A Proposal for the Missouri River Institute

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Numerous private and public organizations provide technical support, data/information and hands-on management for the Missouri River. However, no single academic institution synthesizes information and studies, conducts integrated research, evaluates policies and offers educational programs related to the Missouri River. This poster discusses a proposal to establish the Missouri River Institute (MRI) at the University of Missouri-Columbia (MU). The mission of the MRI would be to disseminate information, conduct research, evaluate policies and develop educational programs that advance knowledge and understanding of the cultural, economic, environmental and social conditions affecting the use, management and restoration of the Missouri River.

Locating the MRI at MU is most fitting because the university has considerable experience in education, research and outreach and is nationally recognized for its programs in natural resources and environment. In addition, the state of Missouri has strategic ties to the Missouri River. Potential beneficiaries of MRI programs include: agricultural producers and input suppliers, barge transportation companies, environmental groups, land owners and managers, levee districts, natural resource management agencies, recreationists, river communities, schools and colleges, water supply districts and others. Short-term goals would be to: determine the geographic emphasis of the MRI (Upper and/or Lower Missouri River, main stem only, main stem plus selected tributaries, etc.); identify potential collaborators; form multidisciplinary teams to identify and prioritize research and educational needs; meet with potential sponsors; establish an advisory committee; hire staff and purchase equipment; compile relevant data, information and studies; and establish an interactive web site.

South Dakota Department of Tourism

Angler Use and Harvest Survey of the Missouri River System in Montana, North and South Dakota, 1997

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Angler use and harvest surveys were conducted in 1997 on Fort Peck Reservoir in Montana; Lakes Sakakawea and Oahe in North Dakota; and Lakes Oahe, Sharpe and Francis Case in South Dakota during daylight hours during the open water season. Anglers spent over 5.5 million hours, harvesting almost 1.7 million fish. The harvest rate for all fish was 0.31 fish/angler hour, ranging from a high of 0.47 in Lake Francis Case to a low of 0.11 in Fort Peck. Walleye *(Stizostedion vitreum)* accounted for 86 percent of all fish harvested. The harvest rate for walleye was 0.26 walleye/angler hour, ranging from a high of 0.44 in Lake Francis Case to a low of 0.08 in Fort Peck. The catch rate for walleye was 0.59 walleye/angler hour. Anglers fishing Lake Francis Case had the highest walleye catch rate at 1.07 walleye/angler hour, followed by Lake's Sharpe and Oahe at 0.82 and 0.66 respectively. These surveys document almost 1.2 million angler days during 1997, resulting in nearly 95 million dollars of direct economic benefits.

Assessment of Larval Fish Consumption by Goldeye in Two Missouri River Backwaters

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The presence of large number of adult goldeye *(Hiodon alosoides)* in backwater habitats of the upper Missouri River, combined with the presence of many other native fishes and their larvae, has raised questions about the predatory effect goldeye may have on the larval fish community. Goldeye and larval fishes

were sampled in backwater habitats during April, May, July, August, and September of 1997. Goldeye were collected with experimental gill nets and larval fishes with light traps. Peak relative abundance of adult goldeye coincided with peak relative abundance of larval fishes in July. We examined the stomach contents from 161 goldeye collected in July and August to determine what proportion of the goldeye diet was composed of larval fishes. Only four stomachs contained larval fish (2.5% frequency of occurrence) and larval fishes composed less than 0.1% of the total number of food items. We found that Corixidae, Coleoptera, and zooplankton (Copepoda and Cladocera) were the primary diet items.

Bad River Water Quality Project

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The Project is an EPA 319 Implementation Project designed to implement and evaluate sediment control practices on the highly erodible croplands and fragile clayey rangelands in the Bad River Watershed of Stanley County, South Dakota.

The watershed is a 3,172 sq. mi. watershed located in west central South Dakota and drains into the Missouri River between the cities of Ft. Pierre and Pierre, SD. Livestock grazing is the dominant land use. Remaining land is used for hayland and cropland. Farm sizes vary from 3,000 to 35,000 acres.

The Bad River does not support its assigned beneficial uses primarily because of sediment. The sediment delivery of 3.25 million tons per year severely impacts the Lake Sharpe impoundment of the Missouri River. The sport fishery contributes $2.5 million annually to the local economy when not impaired by turbidity from the Bad River. Sediment has significantly reduced channel capacity in the Missouri River. This has increased flooding in the municipalities and also caused the Corp of Engineers to reduce power generation from Oahe Dam because of the flooding caused by high winter flows.

The resulting project was based on the voluntary efforts of the local landowners in cooperation with the Stanley County Conservation District and Natural Resource Conservation Service to implement Best Management Practices in the watershed to reduce erosion and sedimentation. The project has demonstrated that significant sediment reduction can be achieved without jeopardizing the economic stability of the cooperators. Sediment in the target sub-watershed was reduced from 82.7 tons/ac-ft of runoff to 10.2 tons/ac-ft of runoff within a five year time period.

Bird Biodiversity on the Missouri River Benedictine Bottoms Mitigation Site from 1994-1999

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Documentation of the increasing bird diversity is part of a larger study of biodiversity taking place as the Corps of Engineers facilitates the transition of the Benedictine Bottoms from agricultural land to a managed riparian hardwood forest-wetland complex. Four methods were used in the collection of data: (1) Levee Survey: The 3.8 mile levee bisects the study site, and bird sightings are recorded to the nearest tenth of a mile. (2) The site is subdivided into three survey areas. The observer walked through each transect while recording data. Observations are correlated with these factors: date, time, temperature, cloud cover, wind direction/speed, precipitation (type), and location. (3) Through the use of the Kansas Breeding Bird Atlas Project (KBBAT) methods, the breeding status of all species is assessed. (4) The interior roads on the Bottoms were driven and we sampled by noting the species and numbers of individuals seen. Changes in habitat have already attracted at least 130 bird species, many associated with wetlands, notably White-faced Ibis, Black-crowned Night-Heron,Yellow-crowned Night-Heron, Peregrine Falcon, Least Tern, White Pelican, and Bald Eagle. Funding in part came from the Kansas Department of Wildlife and Parks and the Evah C.Cray Residuary Charitable Trust, and Discovery College Committee.

Entrainment of Ichthyoplankton in the Lower Yellowstone River as they Relate to Irrigation Intakes, 1995-1997

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We analyzed catch data from drift samples of ichthyoplankton from the lower 30 miles of the Yellowstone River in Montana and North Dakota. A total of 63 samples were collected using a D-shaped larval net at various habitat types. The project included several habitat types, including shallow

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water and deep water main channel and side channel habitats during late June or early July from 1995 through 1997. Analysis of the data included looking at catch rates for four categories; paddlefish *(Polydon spathula)* or sturgeon *(Scaphrynchus)* eggs or larvae, fish eggs, larval fish, or invertebrates. We compared the catch rates for each category at the various habitat types. We found increased catch rates for all categories at the bottom of the main channel and at the surface in shallow water side channel habitats. Current recommendations include that irrigation intakes draw water from the bottom of the water column. Results from this project suggest that the recommendation for the placement of irrigation intakes may need to be modified for riverine habitats. Further work is needed to more clearly identify species-specific impacts.

Fishes of the Missouri National Recreational River, South Dakota and Nebraska

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The Missouri National Recreational River was added to the National Wild and Scenic Rivers System in 1978. This 59-mile section of the river is one of the few remaining reaches that remains in a relatively natural condition. There has never been a thorough inventory of the fish community. We collected fish during three summers (1996-1998) from six macro habitats (channel crossovers, inside bends, outside bends, secondary channels connected to the river, secondary channels not connected to the river, tributary mouths) using five gears (experimental gill net, drifting trammel net, trawl, electrofisher, and seine). Physical conditions (water velocity, bottom substrate, turbidity, temperature) where fish were collected were also measured. In 1996, 4,042 fish of 40 species were collected; in 1997 the total was 8,377 fish of 43 species. Data from the 1998 field season are being analyzed. Numerically dominant species in 1996 were emerald shiner (52%), gizzard shad (16%), river carpsucker (5%), and sand shiner (3%); whereas in 1997, species comprising more than 3% of the total catch were gizzard shad (39%),

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emerald shiner (19%), quillback (8%), spotfin shiner (7%), and sand shiner (3%). Common recreational species included channel, blue, and flathead catfish, walleye, sauger, drum, smallmouth and largemouth bass, white crappie, northern pike, and yellow perch. Introduced species were grasscarp, rainbow smelt, and white bass. Species thought to be rare included shovelnose sturgeon and sicklefin chub. These data will help the National Park Service implement management plans with full consideration for conserving and enhancing fishery resources.

Microbial Biodiversity on the Benedictine Bottoms

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The U.S. Army Corps of Engineers initiated a program to mitigate the wetland habitats along the Missouri River that had been converted to agricultural use. An important function of this mitigation is to restore the disturbed habitat to some previous 'natural' conditions. This project to restore the area in Atchison county called the Benedictine Bottoms back to its native floodplain habitat began at the end of the 1993 growing season. Since then many trees, shrubs, and grasses have been planted and the level of biodiversity has increased. Microorganisms play a very important role in biodiversity and are essential to ecosystem dynamics. These organisms are key to various biogeochemical cycles such as soil nitrification. Beginning in winter 1998 soil samples were taken at a depth of five centimeters and analyzed for the number of taxa and abundance of microorganisms. Temperature and pH level at each sample site were also measured. The initial results of our investigation show an average of 6.5 X 105 colony forming units and a minimum of five different taxa of bacteria occurring in every five grams of soil. The average soil temperature was 9.0 degrees Celsius, and the average pH level was 7.75. The significance of different temperature and pH levels on microbial biodiversity in the soil at different sample sites was analyzed. Our research suggests that the great majority of microorganisms in the sample are nonpathogenic bacteria and play an important role in biological cycles.

Smallmouth Bass Movement and Habitat Use in Lower Lake Oahe, South Dakota

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Smallmouth bass movement and habitat use patterns were documented for two length groups (245-290 mm and ≥ 350 mm) of smallmouth bass in lower Lake Oahe, SD from May 1996 through October 1997. Objectives included documenting smallmouth bass habitat use and movement patterns to identify species habitat requirements and transferring this information to anglers to improve utilization of smallmouth bass by anglers. Smallmouth bass of both length groups followed the same general patterns in depth use, daily activity, distance from shore, and temperature use throughout the study. Peaks in daily activity occurred at dawn and dusk and fish were inactive at night. Fish moved shallow in late May and early June in preparation for spawning. After completion of spawning and rearing of young in early July, summer home ranges were established and generally occupied until mid-September. During late September and October, offshore movements to deeper water (> 10 m) were common and fish over-wintered in these areas. Summer home range size was greater for smallmouth bass in the ≥350-mm length group. Smallmouth bass in the 245-290-mm length group utilized cover more than larger bass, with rip-rap and flooded trees or brush being the predominant cover types used. Smallmouth bass ≥350 mm in length were generally deeper and further from shore than bass in the 245-290-mm length group. Smallmouth bass appear to home in Lake Oahe as a number of fish implanted with transmitters in May and June of 1996 at Oahe Dam returned there to overwinter.

State of the Flood Plain: The Lower Missouri River in Winter 1993/4 and May 1998

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The 1993 Flood along the Lower Missouri River caused extensive damage and dramatically altered the river and its floodplain. Most of the damaged areas were quickly repaired and returned to agricultural production. However, some areas were left to develop with minimal interference and have evolved towards a more natural wetlands state. Using remote sensing (satellite images), we can monitor large sections of the river system and document the changes that are occurring. We have combined some of these observations to provide two snapshots of the Lower Missouri River from Kansas City, MO, to St. Louis, MO. The first satellite image mosaic captures the river system just after the 1993 Flood, highlighting the damage caused by the floodwaters. The second mosaic shows the Missouri River in May 1998. In this mosaic, the areas reverting to wetlands are easily visible.

Status and Trends of the Lake Oahe Coldwater Fishery

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Lake Oahe is a large, mainstem, Missouri River storage reservoir. Initial attempts at establishing a coldwater fishery in Lake Oahe occurred during the early 1970's using kokanee salmon, bonneville cisco, opossum shrimp and lake trout were relatively unsuccessful. Downstream passage of rainbow smelt from Lake Sakakawea resulted in rainbow smelt becoming abundant in Lake Oahe by 1977. Downstream passage of chinook salmon stocked in Lake Sakakawea lead to the implementation of chinook salmon stocking and egg take operations for Lake Oahe in 1981. Today rainbow smelt are the primary prey

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fish species in the lower two thirds of Lake Oahe and the condition of walleye and chinook salmon is related to the status of the rainbow smelt population. Chinook salmon population structure and dynamics characteristics (abundance, condition, growth, maturation patterns) have varied greatly since the development of the chinook salmon fishery in the early 1980's. This poster will address potential driving mechanisms behind changes in the chinook salmon population status over time and the current status of the chinook salmon population and fishery.

The Biodiversity of Non-Avian Terrestrial Vertebrates on the Benedictine Bottoms, 1995-1998

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The U.S. Army Corps of Engineers has purchased and revegetated 943 ha. of floodplain habitat on the Missouri River in Atchison County, Kansas, called the Benedictine Bottoms. Our goal is to quantify changes in the biodiversity of amphibians, reptiles, and mammals residing on the Bottoms as the mitigation efforts proceed. Throughout the Spring and early Summer of 1994-1998, the presence of anuran species were determined by nocturnal observations and specimen collection. Reptiles were observed during daylight hours. Every month 40-50 standard mammal traps were placed among seven transect sampling sites for three nights. Deer spotlight surveys were conducted on a six kilometer portion of elevated road surrounding the Bottoms during the months of October and November. 19 species of anuran amphibians and reptiles were found, and 21 species of mammals were trapped or spotted on the Bottoms. Up to the end of 1998, an average of 30 Whitetail Deer *(Odocoileus virginianus)* were seen during each survey with 68% does and the remaining 32% were classified as immature bucks, mature bucks, fawns, or unclassified individuals. Comparisons with a nearby undisturbed floodplain habitat in Leavenworth, Kansas, revealed a high frequency of amphibian, reptile, and mammal species in common. This work was supported in part by the Cray Residual Fund and the Benedictine College Discovery Grant.

White Crappie Biology in an Upper Missouri River Backwater

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Research conducted in a large Missouri River backwater (MRB) in western North Dakota revealed the presence of a substantial white crappie *(Pomoxis annularis)* population. The function of centrarchids in northern-latitude riverine backwaters is not well understood. Thus, we collected white crappie in May, July, August, and September to assess the structure and dynamics of this population. Mean back-calculated length at age was 77-, 163-, 228-, 245-, 277-, and 299-mm total length (TL) at ages 1-6 respectively. White crappie seasonal and annual growth in the MRB were comparable to other regional populations. Size structure varied seasonally, ranging from a proportional stock density (PSD) high of 64 in May to a low of 28 in July. Incremental relative stock density (RSD) values indicated that the population is dominated by white crappie between 130- and 250-mm TL. Assessment of the age structure indicated that the 1995 year class (age 2) was relatively abundant. White crappie body condition values were highest for all length groups in July and August, with mean relative weight (Wr) values of 93 to 122. Wr values were lowest in September, with means ranging from 78 to 99. The food habits of white crappie in this MRB varied with white crappie length in August and September; however, all crappie had diets dominated by Cladocera, Corixidae, and fish eggs in May. White crappie less than 200-mm TL in August and September primarily consumed zooplankton, whereas crappie greater than 200 mm focused on fishes and Corixidae.