molly Webb
U.S. Fish and Wildlife Service

Collaborator
Greg Watson
U.S. Fish and Wildlife Service

Project Duration
May 2011 – July 2014
Completed

Funding
U.S. Fish and Wildlife Service SSP
USGS RWO 66
MSU index 4W3528

Understanding the spawning behavior and spawning habitat requirements of shovelnose sturgeon affected by regulated rivers is necessary to inform fishery management actions directed at maintaining and recovering shovelnose sturgeon populations. Shovelnose sturgeon spawning was studied in an artificial river at the Bozeman Fish Technology Center from 2011–2014. Spawning trials performed in 2011 focused on developing methodology and describing the spawning behaviors of shovelnose sturgeon. Spawning duration varied from 3 to 18 h (defined as the shortest and longest periods from first oviposit to final oviposit for an individual female). Spawning bouts or coupling lasted 2-3 seconds. About 50 individual spawning bouts or couplings occurred for each female. Hundreds to thousands of eggs were released during each spawning bout. Courtship and mating behaviors of shovelnose sturgeon included polyandrous and polygynous mating and a single couple per spawning bout. Additionally, shovelnose sturgeon were observed to spawn over gravel (2-64 mm) and cobble substrate (65-256 mm), spawned in close proximity to the substrate (0-18 cm), and the majority of eggs released by a female attached to the substrate a few meters downstream of the spawning site. Spawning trials performed in 2012-2014 examined microhabitat characteristics (water velocity and substrate) connected to spawning site selection. Preliminary analysis showed shovelnose sturgeon spawning site selection was influenced by water velocity. Water velocities available in the living stream were characterized for each individual trial. Manly selection ratios and chi-squared log likelihood selection ratios indicated that shovelnose sturgeon did not select velocities in proportion to availability. Substrate and velocity influenced site selection. Understanding the behavioral ecology of sturgeon spawning will help river managers determine how controlled flow regimes might be best used (e.g., timing and magnitude) to promote spawning and recruitment. The information collected on shovelnose sturgeon may have management applications that can also be used to aid in the recovery of pallid sturgeon.

Total Project Cost		$107,840.00
Beginning Balance – January 2014		$ 16,726.52
Expenditures – January 2014 - July 2014		
Salaries and Benefits	$ 14,253.69	
Contracted Services	$ 63.00	
Supplies	$ 108.39	
Travel	$ 119.52	
IDCs @ 15%	$ 2,181.92	
Total Spent		$ 16,726.52
Balance		$ -0-
Waived IDCs		$ 4,217.70

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

Investigators

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

Collaborators

Brad Cady, Brad James
Washington Department of Fish and Wildlife

Project Duration

October 2006 – September 2015

Funding

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

During 1 April through 31 December 2012, Montana State University and U.S. Fish and Wildlife Service researchers collected gonadal biopsies from adult white sturgeon in Bonneville Reservoir with the Washington Department of Fish and Wildlife. The objective of this research is 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 first year in this study area. The white sturgeon were caught by set-line (n = 79). Gonadal tissue was collected by biopsy, and the gonad samples were processed histologically. In 2012, a total of 93 fish were handled during the season (June-August), 79 of which were new fish to the study, and 14 of which were handled twice or more in the season (i.e., within season recapture). A total of 79 gonad samples were collected for histological analysis from white sturgeon in Bonneville Reservoir. Of the 79 gonad samples, 43 were collected from females, 32 were collected from males, and 4 samples did not contain germ cells. The reproductive structure of the adult white sturgeon population in Bonneville Reservoir was determined using the 2012 data. Of the females (n = 43), 68% were pre-vitellogenic (Stages 1 and 2), 28% were vitellogenic (Stages 3 and 4), 2% were post-vitellogenic or ripe (Stage 5), 0% were postovulatory (Stage 7), and 2% were undergoing follicular atresia (Stage 8). Of the males (n = 32), 78% were pre-meiotic (Stage 2), 6% were mid-spermatogenic (Stage 3 and 4), 0% were spermiating (Stage 5), and 16% were post-spermiation (Stage 6). There were proportionally less than half of the actively reproducing females (post-vitellogenic or ripe, post-ovulatory, and undergoing follicular atresia) in Bonneville Reservoir (4%) compared to below Bonneville Dam where about 10% 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 (16%) compared to below Bonneville Dam (18%). The sex ratio of the adult white sturgeon population in Bonneville Reservoir using the 2012 data was 1:1.2 males to females.

Total Project Cost		$ 77,289.00
Beginning Balance - January 2014		$ 11,295.00
Additional Funding – 2014		$ 9,247.00
Expenditures - January 2014 - December 2014		
Salaries and Benefits	$ 6,627.92	
Supplies	$ 893.72	
Travel	$ 3,977.59	
Rent	$ 3,983.12	
IDCs @ 44%	$ 5,059.65	
Total Spent		$ 20,542.00
Balance		$ -0-
Waived IDCs		$ -0-

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

Investigators

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

Funding

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

Project Duration

June 2011 – August 2015

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 sturgeons and sustained production of high quality sturgeon caviar. The aquaculture farms in California and Idaho are used to conduct a collaborative study, with participation of four states and four sturgeon farms, aimed at investigating these effects on the ovarian adiposity, roe yield, and caviar quality in farmed sturgeon. 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 2014		$ 47,922.54
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 9,320.55	
Contracted Services	$ -0-	
Supplies	$ 1,535.77	
Travel	$ 3,180.47	
IDCs @ 0%	$ -0-	
Total Spent		$ 14,036.79
Balance		$ 33,885.75
Waived IDCs		$ 6,176.19

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

Investigator
Christopher Guy
Assistant Unit Leader, MTCFRU

Graduate Student
Sean Lewandoski, M.S.

Project Duration
July 2011 – June 2015

Collaborators
Mark Smith
Paul Gerrity
Wyoming Game and Fish Department

Funding
Wyoming Game and Fish Department
MSU index 4W3554

In the Wind River drainage, burbot are a popular sport fish and an important cultural resource for the Eastern Shoshone and Northern Arapahoe tribes. However, overexploitation may be limiting these populations. To address this issue, we estimated exploitation by tagging 1,041 burbot in Bull Lake and 476 burbot in the Torrey Creek drainage with Carlin-type tags from 2011 through 2013. We also estimated tag loss (20% for the 2011 cohort and 4% for the 2012 cohort) and tag reporting (16%) to minimize bias in our exploitation estimates. In Bull Lake, annual exploitation was 11% (95% CI: 4–19%); in the Torrey Creek drainage, exploitation was 2% (95% CI: 0–16%). Mean exploitation estimates were low; however, the upper ends of both confidence intervals approach values that merit concern. Using population size-structure and parameter estimates, including exploitation, natural mortality, abundance, and growth rate, we constructed a stage-structured model to investigate the effects of varying exploitation rates on the Bull Lake and Torrey Creek drainage burbot populations. Model results indicated that the burbot populations were sustainable at the observed exploitation rates in both drainages. Thus, more restrictive harvest regulations are currently not warranted in Bull Lake or the Torrey Creek drainage.

Total Project Cost		$154,890.00
Beginning Balance – January 2014		$ 28,278.62
Additional Funding – 2014		$ 14,640.00
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 13,807.28	
Contracted Services	$ -0-	
Supplies	$ -0-	
Communication	$ -0-	
Travel	$ 1,257.94	
Rent	$ -0-	
Repair and Maintenance	$ -0-	
Tuition	$ 2,396.84	
Participant Support	$ 370.00	
IDCs @ 15%	$ 3,566.45	
Total Spent		$ 21,398.51
Balance		$ 21,520.11
Waived IDCs		$ 4,279.66

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

Investigator
Christopher Guy
Assistant Unit Leader, MTCFRU

Collaborators
Travis Horton
Montana Fish, Wildlife and Parks

Graduate Student
Jan Boyer, M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W3860

Project Duration
January 2012 – June 2015

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. Spawning success and early-life history influence numbers of juveniles recruited into a population; thus, our objectives were to describe the spatial and temporal extent of spawning, determine fecundity, spawning periodicity, and age-at-maturity, identify effective sampling methods for age-0 fish, and describe the spatial distribution of age-0 fish. 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. Gonad samples and otoliths were collected from fish sampled in October 2012 (n = 147) to examine age at maturity and spawning periodicity, and whole ovaries were collected and used to estimate fecundity for a subsample of females (n = 28). Four sampling gears were tested in May 2013 to compare their effectiveness at sampling age-0 mountain whitefish. In May 2014, seining was used to sample age-0 mountain whitefish at backwater and channel sites throughout the entire study site. Females in this population spawned annually, were 90% mature at age 3.7 (2.2 – 5.6, 95% CI), and fecundity was estimated to be 18,221 eggs per kg body weight. In 2013 and 2014, spawning occurred between the third week of October and first week of November. During spawning, 28% of the tagged fish were observed in an area accounting for 5% of study site length, near Varney Bridge. Seines were the most efficient sampling gear tested for capturing age-0 mountain whitefish. In 2014, the reach downstream of Varney Bridge had the highest catch per unit effort (C/f) of age-0 mountain whitefish, and the percentage of spawning adults in the 25 km upstream of a sampling site was positively associated with juvenile C/f (Z = 2.537, df =15, $P < 0.001$). Within this reach, age-0 mountain whitefish were associated with silt-laden backwater and eddy habitats. Future investigations on mechanisms influencing recruitment should focus on the reach where we observed high numbers of spawning adults and age-0 fish.

Total Project Cost		$160,819.00
Beginning Balance – January 2014		$ 3,470.76
Additional Funding 2014		$ 44,347.00
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 22,961.87	
Contracted Services	$ 1,154.91	
Supplies	$ 1,641.86	
Communications	$ -0-	
Travel	$ 5,840.18	
Rent	$ 1,525.00	
Repair and Maintenance	$ 126.50	
Tuition	$ 5,097.50	
IDCs @ 0%	$ -0-	
Total Spent		$ 38,347.82
Balance		$ 9,469.94
Waived IDCs		$ 16,873.04

Evaluation of management actions in the Big Hole River basin on Arctic grayling relative abundance

Investigator
Christopher Guy
Assistant Unit Leader, MTCFRU

Collaborators
Travis Horton
Montana Fish, Wildlife and Parks

Graduate Student
Austin McCullough, M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 423194

Project Duration
August 2012 – June 2015

In North America, Arctic Grayling distribution has been documented throughout Alaska and northern Canada west of the Hudson Bay, and in association with two disjunct populations in Michigan and the upper Missouri River Basin. Populations in Alaska and Canada are considered robust; however, Arctic Grayling were extirpated from Michigan in the 1930s and, in the Missouri River Basin, are limited to five isolated indigenous populations in Montana that occupy less than 5% of the historic range. Arctic Grayling in Montana are currently designated as sensitive species and have been considered for protection under the Endangered Species Act since 1982. Conservation efforts in Montana have largely focused on the Big Hole River population since abundance and distribution began to decline in the early 1980s. In 2006, a Candidate Conservation Agreement with Assurances program was established to facilitate conservation actions on non-federal properties in the upper watershed, and the program currently includes 30 participating landowners and about 61,000 hectares. Conservation actions have been implemented to remove or mitigate the effects of environmental conditions that are hypothesized to negatively influence Arctic Grayling abundance, occurrence, or both. Specific environmental conditions include interactions with non-native salmonids, degraded and fragmented habitat, reduced stream discharge, and increased stream temperature. However, little quantitative information exists that evaluates the influence of the environmental conditions on Arctic Grayling to support the current hypotheses or inform conservation actions. Arctic Grayling and environmental conditions have been measured throughout the upper Big Hole Watershed in conjunction with conservation efforts (1982 through 2014). Arctic Grayling abundance, non-native salmonid abundance, riparian habitat condition, stream discharge, and stream temperature data have been collected at varying spatial and temporal patterns and are available for exploratory analysis. Thus, the objective of this study is to use historical data to evaluate the relationships among Arctic Grayling abundance and occurrence, non-native salmonid abundance, riparian-habitat condition, stream discharge, and stream temperature. Evaluating relationships among these data is expected to provide a better understanding of Arctic Grayling ecology, evaluate hypotheses that currently guide management, inform managers of the conservation actions that probably provide the most benefit, and establish a foundation of knowledge to guide future research.

Total Project Cost		$ 10,398.00
Beginning Balance – January 2014		$ 5,339.12
STIP interest – 2014		$ 2.99
Expenditures – January 2014 - December 2014		
Travel	$ -0-	
Communication	$ -0-	
Tuition	$ 3,355.55	
Total Spent		$ 3,355.55
Balance		$ 1,986.56

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

Funding
Montana Fish, Wildlife and Parks
MSU index 4W4708

Project Duration
November 2013 – December 2016

Habitat fragmentation caused by dams adversely affects the distribution and connectivity of fish populations. In 2008, the U.S. Fish and Wildlife Service concluded that the Thompson Falls Hydroelectric Project was adversely affecting bull trout. Understanding the effects of Thompson Falls Reservoir on the out-migration behavior and survival of juvenile bull trout may lead to the development of new procedures for the operation of Thompson Falls Dam to maximize the survival of out-migrating bull trout. Data collected in 2014 revealed that low numbers (n = 5) of acoustically-tagged bull trout out-migrated from West Fork Thompson River into the mainstem Thompson River and no bull trout out-migrated into Thompson Falls Reservoir. This resulted in an adjustment of the previously stated objectives. The current objectives of this study are 1) characterize the spatial and temporal aspects of out-migrating sub-adult bull trout within the Thompson River drainage, 2) describe travel time and rate, and 3) to estimate survival rate of out-migrants. To accomplish these objectives, bull trout will be sampled in summer 2015 in Fishtrap Creek and West Fork Thompson River drainages and implanted with PIT tags. Timing of out-migration from Fishtrap Creek and West Fork Thompson River will be independently assessed with a PIT tag antenna installed at each tributary confluence with the mainstem Thompson River. Actively out-migrating juvenile bull trout will be sampled during the autumn of 2015 using directional weir traps placed in Fish Trap Creek and the West Fork Thompson River at the confluence with the mainstem Thompson River. Twenty-nine actively out-migrating juvenile bull trout (≥ 38 g) will be surgically implanted with Lotek MAP coded acoustic transmitters and monitored throughout the autumn and early winter using a combination of stationary and mobile hydrophone receivers. Because acoustic telemetry is ineffective in shallow and turbulent river systems, additional juvenile bull trout (n = 15) will be implanted with radio transmitters to increase the likelihood of obtaining movement data within the Thompson River.

Total Project Cost		$ 44,924.00
Beginning Balance – January 2014		$ 44,924.00
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 18,494.65	
Contracted Services	$ 12.75	
Supplies	$ 8,743.18	
Communications	$ 11.50	
Travel	$ 5,653.25	
Rent	$ 1,200.00	
Repair and Maintenance	$ 324.99	
Tuition	$ 3,476.60	
Total Spent		$ 37,916.92
Balance		$ 7,007.08
Waived IDCs		$ 16,683.44

Anthropogenic habitat change effects on fish assemblages of the middle and lower Yellowstone River

Investigators

Robert Bramblett
Assistant Research Professor
Alexander Zale
Unit Leader, MTCFRU

Graduate Student

Ann Marie Reinhold, Ph.D.

Collaborators

George Jordan, U.S. Fish and Wildlife Service
Matt Jaeger, Mike Backes, Mike Ruggles, Caleb Bollman, Montana Fish, Wildlife and Parks
Sean Lawlor, USGS
Tony Thatcher, DTM Consulting

Project Duration

January 2008 – December 2013
Completed

Funding

U.S. Army Corps of Engineers, USGS RWO 56, MSU index 4W1987, 4W2650

The Yellowstone River remains the longest unimpounded river in the conterminous United States. However, bank stabilization and floodplain dikes have altered its fish habitat. Therefore, we surveyed fish habitat and fish from Laurel to Sidney, Montana, to (1) quantify changes to side channels attributable to linear bank stabilization and floodplain dikes, (2) compare the habitat use of side channels to main channels by small fish during runoff and base flow, and (3) determine if bank stabilization and side channels influenced main-channel fish assemblages during base flow. Floodplain dike frequency, but not linear bank-stabilization extent, directly correlated to a net loss of side channels from the 1950s to 2001. However, side channels provided important fish habitat. Fish catch rates were similar between side and main channels during base flow, but not during runoff when catch rates in side channels were several times higher than in main channels and assemblage structure differed between side and main channels. Shallow, slow-current velocity (SSCV) habitats were slightly slower in side channels and SSCV patches were larger in side channels than in main channels during runoff, but not during base flow. These habitat differences probably partially explained the patterns in fish catch rates between channel types. During base flow, fish assemblages in main channels varied with bank-stabilization extent and side-channel availability in alluvial (unconfined) and bluff (confined) river bends. Bank stabilization and side channels had different and sometimes opposite influences on fish assemblage structure. Influences of bank stabilization and side channels on fish relative abundances varied depending on species and river bend geomorphology. Assemblage responses to side channels were more consistent and widespread than to bank stabilization, and more fish species were associated with side channels than bank stabilization. Physical differences probably contributed to the assemblage differences between reference and stabilized river bends; stabilized alluvial pools were deeper than reference alluvial pools. The strengths of the relationships among fish assemblages, bank stabilization, and side channels were spatial scale-dependent; optimum scales ranged from less than 200 m to 3,200 m up- and down-stream, suggesting that bank stabilization and side channels influenced fish across multiple spatial scales.

Total Project Cost		$ 466,242.68
Beginning Balance - January 2014		$ 8,528.64
Expenditures - January 2014 - December 2014		
Salaries and Benefits	$ 7,087.71	
Contracted Services	$ -0-	
Supplies	$ 75.71	
Communications	$ 18.03	
Travel	$ -0-	
Rent	$ -0-	
Maintenance	$ -0-	
Tuition	$ 234.75	
IDCs @ 15%	$ 1,112.44	
Total Spent		$ 8,528.64
Balance		$ -0-
Waived IDCs		$ 2,150.69

Habitats and movements of spiny softshells in the Missouri River in Montana

Investigators

Robert Bramblett
Assistant Research Professor
Alexander Zale
Unit Leader, MTCFRU

Collaborators

Jo Ann Dullum
U.S. Fish and Wildlife Service
Steve Leathe
PPL Montana
Lauri Hanauska-Brown
Montana Fish, Wildlife, and Parks

Graduate Student

Brian Tornabene, M.S.

Project Duration

August 2009 - June 2014
Completed

Funding

US Fish and Wildlife Service, PPL Montana, US Bureau of Land Management, Montana Fish, Wildlife, and Parks, Bureau of Reclamation
MSU indexes 4W2596, 4W4273 4W4356

Sparse information exists about the ecology of spiny softshell turtles in large rivers and in Montana where they are at the northern extent of their range, disjunct from downstream populations, and a Montana species of concern. We described spatial and temporal patterns in movements, habitats, and nesting ecology of spiny softshell turtles in relation to natural and anthropogenic factors in the Missouri River from August 2009 through July 2012. Movement rates and home ranges were generally highest in summer, and lowest in winter. Turtles aggregated and showed interannual fidelity to active-period and overwintering-period habitats that were distinct and separated by 0.2–23.3 km. Microhabitat characteristics at turtle locations varied between active and overwintering periods; shallow and slow velocity areas were inhabited from May–September whereas deeper areas with moderate water velocities were inhabited from October–April. We located 25 nests in 2011 and 97 in 2012. Nesting followed peak river stage, and occurred mostly in the afternoon when no humans were present. Nesting and emergence occurred later in 2011 than in 2012, but incubation periods for successfully-emerged nests were similar between years, and fewer nests were successful in 2011. Nearly all nests were in mixed-gravel substrates with sparse vegetative cover. Nest sites during the nesting period were lower and closer to water than nest sites during the emergence period. More islands were nested on in 2012 than 2011 and depredation rate was three times lower on islands than mainland shores in both years. Substrate temperatures in simulated nests during the incubation period were warmer in gravel than sand substrates. Flooding in 2011 probably decreased nesting success by inundating potential nesting habitats and reducing habitat availability thereby delaying the onset of nesting. However, nesting habitats are created and maintained by floods. During winter, freezing episodes occurred at all depths in all simulated nests. The northern range of the species is probably limited by incubation period because hatchlings are unable to overwinter in the nest. Preservation of natural streamflow regimes and protection of habitats from anthropogenic disturbance may facilitate continued existence of spiny softshell turtles in the Missouri River in Montana.

Total Project Cost		$280,472.63
Beginning Balance - January 2014		$ 3,560.72
Expenditures - January 2014 - December 2014		
Salaries and benefits	$ 3,029.52	
Contracted Services	$ -0-	
Supplies	$ 1.03	
Communications	$ -0-	
Travel	$ -0-	
Rent	$ -0-	
Maintenance	$ -0-	
Tuition	$ -0-	
IDCs @ 17.5%	$ 530.17	
Total Spent		$ 3,560.72
Balance		$ -0-
Waived IDCs		$ 803.27

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

Investigators

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

Collaborators

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

Project Duration

September 2011 – September 2015

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 and physiological 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 fish assemblages of northern Great Plains streams. Predicted changes in precipitation and air temperature will be linked to changes in streamflow and in turn, fish assemblages by using empirically derived relations between streamflow and fish assemblages as follows: (1) simulate 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) model relations between streamflow characteristics and baseline fish assemblage structures at these fish sample sites; (3) use PRMS to simulate future daily streamflows at the fish sample sites using projected precipitation and temperature output from a regional climate model; and (4) model future fish assemblage structures based on streamflow projections. Index of Biotic Integrity scores will be calculated for the 1,500 fish sample sites to identify areas of primary conservation concern and compare them to the areas that are most likely to change. The databases have been generated, proofed, and climate models have been run. Fisheries modeling is underway. Results will be presented at workshops with fishery and land managers to help them 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 2014		$ 91,997.06
Expenditures – January 2014 - December 2014		
Salaries and Benefits	$ 59,139.53	
Contracted Services	$ 5,197.50	
Supplies	$ -0-	
Travel	$ 196.58	
IDCs @ 17.5%	$ 11,293.32	
Total Spent		$ 75,826.93
Balance		$ 16,170.13
Waived IDCs		$ 17,101.47

Yellowstone River native fishes movement and habitat selection

Investigator
Robert Bramblett
Assistant Research Professor

Collaborators
Kenneth "Mike" Backes
Montana Fish, Wildlife and Parks

Graduate Student
Brian Tornabene, post M.S.

Funding
Montana Fish, Wildlife and Parks
MSU index 4W4856

Project Duration
March 2014 – March 2015

The Yellowstone River has some of the most pristine large-river habitat in the contiguous United States. Sparse life history and behavioral information for most native species restricts management and conservation options and effectiveness. Our goal was to increase the knowledge base for ecologically and culturally-important native Yellowstone River fish and wildlife to guide the formulation of management and conservation strategies that will benefit this unique ecosystem. Blue Suckers and Shovelnose Sturgeon had long home ranges and extensive movements. Blue Suckers used the Yellowstone River in spring through autumn and emigrated to the Missouri River for overwintering. Burbot, Channel Catfish, and Spiny Softshells had smaller home ranges. All species readily passed upstream of Matthews and Wolf Rapids; however passage at diversion dams varied among structures and species. Blue Suckers passed Intake, Cartersville, and Myers diversions and were rarely blocked at these structures. 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 shorter home ranges, but were able to pass Intake and Cartersville diversions on some occasions, and were blocked on others. We collected little information on passage at diversion dams upstream of Carterville Diversion because few observations of telemetered animals encountering these structures existed. Most passage events at Intake Diversion were via the main channel, rather than via the side channel. Passage irrespective of species was lower at Cartersville Diversion than at Intake Diversion. Overall, little evidence existed that discharge influenced passage success at diversion dams. 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 dispersed along the river, suggesting that suitable spawning and nesting habitats occur at multiple locations.

Total Project Cost		$ 19,868.00
Beginning Balance – March 2014		$ 19,868.00
Expenditures – March 2014 - December 2014		
Salaries and Benefits	$ 15,358.34	
Contracted Services	$ -0-	
Supplies	$ -0-	
Total Spent		$ 15,358.34
Balance		$ 4,509.66
Waived IDCs		$ 6,757.67

Colby/Hunter report update

Investigator
Robert Bramblett
Assistant Research Professor

Collaborators
Don Skaar
Montana Fish, Wildlife and Parks

Project Duration
June 2014 – December 2014
Completed

Funding
Montana Fish, Wildlife and Parks
MSU index 4W4998

The goal of this project is to complete a revision of the 1989 report by Colby and Hunter entitled "Environmental Assessment of the Introduction of Walleye Beyond their Current Range in Montana." The revision includes updates on Walleye ecology, Walleye fisheries in the upper Missouri and Mississippi river systems, status of walleye fisheries in Montana, four case histories of lakes with introduced Walleye populations, discussion, and recommendations. I have completed a literature search and obtained pertinent literature, conducted a survey of fisheries managers in states with introduced Walleye populations, and written a draft of the revision. The status of Walleye fisheries in Montana section is under review by Montana Fish, Wildlife, and Parks biologists.

Total Project Cost		$ 14,822.00
Beginning Balance – June 2014		$ 14,822.00
Expenditures – June 2014 - December 2014		
Salaries and Benefits	$ 14,739.61	
Contracted Services	$ -0-	
Supplies	$ 82.39	
Total Spent		$ 14,822.00
Balance		$ -0-
Waived IDCs		$ 6,521.68

Native prairie special status fish species inventory

Investigator
Robert Bramblett
Assistant Research Professor

Collaborators
Jake Chaffin
Bureau of Land Management

Project Duration
July 2014 – June 2019

Funding
Bureau of Land Management, CESU
MSU index 4W5002

Pearl dace, northern redbelly dace, and the northern redbelly × finescale dace hybrid (hereafter hybrid dace) are Bureau of Land Management sensitive species and Montana Fish, Wildlife and Parks and Montana Chapter of the American Fisheries Society species of special concern. These three native species are facing existing threats, appear to have undergone substantial range contractions, and are at risk of extirpation in Montana. Because their status in Montana is not known, federal and state agencies, tribes, private landowners, and corporations lack necessary information enabling science-based management and conservation of these species. Recent collections support the concern for these three species. For example, pearl dace were captured at only 7 of 1,673 sites during MFWP and Montana State University (MSU) prairie fish surveys in 1999-2007. Not only are they currently rare, alarming evidence of more recent decline exists. Specifically, the Montana State University vertebrate collection has records for pearl dace from a total of 9 creeks during the 1940s to the 1990s. Subsequently, during 1999-2007, eight of these nine creeks were resampled and no pearl dace were captured suggesting extensive range contraction. Moreover, the 1999-2007 collections indicate that hybrid and northern redbelly dace were rare or absent in large geographic areas with historical records of presence. A probable contributing mechanism for the range contractions of pearl, northern redbelly, and hybrid dace is the range expansion of invasive northern pike. Our objectives are to identify streams or drainages that could serve as conservation priority areas for pearl and hybrid dace in Montana and potential management actions that could be used to conserve pearl and hybrid dace. We will compile all known historical and recent distributional records for pearl, northern redbelly, and hybrid dace and formulate a watershed-based stratified sampling plan. We will determine composition and relative abundance of the fish assemblage at each sampling site. We will determine potential threats to these three species at the site and watershed scales. Threats will be assessed by determining if northern pike or other potential predatory or competing nonnative fish species are present, evaluating riparian condition, calculating an Index of Biotic Integrity (IBI) score to assess the health and function of the fish assemblage, and by evaluating the spatial juxtaposition with potential fish passage barriers and land uses such as the Bakken oil extraction area.

Total Project Cost		$ 25,000.00
Beginning Balance – July 2014		$ 25,000.00
Expenditures – July 2014 - December 2014		
Salaries and Benefits	$ -0-	
Supplies	$ -0-	
Travel	$ -0-	
Repair & Maintenance	$ -0-	
IDCs @ 17.5%	$ -0-	
Total Spent		$ -0-
Balance		$ 25,000.00
Waived IDCs		$ -0-

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

Project Duration
November 2014 – March 2017

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

Spawning by pallid sturgeon has been documented in the Yellowstone and Missouri rivers, but no natural recruitment has occurred for decades. Recent research strongly suggests that pallid sturgeon free embryos drift into an anoxic "dead zone" in reservoir headwaters. At the Fort Peck Reservoir headwaters, dissolved oxygen concentrations were 0.0 to 1.32 mg/L, with reduced current velocities, predominantly silt substrate, and high sediment organic matter and respiration rates near the river bed. A laboratory study indicated that free embryo and 40-day post-hatch pallid sturgeon mortality was 100% at dissolved oxygen concentrations of 1.5 mg/L.

Expansion of the Fort Peck study to include Lake Sakakawea is needed to confirm the generality of the results as well as to better define the temporal and spatial extent of any benthic anoxic zone. Specifically, we will address the following questions: Do hypoxic or anoxic conditions exist in the headwaters of Lake Sakakawea? What are the longitudinal and lateral extents of benthic hypoxic and anoxic zones? How do benthic hypoxic and anoxic zones vary with discharge, water velocity, water temperature, sediment organic matter, and sediment microbial respiration within and between years?

We will sample water temperature, dissolved oxygen concentration, current velocity, substrate composition, sediment organic matter, and sediment respiration along transects in the headwaters of Lake Sakakawea. Our general approach will first involve determining the existence of, and the longitudinal location and extent of any existing anoxic zone. If we locate an anoxic zone, we will then sample upstream of the anoxic zone (river zone), within the anoxic zone (transition zone), and downstream of the anoxic zone (reservoir zone). We will also test the river sediment for organic matter content and respiration rates. Sampling will begin in May 2015.

Total Project Cost		$186,405.66
Beginning Balance – November 2014		$186,405.66
Expenditures – November 2014 - December 2014		
Salaries and Benefits	$ -0-	
Supplies	$ -0-	
Travel	$ -0-	
Repair & Maintenance	$ -0-	
IDCs @ 15%	$ -0-	
Total Spent		$ -0-
Balance		$186,405.66
Waived IDCs		$ -0-

Taxonomic and ecological services

Investigator
Robert Bramblett
Assistant Research Professor

Funding
USGS Water Science Center
MSU Index 433295

Project Duration
Ongoing

Beginning Balance - January 2014		$ 11,089.45
Expenditures - January 2014 - December 2014		
Salary and Benefits	$ -0-	
Supplies	$ -0-	
Communications	$ -0-	
Travel	$ -0-	
Administrative fee @ 4%	$ -0-	
Total Spent		$ -0-
Balance		$ 11,089.45

MTCFRU Sales and Service Account
MSU Index 433309

This account manages non-grant work that the Montana Cooperative Fishery Research Unit performs in association with cooperators and collaborators.

Fort Peck water chemistry analysis

Investigators

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

Collaborator

Heath Headley, Montana Fish, Wildlife and Parks

Funding

$15,300.00 MT FWP

Montana Fish, Wildlife & Parks annually stock millions of walleye fry and fingerlings into Fort Peck Reservoir (H. Headley, FWP, personal communication). However, the contribution of those stocked fish to the fishery remains poorly understood. Knowledge is lacking pertaining to 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 should provide the information needed to quantify the proportion of stocked and wild walleye in the fishery as well as identify movements and habitat use of walleye in the reservoir and its tributaries. 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 their nursery areas and occupied at least three study area regions. None of the walleye in our study dispersed among every region. However, 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. A more extensive study will be conducted in 2015 and 2016 with the objectives of 1) assessing the contribution of hatchery-reared fingerlings to the Fort Peck fishery, 2) assessing the contribution of each sampling region to juvenile rearing, and 3) describing general movements of walleye in Fort Peck Reservoir and its tributaries.

Hebgen Lake otolith microchemistry analysis

Investigators

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

Collaborator

Travis Lohrenz, Montana Fish Wildlife and Parks

Funding

$7,099 Madison River Foundation

The contribution of stocked rainbow trout to the Hebgen Lake fishery in southwest Montana remains poorly understood. Otolith microchemistry analysis has repeatedly proven to be a reliable technique for identifying hatchery-reared fish. Given suitable water chemistry variability among Hebgen Lake, its tributaries, and the hatchery, otolith microchemistry analysis should provide the information needed to quantify the proportion of stocked and wild rainbow trout in the fishery. The objectives of this study were to 1) determine the proportion of stocked and wild rainbow trout that compose the Hebgen Reservoir fishery, 2) determine interannual variability of stocked and wild rainbow trout recruitment, and 3) identify rainbow trout spawning and nursery habitats in Hebgen Reservoir and its tributaries. Water chemistry analyses indicated differences in elemental and isotopic concentrations among Hebgen Lake and most of its tributaries. The project was transferred to another research lab at Montana State University for completion because the lead research scientist pursued employment elsewhere prior to otolith preparation.

Beginning Balance - January 2014		$ 13,740.22
Additional Funding – 2014		$ 5,285.06
Expenditures - January 2014 - December 2014		
Salary and Benefits	$ 5,650.20	
Contracted Services	$ 7,760.00	
Supplies	$ 632.27	
Travel	$ 1,193.42	
Administrative fee @ 6%	$ 695.68	
Total Spent		$ 15,931.57
Balance		$ 3,093.71

Montana Cooperative Fishery Research Unit Vehicle Account

Administrator
Alexander V. Zale
Unit Leader, MTCFRU

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 2014		$ 53,007.19
Expenditures - January 2014 - December 2014		
Repairs and Maintenance	$ 6,127.94	
Fuel	$ 14,872.16	
Insurance	$ 2,517.37	
Administrative Assessment Fee @ 4%	$ 1,184.25	
Total Spent		$ 24,701.72
Total Revenue Reimbursed		$ 37,546.49
Balance		$ 65,851.96

Montana Cooperative Fishery Research Unit Watercraft Account

Administrator
Alexander V. Zale
Unit Leader, MTCFRU

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 expensive repairs and replacement of Unit research vessels.

Beginning Balance - January 2014		$ 20,521.50
Expenditures - January 2014 - December 2014		
Supplies	$ -0-	
Equipment	$ -0-	
Maintenance	$ 1,911.89	
Administrative Assessment Fee @ 4%	$ 76.78	
Total Spent		$ 1,988.67
Total Revenue Reimbursed		$ 18,175.00
Balance		$ 36,707.83

Montana Cooperative Fishery Research Unit Operations Account

Administrator
Alexander V. Zale
Unit Leader, MTCFRU

Funding
Yearly: $12,000 from MSU VP Research
MSU index 436899

Beginning Balance - January 2014		$ 13,603.75
Expenditures - January 2014 - December 2014		
Salary and Benefits	$ -0-	
Communications	$ 1,462.31	
Contracted Services	$ 2,910.62	
Supplies	$ 2,001.75	
Travel, training	$ -0-	
Rent (Storage Unit)	$ 6,984.00	
Maintenance	$ -0-	
Administrative Assessment Fee @ 6%	$ 497.79	
Total Spent		$ 13,856.47
Total Revenue from VPR		$ 12,000.00
Balance		$ 11,747.28

Monetary Equivalence for MSU Services and Facilities
January 2014 - December 2014

Accountant 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 ($768,900)	$ 6,151.20
Utilities - General @ 12% of total expenditures ($768,900)	$ 92,268.00
Unit Operations Account	$ 12,000.00
Waived IDCs	$223,683.47
Total	**$408,454.87**

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

Investigator
Alexander V. Zale
Unit Leader, MTCFRU

Funding
Montana Fish, Wildlife and Parks
MSU index 428513

Beginning Balance - January 2014		$ 41,103.50
Additional Funding – July 2014		$ 30,000.00
Expenditures - January 2014 - December 2014		
Salaries and Benefits	$ 4,074.39	
Communication (Telephone/postage)	$ 428.28	
Contracted Services	$ 2,832.28	
Travel	$ 3,980.69	
Supplies	$ 8,365.43	
Repairs and Maintenance	$ -0-	
Rent	$ 177.89	
Tuition	$ 1,627.75	
Total Spent		$ 21,486.71
Balance		$ 49,616.79

Federal Budget
January 2014 - December 2014

Salaries and Benefits	$321,391.49
Supplies	$ -0-
Total	**$321,391.49**

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

USGS

2011 Ford F250 4x4 crew cab (green)
Property No. 433429 – Serial No 1FT7W2BTOBEA70586
Acquisition value $31,697.00
Mileage 29,193

2009 Chevrolet HHR (red)
Property No. 433291 – Serial No. 3GNBAADB4AS513678
Acquisition value $18,720.00
Mileage 18,815

2005 Chevrolet Silverado 2500, 4x4 crew cab (green)
Property No. 430750 - Serial No. 1GCHK23G15F926039 (2005)
Acquisition value $22,948.21
Mileage 92,596

2002 Chevrolet 4x4 Suburban (white)
Property No. 261052 - Serial No. 3GNGK26U52G249012
Acquisition value $31,988
Mileage 115,382

1999 Chevrolet 3/4-ton 4x4 pickup truck (white)
Property No. 252537 -- Serial No. 1GCGK24R9XF049122
Acquisition value $21,009
Mileage 157,877

1989 Chevrolet 4x4 Suburban (tan)
Property No. 261114 - Serial No. 1GNGV26K2KF176088
Acquisition value $15,766
Mileage 154,836

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 656

2008 Ford Escape Hybrid 4WD (grey)
Property No. 132775
Serial No. 1FMCU59H78KA13346
Acquisition Value $26,553.65 (2007)
Mileage 34,999

2005 GMC Sierra 2500 crew cab truck (green)
Property No. 132353
Serial No. 1GTHK23G65F944780
Acquisition Value $24,463.00 (2005)
Mileage 116,546

2001 GMC 1/2 ton 4x4 extended cab truck (green)
Property No. 132228
Serial No. 2GTEK19T911227311
Acquisition Value $15,255.00 (2005)
Mileage 160,485

1999 Ford F250 4x4 crew cab (blue)
Property No. 125014
Serial No. 1FTNW21S8XEA98840
Acquisition Value $11,002 (2005)
Mileage 178,609

1999 Chevrolet 1/2 ton 4x4 extended cab truck (white)
Property No. 132229
Serial No. 2GCEK19T8X1144560
Acquisition Value $12,459.00 (2005)
Mileage 205,174

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 (two)
Property No. 132057
Serial No. 11826A
Acquisition value $7,950 (2004)
Property No. 132058
Serial No. 11827A
Acquisition value $7,950 (2004)