Montana Cooperative Fishery Research Unit

2004 Briefing Booklet

MONTANA COOPERATIVE
FISHERY RESEARCH UNIT

Coordinating Committee Meeting
Missoula, Montana
19 August 2004

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Brian Bellgraph	M.S.
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Andy Dux	M.S.
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Beth Bear	M.S.
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Field Research Technicians 2003/2004

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Helen Schemm	Jeremy Smith	David Staples
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Aaron Williamson		

Graduate Students Receiving Degrees in 2004

Jim De Rito, M.S., will graduate Summer 2004 and has accepted the position of Conservation Director with the Henry's Fork Foundation. Assessment of reproductive isolation between Yellowstone cutthroat trout and rainbow trout in the Yellowstone River, Montana.

Matt Jaeger, M.S., has accepted the position as fisheries biologist in Glendive with Montana Fish, Wildlife and Parks. An empirical assessment of factors precluding recovery of sauger in the lower Yellowstone River: movement, habitat use, exploitation, and entrainment.

Hally Lukins, M.S., has accepted a position with the Colorado Division of Wildlife to continue her work in tamometry. Dynamics of the waterborne stage of *Myxobolus cerebralis* estimated directly by packed-bed filtration.

Nathan Olson, M.S., has accepted a position with the Minnesota Department of Natural Resources working near Eden Prairie. Interactions among hybrid striped bass, white bass, and walleye in Harlan County Reservoir, Nebraska.

Bacterial coldwater disease in westslope cutthroat trout: hatchery epidemiology and control

Investigators

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Unit Leader, MTCFRU
Eileen Ryce
Postdoctoral Associate, MSU

Collaborators

Jay Pravecek
Mark Sweeney
Montana Fish, Wildlife and Parks
Washoe Park State Fish Hatchery

Funding

Wild Fish Habitat Initiative of the Montana University System Water Center, MSU indexes 426508 and 425303

Project Duration

July 2002 – December 2004

Bacterial coldwater disease, caused by the gram-negative bacterium *Flavobacterium psychrophilum*, is a septicemic infection that has caused significant losses of hatchery-reared salmonids worldwide. Currently, bacterial coldwater disease is the only disease found in state fish hatcheries in Montana. Increasingly, these hatcheries are being asked to help restoration programs for rare and sensitive species. The Washoe Park State Fish Hatchery in Anaconda is currently the only facility in the state producing westslope cutthroat trout suitable for restoration programs. Successful control of bacterial coldwater disease in the hatchery would help facilitate restoration of native westslope cutthroat trout *Oncorhynchus clarki lewisi* in Montana.

Bacterial coldwater disease affects all sizes of salmonids; however, juveniles are most susceptible to the disease. The bacterium can be transmitted both horizontally (from fish to fish) and vertically (from adult to egg) and has been observed in the ovarian fluid and on the surface of fish eggs even after disinfection. Transmission within and on the eggs is therefore a major concern in the control of this pathogen. In the absence of a clinical disease outbreak the bacterium is commonly isolated from the brain of fish. This reservoir of bacteria can also act as a potential source of a disease outbreak if triggered by a stress condition. The disease can be precipitated by stress caused by general hatchery procedures including grading, handling, movement, change of feeding regimes and also by poor water quality and the presence of other diseases. The bacterium is also able to survive outside the host making water a possible source of infection.

We used Washoe Park State Fish Hatchery in Anaconda, Montana, as a case study to enhance understanding of the disease in a hatchery setting and to develop practical hatchery-management strategies to better control the pathogen and the disease. Washoe Park typically loses 30 to 45% of its westslope cutthroat trout production to the disease annually. Our objectives were to determine where the pathogen was located in the hatchery system, how it was transmitted, and what factors caused disease outbreaks. We found the bacterium in the warm-spring water source, in the degassing water tower, and in production and broadstock fish. It was transmitted both horizontally and vertically, with both male and female parents passing the pathogen on to their offspring. Transmission from females was vertical only, but both horizontal and vertical transmission from males occurred. Iodine surface-disinfection of eggs post-fertilization eliminated the pathogen

from the egg surfaces, thereby limiting horizontal transmission. Chronic and mild acute stress did not result in disease outbreaks, but a combination of acute stress events associated with moving juvenile production fish from indoor to outdoor raceways did. These fish harbored the pathogen, primarily in cranial tissues, prior to the outbreak. Measures resulting from our findings implemented at Washoe Park to reduce horizontal transmission included cleaning and sterilization of hatchery structures and iodine surface-disinfection of eggs post-fertilization. Eradication of the pathogen from the hatchery is unlikely, but efforts to reduce the frequency and intensity of stress events should reduce the frequency of disease outbreaks; management to reduce the number of fish carrying the pathogen may minimize losses during outbreaks.

Total Project Cost		$121,081.00
Beginning Balance – July 2003		$ 47,526.65
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$24,956.62	
Repair and Maintenance	$ 454.72	
Communication	$ 129.27	
Travel	$ 1,295.44	
Supplies	$ 1,714.77	
Awards	$ 425.00	
IDCs @ 26%	$ 6,817.94	
Total Spent		$35,793.66
Balance		$11,732.89
Waived IDCs		$ 8,036.47

Dynamics of the waterborne stage of *Myxobolus cerebralis* estimated directly by packed-bed filtration

Investigator
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Unit Leader, MTCFRU

Collaborator
Frederic Barrows
Bozeman Fish Technology Center,
U.S. Fish and Wildlife Services

Graduate Student
Halcyon Lukins, M.S.

Funding
Whirling Disease Initiative of the National Partnership on the Management of Wild and Native Cold Water Fisheries, via the Montana University System Water Center, MSU Index No. 42649

Project Duration
May 2002 - April 2004 – **Completed**

Whirling disease is a parasitic infection caused by the myxozoan *Myxobolus cerebralis*. *M. cerebralis* has a complex life cycle with two hosts, the oligochaete worm *Tubifex tubifex* and a salmonid fish, and two infective spore stages, the myxospore and the triactinomyxon. The myxospore stage is ingested by the worm and matures into the triactinomyxon. The triactinomyxon is released into the water column where it floats freely until making contact with a salmonid fish. The triactinomyxon injects sporoplasms into the salmonid, which mature into myxospores and are released upon the death and decomposition of the fish. The myxospores are then available for worm consumption, repeating the cycle.

Past assessments of whirling disease infection risk on wild trout populations have relied on disease severity experienced by cultured fish exposed in sentinel cages or flat-screen filtration of *Myxobolus cerebralis* triactinomyxons. The former technique is indirect and inexpedient whereas the latter is imprecise and inaccurate. We examined spatial and temporal dynamics of *Myxobolus cerebralis* triactinomyxon concentrations directly using packed-bed filtration at five mainstem sites on the upper Madison River and at Willow Creek, and a tributary to the Jefferson River; packed-bed filtration provides accurate and precise estimates of ambient triactinomyxon concentrations. We also compared findings inferred from indirect sentinel-cage trials and our concurrent direct measurements.

Triactinomyxon concentrations were consistently higher at Willow Creek than at the five sites on the Madison River, at which concentrations did not differ spatially. Concentrations at all sites peaked in spring and autumn, partially in response to seasonal changes in water temperature. Variation in concentrations among five consecutive days was absent, but strong diel variation was evident; at Willow Creek, concentrations were elevated during periods of low light intensity. Indirect sentinel-cage sampling and simultaneous, direct packed-bed filtration largely corresponded, except in one low-temperature sample when a low percentage of fish became infected despite high concentrations of triactinomyxons. Packed-bed filtration proved to be a rapid

efficient, and effective method for assessing whirling disease infection risk among wild trout.

Total Project Cost		$55,128.00
Beginning Balance – July 2003		$12,392.76
Expenditures – July 2003 - April 2004		
Salaries and Benefits	$10,640.56	
IDCs @ 17%	$ 1,752.20	
Total Spent		$12,392.76
Balance		-0-
Waived IDCs		$ 3,390.80

Movements of resident and non-resident anglers in Montana: implications for transferring whirling disease among drainages

Investigators
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Unit Leader, MTCFRU

Collaborator
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Kiza Gates, M.S.

Funding
Whirling Disease Initiative, Montana
University System Water Center,
MSU Index 425605

Project Duration
July 2004 - December 2005

Whirling disease remains a problem throughout much of the Intermountain West. Despite the numerous studies on the biology of *Myxobolus cerebralis*, little is known about the incidental transfer of *M. cerebralis* among drainages by anglers. It is highly likely that anglers can transfer *M. cerebralis* based on the data that myxospores are found in the sediment, myxospores are highly resilient to environmental stress, fishing equipment often captures benthic sediment, and anglers are highly mobile organisms. Therefore, this research study will identify the likelihood of detecting myxospores relative to sediment amount, quantify the amount of angler movement among basins, quantify amount of sediment on angling equipment, determine if the sediment on angling equipment contains myxospores, and determine sediment load and presence of myxospores on various wader and boot types. The results from this study will be useful in developing management strategies to reduce the spread of whirling disease and other invasive species throughout Montana and likely most of the Intermountain West.

Total Project Cost	$49,993.00
Beginning Balance – July 2004	$49,993.00
Balance	$49,993.00

Habitat use, movements, growth, and food habits of juvenile stocked pallid sturgeon and indigenous shovelnose sturgeon in the Missouri River above Fort Peck Reservoir

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Funding
Montana Fish, Wildlife and Parks, MSU index 426856

Project Duration
January 2003 - June 2005

Natural recruitment of pallid sturgeon *Scaphirhynchus albus* has not been observed in the Missouri River above Fort Peck Reservoir for over 30 years. As a result, it is estimated that only 30 to 150 adult pallid sturgeon remain in this river reach. In an effort to recover the pallid sturgeon, 736 hatchery-reared juvenile pallid sturgeon (HRJPS) were stocked as yearlings in 1998. Anecdotal data suggested that the 1997 year class of HRJPS are growing slower than indigenous juvenile shovelnose sturgeon *Scaphirhyncus platorynchus* of the same age. Thus, in the summer of 2003 we implanted transmitters in 9 HRJPS and 12 indigenous juvenile shovelnose sturgeon to track movements and determine habitat use for the two species. Upon relocating a fish, the river kilometer of the fish location was recorded and various abiotic habitat were measured (e.g., depth, velocity, temperature, substrate, distance to thalweg). In addition, we sampled both species using drifting trammel nets, benthic trawling, set lines, and angling to obtain growth and food habits data.

The results of this study will determine if stocking hatchery-reared pallid sturgeon is a viable short-term conservation method for restoring pallid sturgeon populations. The results will also provide insight into the factors limiting recruitment of pallid sturgeon in the Missouri River above Fort Peck Reservoir.

Total Project Cost		$87,095.00
Beginning Balance – July 2003		$48,824.82
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$1,867.57	
Repair and Maintenance	$ 187.40	
Communication	$ 215.95	
Travel	$3,951.81	
Supplies	$4,709.52	
Awards	$ 608.75	
IDCs @ 0%	-0-	
Total Spent		$28,345.00
Balance		$20,479.82
Waived IDCs		$11,763.18

Interactions between walleye and sauger in the Missouri River

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Graduate Student
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Funding
Montana Fish, Wildlife and Parks,
MSU Index 426966

Project Duration
August 2003 - January 2006

Sauger are native to Montana and widely distributed throughout North America. However, sauger populations have been declining throughout Montana since the early 1990s. There has been an 85% decline in age-0 and adult sauger in the Yellowstone River from the 1980s to 1990s. It was thought that the severe drought in the late 1980s was the mechanism for the decline; however, despite the increase in flows in the mid 1990s, sauger populations have not rebounded. Numerous theories exist on why sauger populations are declining in Montana such as i) water diversion and movement barriers, ii) hybridization with non-native species (i.e., walleye), iii) species interactions (i.e., smallmouth bass and walleye), iv) overexploitation, and v) river flow and reservoir levels.

A lack of basic information on sauger ecology makes managing sauger difficult in Montana and throughout their native range. Thus, the objectives of this study are to better understand movement, habitat use, and food habits of sauger in the middle Missouri River. In addition, this study will evaluate movement, habitat use, and food habits of walleye to determine the degree of overlap between walleye and sauger with respect to diet and habitat use. Understanding the interactions between sauger and walleye in the middle Missouri River will provide insight into the potential effects of walleye on sauger in Montana.

These data will be used to better understand the ecology of sauger in the middle Missouri River and determine the extent of diet and spatial overlap between sauger and walleye. We hypothesize that these species will exhibit spatial and diet overlap and that walleye influence the trophic position of sauger populations in the middle Missouri River. Further, these data will provide information regarding movement patterns and the effects of varying discharge on movement of sauger and walleye. Finally, habitat use and potential spawning areas will be described in an attempt to identify important areas of conservation and management.

Total Project Cost		$87,113.00
Beginning Balance – August 2003		$87,113.00
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$16,947.24	
Repair and Maintenance	$ 469.94	
Communication	$ 314.45	
Contracted Services	$ 599.57	
Travel	$ 3,537.46	
Supplies	$12,039.29	
Rent	$ 30.00	
IDCs @ 0%	-0-	
Total Spent		$33,937.95
Balance		$53,175.05
Waived IDCs		$14,084.25

Development of a conservation agreement for sauger in the Missouri and Yellowstone rivers

Investigator
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Collaborator
Robert Snyder
Montana Fish, Wildlife and Parks

Funding
Montana Fish, Wildlife and Parks,
MSU index 426699

Project Duration
August 2002 - December 2003 –
Completed

Historically, sauger were distributed throughout Montana and inhabited turbid waters of the Missouri and Yellowstone river drainages. However, recent studies suggest that sauger populations in the upper portions of both river systems have declined, as well as in Ft. Peck Reservoir. In response to population declines, the Montana Department of Fish, Wildlife and Parks (MTFWP) initiated a status review that was completed in 1999. As a result of data compiled in the status review, sauger were added to the lists of sensitive species maintained by MTFWP, the Montana Natural Heritage Program, and the Montana Chapter of the American Fisheries Society.

It is estimated that sauger currently persist in about 50% of the estimated 2,015 river miles that historically supported sauger, and are common in only about 21% of that former range. In tributary drainages, an estimated 77% of tributary streams no longer support resident sauger. Reduction in abundance has occurred over the past 20 years and subsequently angler harvest rate has declined. In response, MTFWP has greatly limited sauger harvest in the upper portions of the range.

Causes of the decline are unknown, but suspected causes include low flows, alteration of flows by dams and diversions, reservoir management, entrainment in ditches and diversions, alterations or disturbance to spawning habitats, blockage of migratory corridors, and interactions with non-native species including the closely related walleye. There is a need to summarize existing data on sauger, identify information gaps, develop monitoring protocols to better monitor populations and trends, identify threats and limiting factors, provide recommendations to address those threats, and to use the latter data to develop a conservation agreement that will help direct management of sauger and their habitat.

The Memorandum of Understanding and Conservation Agreement for sauger was developed to expedite the implementation of conservation measures in Montana as a collaborative effort among resource agencies, academic institutions, conservation organizations, resource users, and private land owners. Threats that warrant listing sauger as a Species of Special Concern by the State of Montana should be reduced or eliminated through the implementation of this document. The Conservation Agreement outlines six objectives to obtain the goal of assuring the long-term self-sustaining persistence of sauger in the Missouri River and Yellowstone River basins in Montana. The objectives are as follows: i) develop an upper Missouri River Sauger Work Group by 2006, ii) determine the genetic status, distribution, and abundance of sauger populations, iii)

identify and reduce specific threats to sauger and its habitat to the greatest extent possible, iv) protect current populations and increase the distribution of sauger within its native range, v) implement a recovery plan that includes a standardized sampling program by 2008 to document progress toward the goal, and vi) provide technical information, administrative assistance, and financial resources to meet the above objectives and goal.

Total Project Cost		$43,793.00
Beginning Balance – July 2003		$22,168.30
Expenditures – July 2003 - June 2004		
Repair and Maintenance	$ 662.13	
Travel	$ 1,861.00	
Contracted Services	$ 245.80	
Communication	$ 693.10	
Supplies	$12,266.35	
Awards	$ 6,417.90	
IDCs @ 0%	-0-	
Total Spent		$22,146.28
Balance		$ 22.02
Waived IDCs		$ 9,190.71

Yellowstone River fish assemblage response to anthropogenic factors: preliminary evaluation for the cumulative effects study

Investigators
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Collaborator
George Jordan
U.S. Fish and Wildlife Service

Funding
Montana Department of Environmental Quality, Custer County Conservation District, MSU index 425051

Project Duration
May 2003 - February 2004 – **Completed**

The Yellowstone River originates in Yellowstone National Park, Wyoming and flows through Montana to its confluence with the Missouri River in North Dakota. It is the longest free-flowing river in the contiguous United States and has a relatively natural flow regime. However, 100-year flood events in 1996 and 1997 caused substantial damage to private property through channel scour and streambank erosion. Consequently, the federal government and private individuals began installing bank stabilization structures. This activity prompted investigations regarding potential cumulative effects of existing and future bank stabilization projects on the Yellowstone River ecosystem. The cumulative effects study of anthropogenic alterations on the lower Yellowstone River (Springdale, Montana to the confluence with the Missouri River) is a proposed multidisciplinary project to be conducted by government agencies, universities, and private corporations, similar to the project recently completed on the upper Yellowstone River. The objective of this project was to define suitable high and low artificially modified sites for use in the subsequent study that will evaluate the lower Yellowstone River fish assemblage response to anthropogenic alterations. We identified fourteen sites (seven paired sites) that were similar with respect to geomorphological characteristics, but had varying anthropogenic alterations. These sites were proposed for use in the multidisciplinary study.

Total Project Cost		$28,876.00
Beginning Balance – July 2003		$28,726.51
Expenditures – July 2003 - June 2004		
Salary and Benefits	$15,239.09	
Travel	$ 877.07	
Supplies	$ 3,911.32	
Awards	$ 2,136.90	
IDCs @20%	$ 4,432.88	
Total Spent		$26,597.26
Balance		$ 2,129.25
Waived IDCs		$ 6,605.06

Status assessment of burbot in Montana

Investigators
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Collaborator
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Montana Fish, Wildlife and Parks

Funding
Montana Fish, Wildlife and Parks,
MSU index 426924

Project Duration
February 2003 - August 2004

In the U.S., burbot occur in deep, cold lake and river waters of the northern U.S., north of the 40th parallel including in Montana in both the Missouri and Columbia river drainages. Because of their use of deep-water habitat and their limited sport fish potential, not much is known about burbot population status and trends. Typical survey methodology (e.g., gill netting, electrofishing, creel surveys) and timing are not very effective at capturing burbot. Therefore, there is little comprehensive data on the species, and even the most basic natural history information is lacking in most areas (i.e., spawning locations). In order to develop a better understanding of population status and trends, new additional monitoring would have to be implemented specifically for burbot.

Despite a lack of comprehensive population trend data, there is increasing anecdotal concern about the status of burbot. A survey of Montana fisheries biologists indicated that biologists whose areas cover 73% of the species range in Montana are concerned about the current status of burbot. Biologists in several drainages are reporting seeing fewer and fewer burbot in their monitoring areas. Anglers who regularly fish for burbot have expressed concern about fewer and smaller fish in some of the areas where they fish. The Kootenai River population of burbot below Kootenai Falls has been petitioned for listing as endangered under the Endangered Species Act, with dam operations cited as a cause of decline. The U.S. Fish and Wildlife Service is presently conducting a formal status review of that population.

There is a need to compile and synthesize all existing data and anecdotal information about burbot in order to fully understand their status in Montana, and to develop recommendations and management actions to address potential causes of decline. Thus, the objective of this project is to develop a comprehensive status assessment of burbot in Montana.

Total Project Cost		$20,000.00
Beginning Balance – July 2003		$15,972.52
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$11,958.12	
Travel	$ 2,612.30	
Communications	$ 6.72	
Supplies	$ 786.63	
Awards	$ 608.75	
IDCs @ 0%	-0-	
Total Spent		$15,972.52
Balance		-0-
Waived IDCs		$ 6,628.60

Habitat use of lake trout in Lake McDonald, Glacier National Park

Investigator
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Collaborators
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National Park Service
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U.S. Fish and Wildlife Service

Graduate Student
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Funding
National Park Service, MSU indexes 426747 and 425234

Project Duration
January 2003 - December 2005

The indigenous fishery of Lake McDonald in Glacier National Park (GNP) has been radically altered by a succession of habitat disturbances and ecological manipulations dating from the early 1900s. Park managers are particularly concerned about the welfare of the bull trout, a native char recently placed under the protection of the Endangered Species Act (ESA) as a threatened species. The native westslope cutthroat trout, a "Species of Special Concern" in Montana, is also imperiled in the lake. Field surveys and angler creel censuses carried out during the past 70 years have documented declines of both species in Lake McDonald, likely due to the entry of lake trout into the basin. Four additional non-native species are also present in the system. The habitat use and spatial relationships among lake trout and the native species, especially bull trout, are poorly understood. A comprehensive assessment of damage to aquatic and riparian habitats in the Lake McDonald basin has not been made. Information about the condition of historic spawning habitats is also lacking.

This research project will provide information relative to the use of lake trout. The results from this project will contribute to the development of a strategic plan aimed at restoring to the extent possible the ecological integrity of the Lake McDonald ecosystem. Knowledge gained is expected to yield recommendations aimed at preventing the further decline of native fish populations in the basin. In addition, it is likely that the results from this research project will be applicable to several other large lakes at the west side of GNP that are similarly impaired. Knowledge and mitigation techniques that evolve from this research project will also benefit other parks in the western U.S. that are dealing with non-native fish issues.

Total Project Cost		$135,594.00
Beginning Balance – July 2003		$ 96,942.50
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$19,803.39	
Repair and Maintenance	$ 832.21	
Communication	$ 301.19	
Contracted Services	$ 59.97	
Travel	$ 2,593.70	
Supplies	$ 3,506.13	
IDCs @ 15%	$ 4,358.21	
Total Spent		$ 31,454.80
Balance		$ 65,487.70
Waived IDCs		$ 8,695.53

Evaluation of fish assemblages and habitat variables in streams bisecting Going-to-the-Sun Road, Glacier National Park

Investigators
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Andy Dux, MSU

Collaborator
William Michels
National Park Service

Funding
National Park Service, MSU 425193

Project Duration
August 2003 - March 2005

Glacier National Park is considering the rehabilitation of Going-to-the-Sun Road (completed in 1932 and a National Historic Landmark). Repairs are needed to correct structural deficiencies in the road and improve safety. According to the National Park Service, if Going-to-the-Sun Road is not rehabilitated it will continue to deteriorate resulting in further damage to natural, historic, and cultural resources in the Park.

Many of the aquatic resources in the Park have been altered by the introduction of non-native fishes. However, there are areas within the park that provide refugia for native fishes and likely represent genetically pure stocks. Thus, protecting these populations from anthropogenic factors such as impacts from road construction is critical to the continued existence of native fishes within the Park. There are eleven native fish species present west of the Continental Divide along Going-to-the-Sun Road: westslope cutthroat trout, bull trout, mountain whitefish, pygmy whitefish, redside shiner, peamouth, northern pike minnow, longnose sucker, largescale sucker, slimy sculpin, and shorthead sculpin. In addition, five non-native fish species are found west of the Continental Divide in the Park: rainbow trout, brown trout, kokanee salmon, lake whitefish, and lake trout.

It is anticipated that rehabilitation of the Going-to-the-Sun Road will result in soil disturbance, erosion, and sedimentation of streams and lakes. These disturbances are predicted to be short-term. Nevertheless, understanding the potential impacts to fish populations and assemblages in this fragile ecosystem is critical. The purpose of this study is to evaluate the streams bisecting Going-to-the-Sun Road prior to road construction. This study will describe the fish assemblage and associated habitat in streams bisecting Going-to-the-Sun Road. Further, sensitive areas containing bull trout or critical habitat for bull trout will be identified.

Total Project Cost		$12,000.00
Beginning Balance – August 2003		$12,000.00
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$1,957.89	
Travel	$ 523.88	
Supplies	$1,510.05	
IDCs @ 15%	$ 598.76	
Total Spent		$ 4,590.50
Balance		$ 7,409.50
Waived IDCs		$ 1,306.30

Evaluation and action plan for protection of 15 threatened adfluvial populations of bull trout in Glacier National Park

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U.S. Fish and Wildlife Service
Jim Tilmant
National Park Service

Graduate Student
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Funding
U.S. Geological Survey - Biological Resources Division, USGS RWO 50, MSU indexes 425486 and 4W0045

Project Duration
March 2004 - June 2007

Non-native lake trout *Salvelinus namaycush* are invading and rapidly compromising native fish species complexes in large glaciated lakes of the upper Columbia River Basin. Recent research has identified dramatic recent declines of bull trout *Salvelinus confluentus* over the last 25 years in the four largest lakes on the west side of Glacier National Park (Lake McDonald, Kintla Lake, Bowman Lake, and Logging Lake). These declines are associated with corresponding increases in numbers of invasive lake trout, which have colonized these waters from downstream or adjacent sources in the Flathead River drainage. In addition, over the past three years the invasion of Harrison and Lower Quartz Lakes by lake trout has been verified. Best available science indicates that conversion of these unique native bull trout ecosystems to lake trout-dominated systems is a common result once lake trout invade and become established. Extirpation of bull trout from at least some of these lakes is likely to occur in the foreseeable future.

Quartz Lake, Upper Kintla Lake and Trout Lake in Glacier National Park (along with Big Salmon Lake in the adjacent Bob Marshall Wilderness), are the four largest lakes remaining in the entire Columbia River basin that contain native bull trout not currently known to have been compromised by the introduction of non-native fish species. This makes protection of these waters a recovery priority and an issue of importance on a regional and national scale. Glacier National Park and the Bob Marshall Wilderness are two areas within the range of bull trout where the population ecology and the species is poorly understood. More notably, these areas have the greatest potential for maintaining source populations. It is critical that we understand the population ecology of bull trout and potential threats of invasion by lake trout in these areas if we want to develop a functional action plan.

The objectives of this project are: i) evaluate bull trout status, demographics, spawning and recruitment potential. Assess invasion status and potential for non-native species in six lakes (Upper Kintla, Trout, Arrow, Isabel, Lincoln, and Akokala) where bull trout status is currently largely unknown, ii) assess bull trout population status through redd counts or other means in the

Quartz Creek drainage and propose and implement a barrier strategy to isolate the three uppermost lakes (Cerulean, Quartz, and Middle Quartz) in this highest priority watershed from imminent lake trout invasion from downstream, and iii) with successful completion of the above steps, the ultimate objective of this proposal is to develop a comprehensive action plan for the long-term monitoring, management, and eventual recovery of bull trout resources in these lakes in Glacier National Park. The action plan will include specific management recommendations, including detailing a long-term monitoring program, and identifying specific short-term and long-term actions to reverse the ongoing effects of invasion and establishment of non-native lake trout and other species in Glacier National Park lakes. The action plan will be used by FWS and NPS to implement bull trout recovery in Park waters. These lakes contain 15 of 52 naturally occurring adfluvial populations of bull trout in the entire Columbia River Basin and include the majority of the remaining bull trout lakes that occur in unmanaged watersheds in the entire Pacific Northwest.

Total Project Cost		$132,738.00
Beginning Balance – March 2004		$132,738.00
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$5,896.60	
Communication	$ 63.70	
Supplies	$5,865.47	
IDCs @ 15%	$1,773.88	
Total Spent		$ 13,599.65
Balance		$119,138.35
Waived IDCs		$ 3,869.97

Montana prairie riparian native species study
and
Landscape-level factors influencing the distribution of fishes in Eastern Montana prairie streams

Investigators
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Unit Leader, MTCFRU
Christopher Guy
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Collaborator
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Montana Fish, Wildlife and Parks

Graduate Student
Melissa Jones-Wuellner, M.S.

Funding
Montana Fish, Wildlife and Parks,
MSU index 426499

Project Duration
April 2002 - June 2006

An analysis of the Montana River Information System database maintained by the Montana Department of Fish, Wildlife and Parks revealed that more than 18,000 miles of streams in Montana have not been surveyed. The overwhelming majority of these waters are small, warmwater prairie streams located in eastern Montana. A strong likelihood exists that many of these streams contain intact, diverse assemblages of native non-game fish and amphibian species. Similarly, data are scarce or non-existent for amphibians, reptiles, birds, and small mammals in the riparian corridors through which these prairie streams flow. The purpose of this study is to gain a greater understanding of the vertebrate faunas that occur in a diversity of prairie stream and associated riparian/grassland habitats by performing a survey of fish, amphibians, reptiles, birds, and mammals. This information will enable resource managers to better understand and manage prairie species and their habitat.

The primary objectives of this study are: i) determine species presence and diversity of fish, amphibian, reptile, bird, and mammal species that occur in or around small streams in eastern Montana, ii) fill in data gaps on prairie fish, amphibian, reptile, bird, and mammal species distribution, iii) determine where intact assemblages of native aquatic species occur, iv) increase knowledge about the distribution of sensitive species, and v) gather baseline data to be used to respond to resource pressures such as coalbed methane extraction and bait fish seining.

Total Project Cost		$388,672.00
Beginning Balance – July 2003		$334,367.42
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$38,717.45	
Repair and Maintenance	$ 186.18	
Communication	$ 681.08	
Contracted Services	$ 573.92	
Travel	$ 8,462.33	
Supplies	$ 337.59	
Awards	$ 85.00	
IDCs @ 0%	-0-	
Total Spent		$ 49,043.55
Balance		$285,323.87
Waived IDCs		$ 20,353.07

An index of biotic integrity for the Missouri River and lower Yellowstone River

Investigators
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Unit Leader, MTCFRU
Robert White
Unit Leader Ret., MTCFRU

Graduate Student
Lee Bergstedt, Ph.D.

Funding
U.S. Army Corps of Engineers
USGS RWO 35, MSU Index 428254

Project Duration
August 1998 - April 2004 – **Completed**

This study was part of a basin-wide effort among the Cooperative Research Units in Montana, Idaho, South Dakota, Iowa, Kansas, and Missouri (the Missouri River Benthic Fish Consortium), and the Montana Department of Fish, Wildlife and Parks. The base study was designed to 1) describe and evaluate recruitment, growth, size structure, body condition, and relative abundance of selected benthic fishes within and among river zones and among study segments, and 2) describe habitat use of benthic fishes along the entire mainstem warmwater riverine portion of the Missouri River.

This component addressed the need to develop an effective biological assessment tool to describe the current status of the biota and measure the response to any remediation efforts of changes in water management practices on the Missouri River. Substantial modifications have occurred on the Missouri River and increasing concern exists about fish and wildlife values on the river. The three main objectives of this investigation were to 1) characterize the fish assemblage of the warmwater riverine reaches of the Missouri River, 2) develop a numeric multimetric index of biotic integrity to describe the changes associated with major river modifications along all warmwater riverine reaches of the Missouri River, and 3) identify the appropriateness of this method for long-term use on the Missouri River system. This study tested the broad hypothesis that biotic integrity declined in reaches with increased environmental degradation in the Missouri River. Answering several more-specific hypotheses tested this general hypothesis (e.g., species with specialized feeding requirements decline in reaches with increased environmental degradation).

The final IBI included the following metrics: number of native species, percent large-river faunal group fishes, number of native cyprinids, percent round-bodied catostomids, number of sensitive species, percent tolerant species, percent detritivores and filter-feeders, percent insectivorous cyprinids, percent top carnivores, catch per unit effort, percent introduced fishes, and percent of fishes with deformities, eroding fins, lesions or tumors. It appears to be able to discriminate between the best attainable conditions in the upper basin and conditions within zones where human activities such as channelization, dredging, flow regulation, and urbanization have affected aquatic communities.

Assessment of reproductive isolation between Yellowstone cutthroat trout and rainbow trout in the Yellowstone River, Montana

Investigator
Alexander Zale
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Graduate Student
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Funding
Montana Fish, Wildlife and Parks, MSU index 427334; National Fish and Wildlife Foundation, MSU index 426135; Jackson Hole One Fly Foundation, MSU index 426681

Project Duration
January 2001 - August 2004 – **Completed**

The genomic extinction of Yellowstone cutthroat trout *Oncorcynchus clarki bouvieri* has occurred throughout many pars of its historic range due to displacement and introgression with introduced rainbow trout *O. mykiss*. However, fluvial cutthroat trout may still retain their genetic integrity while co-existing with rainbow trout in the Yellowstone River drainage, Montana. We assessed whether spatial or temporal reproductive isolation, or both, occurs between these taxa. Time and place of spawning was determined by radio-telemetry of a total of 164 trout (98 cutthroat, 37 rainbow, and 29 cutthroat x rainbow hybrids) over three spawning seasons, from 2001 to 2003. Fish were telemetered in four areas of a 140-km segment of the mainstem Yellowstone River. Of the 164 radio-tagged fish, 73 (44 cutthroat, 15 rainbow trout, and 14 hybrids) were assumed to have spawned. Fifty-five (75.3%) of 73 radio-tagged fish that spawned used 16 tributaries, 17 (23.3%) used 7 river side channels, and 1 (1.4%) used the main channel of the Yellowstone River. The majority of fish that spawned (62%) used five spawning areas. These were used by 79% (N = 11) of hybrids, 61% (N = 27) of cutthroat trout, and 47% (N = 7) of rainbow trout that spawned. Spawning-area and spawning-reach overlap index values were high among all taxa. In contrast, mean migration and spawning dates of rainbow trout and hybrids were 5 to 9 weeks earlier than cutthroat trout. Rainbow trout and hybrids began migrating and spawning in April and May when Yellowstone River discharges were lower and water temperatures were colder than discharges and temperatures during cutthroat trout migration and spawning in June and July. Spawning-period overlap index values between rainbow trout and hybrids versus cutthroat trout were typically less than half the spatial overlap index values. Therefore, difference in time of spawning is likely the predominant mechanism eliciting reproductive isolation. Management actions focused on later spawning cutthroat trout in tributaries may enhance temporal reproductive isolation from rainbow trout and hybrids.

Total Project Cost		$88,780.00
Beginning Balance July 2003		$13,504.98
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$10,209.29	
Repair and Maintenance	$ 45.40	
Contracted Services	$ 854.67	
Travel	$ 1,971.78	
Supplies	$ 423.84	
IDCs @ 0%	$ -0-	
Total Spent		$13,504.98
Balance		$ -0-
Waived IDCs		$ 5,604.57

Evaluation of entrainment losses of westslope cutthroat trout at private irrigation diversions on Skalkaho Creek, Montana

Investigators

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Thomas McMahon
MSU Dept. of Ecology

Collaborator

Christopher Clancy
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Graduate Student

Steve Gale, M.S.

Funding

Wild Fish Habitat Initiative of the Montana University System Water Center, MSU indexes 426493 and 425305

Project Duration

July 2002 - December 2004

The Bitterroot River flows through irrigated farm and ranch land in southwest Montana to its confluence with the Clark Fork River near Missoula. Five major water diversions and numerous smaller canals remove substantial quantities of water from the Bitterroot River during the irrigation season. Many tributaries of the Bitterroot River are also diverted for irrigation during the summer months and contribute little stream flow to the river during that time. Both the mainstem of the Bitterroot River and its tributaries are therefore chronically dewatered during the irrigation season. Skalkaho Creek is a 40-km long tributary of the Bitterroot that supports a healthy population of westslope cutthroat trout along with brook trout, brown trout, bull trout, mountain whitefish, redside shiner, and slimy sculpin. We are examining the effects of eight lowhead dams on lower Skalkaho Creek that are believed to divert downstream migrant westslope cutthroat trout into irrigation canals. Both post-spawn adults migrating back to the Bitterroot River and juveniles emigrating downstream from nursery reaches of Skalkaho Creek and its tributaries are likely entrained and become trapped and die in the irrigation canal system, thereby resulting in a net loss to the population. Private landowners and irrigators in the drainage were concerned over these possible losses and are installing fish screens at the diversions in cooperation with the Montana Department of Fish, Wildlife & Parks.

Our study is assessing the efficiency of the fish screens by comparing the proportions and number of downstream-migrating juvenile and adult westslope cutthroat trout entrained at each of the diversions before and after screening, and by assessing passage efficiency of screen bypasses. Entrainment rates are being estimated using telemetry and fish traps. Field work commenced in spring of 2003 and will continue through autumn of 2004.

Total Project Cost		$163,269.00
Beginning Balance – July 2003		$124,595.89
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$ 5,030.35	
Repair and Maintenance	$ 70.70	
Communication	$ 429.96	
Contracted Services	$ 1,313.76	
Travel	$ 3,298.14	
Supplies	$63,118.84	
Rent	$ 3,989.84	
Equipment	$ 4,800.00	
Awards	$ 120.00	
IDCs @ 26%	$20,116.99	
Total Spent		$102,288.58
Balance		$ 22,307.31
Waived IDCs		$ 22,332.77

Thermal requirements of westslope cutthroat trout

Investigators
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Collaborator
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U.S. Fish and Wildlife Service

Graduate Student
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Funding
Wild Fish Habitat Initiative of the Montana University System Water Center, MSU indexes 426492 and 425304

Project Duration
July 2002 - December 2004

Historically, westslope cutthroat trout *Oncorhynchus clarki lewisi* ranged widely over western Montana, Idaho, and portions of eastern Washington and Oregon. Like many other native trout, westslopes now persist in only a small portion of their original range, and are listed as a Species of Special Concern in Montana. Leading causes for their decline are habitat degradation and displacement by non-native rainbow, brook, and brown trout. Water temperature is considered a key factor for coldwater species like trout, yet the thermal requirements of westslope cutthroat trout, like many other native fishes are largely unknown. In addition, increased water temperature is thought to favor non-natives in many cases, yet the effect of temperature on competition between westslope cutthroat and non-natives is unknown. Furthermore, hybridization between westslope cutthroat trout and non-native rainbow trout has resulted in a decline in populations of genetically pure westslopes. It is unclear what the thermal requirements of these hybrids are, as well as how the competitive interactions among hybrids, genetically pure westslope cutthroat trout, and other non-natives are influenced by water temperatures.

This laboratory study aims at testing how temperature affects the vital processes of growth and survival of westslope cutthroat trout. It is being conducted at the USFWS Bozeman Fish Technology Center. Our laboratory protocol allows simultaneous assessment of fish growth and survival following full physiological acclimation under many different thermal regimes over long time periods. Objectives are to i) define the upper lethal and optimum growth temperatures of westslope cutthroat trout, ii) determine how temperature influences competitive interactions between westslope cutthroat trout and rainbow trout, and iii) contrast how thermal requirements of westslope x rainbow hybrids compare with pure westslope cutthroat trout and pure rainbow trout as a means of assessing why hybrids between these two species have been so successful.

Preliminary results suggest the upper limit for indefinite survival of westslope cutthroat trout is near 21° C. In contrast, we observed greater than 90% survival among at 8 to 20° C. Peak growth was at about 12° C. These thermal requirements are surprisingly similar to those of bull

trout. Our previous work showed that bull trout have among the lowest upper lethal limits of North American salmonids.

Total Project Cost		$83,137.00
Beginning Balance – July 2003		$56,574.00
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$14,942.51	
Communication	$ 190.17	
Contracted Services	$ 135.25	
Travel	$ 4,709.19	
Supplies	$ 2,444.13	
Awards	$ 425.00	
IDCs @ 26%	$ 5,940.00	
Total Spent		$28,786.25
Balance		$27,787.25
Waived IDCs		$ 6,006.29

Evaluation of the efficiency and efficacy of non-native fish eradication and exclusion techniques for native fish restoration

Investigator
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Unit Leader, MTCFRU

Graduate Student
Peter Brown, Ph.D.

Funding
Wild Fish Habitat Initiative of the Montana University Water Center, MSU index 425311

Project Duration
October 2003 - December 2004

Native fish conservation has become a pressing issue for resource managers, often because of threats posed by non-native fish species. Predation and competition for resources can drive native populations extinct and hybridization reduces the genetic integrity of native populations. When presented with a non-native fish species problem, managers frequently undertake native fish restoration projects. These projects use a combination of techniques to eradicate non-native fish species and prevent their reinvasion. Yet, despite their widespread use as management tools, the success rate of these projects varies widely and they are rarely evaluated sufficiently.

The goal of this project is to increase the success rate of native fish restoration. To achieve this goal, we will carry out a thorough investigation of the techniques used to remove non-native fish and the design of barriers to reinvasion. Initially, interviews with project leaders and site visits of ongoing and past restoration projects will be used to determine the current methods of fish removal and barrier design. These interviews will also identify projects for which a more thorough evaluation needs to be made. Evaluation of unsuccessful restoration projects will identify potential causes of failure. With these causes identified, field and laboratory studies of fish removal and barrier design will be used to increase the efficacy of these techniques. Understanding the inefficiencies of fish removal techniques and barrier design will increase the overall effectiveness of native fish restoration.

Total Project Cost		$49,655.00
Beginning Balance – October 2003		$49,655.00
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$8,439.56	
Communication	$ 94.95	
Contracted Services	$ 239.62	
Travel	$1,245.59	
Salary	$6,770.98	
Awards	$ 721.40	
IDCs @ 26%	$4,424.09	
Total Spent		$21,836.19
Balance		$27,818.81
Waived IDCs		$ 4,637.93

An empirical assessment of factors precluding recovery of sauger in the lower Yellowstone River: movement, habitat use, exploitation, and entrainment

Investigators
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Collaborator
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Graduate Student
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Funding
Montana Fish, Wildlife and Parks,
MSU indexes 426920 and 428513

Project Duration
January 2001 - June 2004 – **Completed**

The lower Yellowstone River has traditionally supported an important recreational fishery and until relatively recently sauger *Sander canadensis* were the most common game fish in this system. However, sauger numbers have declined since the mid 1970s and reached a historical low in the late 1980s and early 1990s following several drought years. It was expected that sauger abundances would rebound following high-water years in the mid 1990s, but no response in the population was observed. Declines in the Yellowstone watershed, as well as a synchronous decrease in abundance and lack of subsequent recovery by other Montana sauger populations, led to the classification of sauger as an Imperiled Species of Special Concern in Montana. Migratory barriers, habitat loss, overexploitation, and entrainment at irrigation diversions were suggested to explain the failure of Yellowstone River sauger to return to historical abundances. However, lack of information regarding sauger exploitation rates and ecology, specifically as they relate to seasonal movement patterns and habitat use, made it difficult to assess the validity of these hypotheses and effectively manage sauger in the Yellowstone River.

The objectives of this study were to characterize seasonal movement patterns, habitat use, aggregation, movement, exploitation, and Intake canal entrainment rates of the Yellowstone River adult sauger population. They were directed at determining which factors prevented recovery of the Yellowstone River sauger fishery. Assessment of movement patterns and rates provided an understanding of the extent that diversion dams restricted sauger movement throughout the year. Evaluation of habitat use allowed characterization of seasonally important habitat types and elucidated the role of diversion dams in preventing sauger from accessing them. Investigation of habitat use also allowed assessment of whether spawning habitat was limited. Description of seasonal patterns of aggregation provided an understanding of times and locations that sauger were most susceptible to overexploitation. Estimation of exploitation rates incorporating tag loss and angler non-reporting allowed accurate assessment of angler harvest. Estimation of entrainment rate in Intake canal provided a better understanding of the effect of entrainment at irrigation diversions relative to other sources of mortality. Satisfying these objectives provided information to guide the formation of management strategies to benefit the

recovery of the Yellowstone River sauger fishery.

Seasonal movement, aggregation, and habitat use were investigated by telemetering and tracking 30 fish in 2001, 31 fish in 2002, and 30 fish in 2003. Exploitation and entrainment rates were assessed by tagging 957 sauger with reward tags. Tag-shedding rate (2.1%) was estimated by double-tagging and non-reporting rate (61.5%) was estimated using postcards as tag surrogates.

Sauger aggregated near spawning areas in spring and subsequently dispersed 5 to 350 km to upstream home river locations where they remained for the rest of the year. During the spawning period, terrace and bluff pools, which are unique geomorphic units associated with bedrock and boulder substrate, were positively selected while all other habitat types were avoided. Spawning habitat did not appear to be scarce; mainstem areas distributed over 250 kilometers were used for spawning. However, tributary use during spawning was rare. Following movement to home locations, sauger used most habitat types in proportion to their availability but selected reaches of specific geologic types. Diversion dams did not appear to affect movements or habitat use of adult sauger. Most sauger did not encounter diversion dams during annual migrations between spawning and home locations and, although diversion dams separated seasonally important habitat types of some sauger, movement was not ostensibly restricted. Exploitation rates were low overall (18.6%) and were lower in spring when sauger were aggregated than in autumn when they were randomly distributed. However, the potential for seasonally high exploitation exists. The probability of individual sauger being captured in autumn was high and low exploitation rates resulted from voluntary release of captured fish. Exploitation rates would increase to potentially deleterious levels if all captured sauger were harvested. Entrainment in Intake diversion accounted for about half of non-fishing mortality and entrainment in irrigation canals may cumulatively be the single largest non-fishing source of mortality to adult sauger in the Yellowstone River. However, annual survival rates were high (70.4%).

Migratory barriers, habitat loss, entrainment, and overexploitation of adult sauger likely are not preventing sauger recovery, but the effects of these factors may be more pronounced for juvenile sauger. Habitat alteration and interactions with non-native walleye and smallmouth bass may also affect abundances.

Total Project Cost		$145,000.00
Beginning Balance -- July 2003		$ 4,875.38
Expenditures – July 2003 - June 2004		
Repair and Maintenance	$ 176.38	
Contracted Services	$ 20.35	
Travel	$2,700.60	
Supplies	$1,978.06	
IDCs @ 0%	-0-	
Total Spent		$ 4,875.39
Balance		$ -.01
Waived IDCs		$ 2,023.29

Interactions among hybrid striped bass, white bass, and walleye in Harlan County Reservoir, Nebraska

Investigator
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Collaborators
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Keith Koupal
Nebraska Game and Parks Commission

Graduate Student
Nathan Olson, M.S.

Funding
Nebraska Game and Parks Commission, MSU index 426477

Project Duration
April 2002 - June 2004 – **Completed**

Walleye *Sander vitreus*, white bass *Morone chrysops*, and hybrid striped bass *M. chrysops x M. saxatilis* are common top-level predators in Midwestern reservoirs. However, the ecology and interactions among these species are not well understood. Therefore, we compared the food habits, diet breadth, diet overlap, isotopic composition, vertical distribution, and vertical overlap of these species in Harlan County Reservoir, Nebraska, during the months of June through September 2002 and 2003. In addition, prey selection of hybrid striped bass for walleye and golden shiner *Notemigonus crysoleucas* was evaluated using feeding experiments. All three species consumed similar prey (i.e., gizzard shad *Dorosoma cepedianum*), and diet overlap was high during all months in both years. No species was found to have consistently higher diet breadth. Vertical distribution was similar and spatial overlap was high for white bass and hybrid striped bass in 2002, and between white bass and walleye in 2003. Stable isotope analysis indicated that all three species occupied the same trophic level and that each predator was deriving carbon from a similar prey source. Few hybrid striped bass consumed prey during feeding experiments, thus definitive selection by hybrid striped bass for walleye and golden shiner could not be determined. This study provides the first comprehensive evaluation of these three top-level predators in a reservoir system. Although resource overlap was high among these predators, competition is not suggested or expected because resources do not appear to be limited in Harlan County Reservoir.

Total Project Cost		$93,950.00
Beginning Balance – July 2003		$47,377.39
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$16,755.05	
Repair and Maintenance	$ 3,195.85	
Communication	$ 280.40	
Contracted Services	$ 958.10	
Travel	$ 5,150.96	
Supplies	$10,894.57	
IDCs @26.8%	$ 9,681.05	
Total Spent		$46,915.98
Balance		$ 461.41
Waived IDCs		$ 9,789.08

Riparian habitat dynamics and wildlife along the upper Yellowstone River

Investigators

Andrew Hansen
Jay Rotella
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Funding

U.S. Army Corps. of Engineers
USGS RWO 45, MSU Index 426138

Project Duration

August 2001 - April 2004 – **Completed**

The U.S. Army Corps of Engineers, along with the Upper Yellowstone River Task Force, is assessing the cumulative effects of bank stabilization along the upper Yellowstone River. In this study, we collected bird and vegetation data within riparian zones along the river to determine the attributes of avian and shrub communities within eight vegetation successional stages and three geomorphological reach types. Additionally, we used aerial photos from 1948 and 1999 to investigate change in riparian vegetation over time. Finally, we used statistical models to predict bird richness across portions of the study area. A total of 78 bird species and 15 shrub species were recorded overall. We found that the moderately confined and braided reaches supported the highest bird abundance, diversity, and richness. Within the braided reach, the mature cottonwood stages supported the highest bird richness, diversity, and abundance. The best model for predicting richness included successional stage, which explained 51% of the variation. The braided reach exhibited the highest predicted richness because it supported the most mature cottonwood forest. Analysis of the areal distribution of riparian vegetation over time showed different responses within the braided and moderately confined reaches. Braided reaches experienced an increase in both younger and older successional stages, whereas the moderately confined reach experienced a decline in younger stages and an increase in older stages. Land managers interested in maintaining avian diversity should consider the importance of periodic flooding in maintaining the full range of successional stages of riparian vegetation in this river system.

Total Project Cost		$96,637.00
Beginning Balance – July 2003		$ 6,120.37
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$2,742.65	
Travel	$2,669.91	
Supplies	$ 151.37	
IDCs @ 10%	$ 556.39	
Total Spent		$ 6,120.32
Balance		$ .05
Waived IDCs		$ 1,978.12

Applications of satellite imagery in adaptive resource management

Investigator
Tad Weaver
MSU Dept. of Ecology

Funding
U.S. Bureau of Land Management
USGS RWO 34, MSU index 428984

Project Duration
April 1998 - November 2003 – **Completed**

Botanical survey is expensive because it involves detailed on-the-ground recording. We tested the hypothesis that satellite imagery yields data both less expensive and adequate/superior for several purposes including general mapping estimation of weed control success, and estimation of dead material on rangeland. Satellite data is less useful for other purposes, such as detecting the presence of rare species.

The project had four specific objectives: i) to create a map of Lostwood National Wildlife Reserve, ii) to estimate the effects of burning on upland vegetation, iii) to estimate the litter and standing dead and their impacts on plant growth via temperature, light, and water, and iv) to demonstrate the use of high resolution images in the solution of these problems. These applications will be useful in shortgrass and mixed grass management units throughout the great plains.

Total Project Cost		$135,046.00
Beginning Balance – July 2003		$ 7,772.61
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$5,896.55	
Contracted Services	$ 14.78	
Supplies	$ 408.40	
Awards	$ 745.25	
IDCs @ 10%	$ 706.63	
Total Spent		$ 7,772.61
Balance		-0-
Waived IDCs		$ 2,519.00

Trophic interactions among *Potamopyrgus antipodarum*, periphyton food resources and fish

Investigator
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Graduate Student
Chelsea Cada, M.S.

Funding
U.S. Fish and Wildlife Service,
USGS RWO 47, MSU index 426668

Project Duration
July 2002 - December 2004

Invasions by exotic species can have profound effects on ecosystems. For example, exotic species are believed to have caused population declines in nearly half of the native species listed as threatened or endangered. *Potamopyrgus antipodarum* (Gray) is an aquatic snail native to New Zealand that has colonized North America. Recently, the New Zealand mud snail was found in a tributary (Darlinton Ditch) of the lower Madison River near Three Forks, Montana. Darlinton Ditch may be an excellent area to examine the effects of mud snails on ecosystems because it is a relatively small, physically homogeneous stream. Moreover, mud snails have a distinct invasion front allowing us to work in areas where mud snails and native macroinvertebrates occur together and were native macroinvertebrates occur alone.

We will examine the effects of New Zealand mud snails on the periphyton food resource and to the fish in Darlinton Ditch. Our objectives are to i) determine the extent to which trout and other fishes consume New Zealand mud snails in Darlinton Ditch, and ii) determine the influence of New Zealand mud snails on the periphyton resource in Darlinton Ditch.

Total Project Cost		$31,924.00
Beginning Balance – July 2003		$31,608.68
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$17,156.36	
Travel	$ 62.37	
Supplies	$ 332.82	
Awards	$ 848.15	
IDCs @ 10%	$ 2,066.06	
Total Spent		$20,465.76
Balance		$11,142.92
Waived IDCs		$ 857.41

Bayesian and decision theoretic analysis of the status of the western stock of Steller sea lions in relation to fisheries and environmental factors

Investigator
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Funding
National Marine Fisheries Service
USGS RWO 48, MSU Index 426782

Project Duration
September 2002 - August 2005

The western stock of Steller sea lions, which inhabits the Gulf of Alaska, the Aleutian Islands, and the Bering Sea, has been declining at a significant rate for 3 decades. For part of the period of decline, direct and incidental fishing mortality was a definite contributing factor. In the past two decades, however, direct and incidental mortalities are believed to have diminished to levels too small to account for the continuing decline. The continuing decline constitutes something of an ecological puzzle.

Analysis of age composition of the population suggests high post-weaning mortality of juveniles. Some, but not all, observations on body size, growth rates, condition and behavior of juveniles and adults (but not pups) suggest nutritional stress. It has also been hypothesized that activities of the commercial groundfish trawl fishery may be playing a role in causing a food shortage by local depletion of dense concentrations of forage fish populations, especially pollock, in critical areas and at critical times. But such local depletion, though possible (and to some extent documented for the Atka mackerel fishery), has yet to be documented and characterized empirically for the pollock fishery, and overall the target fish species remain fairly abundant. The picture is further complicated by decadal-scale oceanic regime shifts, which are suspected to have caused large changes in productivity, and which may, in conjunction with fisheries activities or possibly independent of them, have affected the marine community composition in a way that might affect the sea lions. Attempts to correlate regional rates of sea lion decline with fishing activity have been inconclusive.

This project proposes to revisit all the major statistical and modeling analyses for the Steller sea lion assessment within an empirical Bayes framework, so that explicit, rigorous probabilities can be attached to all the inferences. The main analyses that will be pursued are model life tables for various geographic segments of the population, sensitivities of the population growth rate to changes in vital rates, changes in the vital rates within the time spanned by the data, spatial and temporal patterns in the trajectories of the population counts at the various rookeries, correlations between local population trends and local fishery activity, and correlations between population trend and oceanographic indices.

Total Project Cost		$274,600.00
Beginning Balance – July 2003		$251,958.03
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$51,846.64	
Travel	$ 2,436.55	
Supplies	$ 5,042.13	
Tuition	$11,741.00	
IDCs @ 15%	$10,812.16	
Total Spent		$ 81,878.48
Balance		$170,079.55
Waived IDCs		$ 23,167.41

Identification of subclinical biomarkers for chronic wasting disease and strains of the CWD agent

Investigator
Richard Bessen
MSU Veterinary Molecular Biology

Funding
USGS National Wildlife Health Center, Madison, Wisconsin, USGS RWO 51, MSU Index 425504

Project Duration
April 2004 - February 2006

Chronic wasting disease (CWD) is an emerging prion disease of free-ranging and captive deer and elk in North America. The prevalence of CWD in free-ranging mule deer in endemic areas of the western United States is approximately 5% but has been reported to be as high as 15%. In recent years, CWD has been diagnosed in free-ranging and captive cervids outside the endemic areas in the central and western U.S. as well as in Canada. Spread of the disease has been tracked to the movement of CWD-infected cervids from endemic regions. The geographic distribution of CWD will likely extend beyond the current boundaries. One major concern is that CWD may have the ability to spread to other species including domestic livestock and humans. An important determinant for interspecies transmission of CWD is the pathogenic properties of the strain(s) of the CWD agent circulating within cervid populations. However, the types and numbers of strains of the CWD agent in cervid populations is uncertain. Recently, the United States Department of Agriculture declared a CWD emergency that threatens domestic livestock and has presented to Congress a national plan for CWD management.

The current method for surveillance of CWD in cervids involves immunodetection of the abnormal prion protein (PrP^{Sc}) in brain or lymph nodes collected at autopsy. Identification of biomarkers that are predicative of CWD infection in live animals in the subclinical stage of the infection would provide an important tool for surveillance and management of CWD in free-ranging and captive cervids as well as for research purposes aimed at investigating CWD transmission and pathogenesis. Attempts to identify subclinical biomarkers in prion diseases of livestock have not been successful. However, in CWD-infected deer the prion agent targets the neuroendocrine system. Physiological alteration of the neuroendocrine system in CWD could alter gene and protein expression in these tissues, and possibly in circulatory cells, as well as affect the hormone and steriod levels in blood, urine, and saliva. These CWD related changes could form the basis for a simple, live animal test for CWD infection.

The long-term goals of this study are two-fold; to identify subclinical biomarkers of CWD infection and to develop a rapid assay for the identification of CWD strains present in free-ranging and captive cervids. To accomplish the first goal, the specific aims are 1) to identify a rodent model for prion infection of the endocrine system, and 2) to identify biomarkers in endocrine tissues, blood, urine and saliva that are predictive of subclinical infection in a rodent model for prion infection of the endocrine system. To accomplish the second goal, our specific aims are 1) to establish a cervid PrP^{Sc} strain identification assay for CWD, and 2) to identify and monitor strains of the CWD agent in free-ranging and captive cervids.

Total Project Cost		$243,100.25
Beginning Balance – April, 2004		$243,100.25
Expenditures – July 2003 - June 2004		
Salaries and Benefits	$6,332.42	
IDCs @ 15%	$ 949.86	
Total Spent		$ 7,282.28
Balance		$235,817.97
Waived IDCs		$ 2,072.29

Montana Cooperative Fishery Research Unit Vehicle Account

Investigator

Alexander V. Zale
Unit Leader, MTCFRU

Funding

Designated Account – Projects are charged mileage based on project use.

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 – July 2003		$ 8,233.49
Expenditures – June 2003 - July 2004		
Repairs and Maintenance	$3,123.52	
Fuel	$5,326.75	
Insurance	$ 394.88	
MSU Parking Decals	$ 225.00	
Supplies	$ 95.40	
Administrative Assessment Fee @ 4%	$ 357.64	
Total Spent		$ 9,523.19
Total Revenue Reimbursed (60,782 miles)		$22,629.22
Balance		$21,339.52

Montana Cooperative Fishery Research Unit Operations IDC Account

Investigator
Alexander V. Zale
Unit Leader, MTCFRU

Funding
10% of Indirect Costs derived from projects

Beginning Balance – July 2003		$6,705.06
Expenditures – July 2003 - June 2004		
Petty Cash	$ 100.00	
Communications	$ 989.14	
Contracted Services	$1,125.48	
Supplies	$2,290.14	
Rent (Storage Unit)	$2,065.00	
Buildings/Grounds	$ 696.13	
Administrative Assessment Fee	$ 258.16	
Total Spent		$7,524.05
Total Revenue from IDCs		$6,990.71
Balance		$6,171.72

Monetary Equivalence for MSU Services and Facilities
July 2003 - June 2004

Accountant Salary and benefits	$ 35,466.52
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 ($663,110.13)	$ 5,304.88
Utilities – General @ 9.9% of total expenditures ($663,110.13)	$ 65,647.90
Waived IDCs	$193,452.21
Total	**$324,344.97**

Federal Budget (October 2003 - September 2004)

Salaries and Benefits	$209,786.81
Unit Operations ($18,000 budgeted)	
Recognition Awards and Benefits (Chris Guy)	$ 1,074.32
Office Equipment	
Fax Machine	$ 695.00
Scanner and Color Printer	$ 420.59
Postage return	$ 20.67
Office Furniture (Admin. Desk)	$ 1,128.00
General Office Supplies	$ 489.12
Research Equipment	
Electrofishing Backpack	$ 7,467.59
Microscope Base	$ 1,545.30
Working Capital Vehicle Fund	$ 5,000.00
Total	**$227,807.40**

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

Montana Fish, Wildlife and Parks contributes $30,000 annually to the operation of the Montana Cooperative Fishery Research Unit. During fiscal year 2004, a portion of these funds was used to subsidize the completion of the project entitled "An empirical assessment of factors precluding sauger recovery on the lower Yellowstone River: movement, habitat use, exploitation, and entrainment" conducted by unit leader Alexander V. Zale and graduate student Matthew Jaeger.

Beginning Balance – July 2003		$ 34,493.48
Expenditures – July 2003 - July 2004		
Salaries and Benefits	$15,974.63	
Communication (Telephone/postage)	$ 288.66	
Contracted Services	$ 809.10	
Travel	$ 4,860.14	
Supplies	$ 3,349.89	
Awards	$ 1,120.21	
Buildings/Grounds/Electricity	$ 2,589.80	
IDCs @ 0%	-0-	
Total Spent		$ 28,992.43
Balance		$ 5,501.05
Waived IDCs		$ 12,031.86

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

USGS

2002 Chevrolet 4x4 Suburban (white)
Property No. 261052 – Serial No. 3GNGK26U52G249012
Acquisition value $31,988
Mileage 47,654

1999 Chevrolet 3/4-ton 4x4 pickup truck (white)
Property No. 252537 -- Serial No. 1GCGK24R9XF049122
Acquisition value $21,009
Mileage 51,377

1995 Ford Taurus GL station wagon (green)
Property No. 261116 – Serial No. 1FALP57U9SA292782
Acquisition value $15,068
Mileage 54,449

1993 Dodge 3/4-ton 4x4 pickup truck (tan)
Property No. 261115 – Serial No. 1B7KM26Z3PS205857
Acquisition value $12,221
Mileage 141,560

1989 Chevrolet 4x4 Suburban (tan)
Property No. 261114 – Serial No. 1GNGV26K2KF176088
Acquisition value $15,766
Mileage 106,490

1989 Chevrolet 4x4 regular cab pickup (blue)
Property No. 4320218 – Serial No. 1GCFK24K2KZ259793
Acquisition value $1,500
Mileage 117,192

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

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

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

U.S. Army Corps of Engineers

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

MT Fish, Wildlife and Parks

1988 Chevrolet 2-wheel drive pickup truck (white)
License Number FWP 793
Mileage 103,904

Montana State University

1985 Chevrolet Suburban (blue)
Property No. 87466
Serial No. 7712
Acquisition value $11,247
Mileage 90,932

1985 Ford ½-ton 4x4 pickup truck (brown)
Property No. 87521
Serial No. 0527
Acquisition value $9,301
Mileage 138,309

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

SRX 400A Datalogging Coded Series Receiver 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)

2003 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 are 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.