

**2010**  
**MRNRC Conference and BiOP Forum**  
**A Climate for Change**  
**Poster Abstracts**

**Title:** Use Distribution of Adult Pallid Sturgeon, *Scaphirhynchus albus*, in the Missouri River below Gavins Point Dam

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**Abstract:** The U.S. Geological Survey and Nebraska Game and Parks Commission are conducting a cooperative research project to investigate sturgeon behavior and movement in the Lower Missouri River. Data for this study are collected through a large scale telemetry effort, which includes approximately 85 adult pallid sturgeon (*Scaphirhynchus albus*) implanted with acoustic transmitters. Longitudinal movement and space-use requirements of pallid sturgeon within the Missouri River have not been thoroughly characterized. We calculated 95% use distributions, the extent of area with a 95% probability of occurrence of a specific fish during a specific time period, to describe geographic space-use requirements of telemetered pallid sturgeon during 2008 and 2009. Use distributions did not differ by sex in 2008 ( $t=0.86, p=0.40, df=71$ ), but did differ by sex in 2009 ( $t=2.13, p=0.04, df=54$ ). Use distributions were significantly smaller in 2009 than 2008 for males ( $t=2.01, p=0.05, df=80$ ) and females ( $t=2.43, p=0.02, df=34$ ). The mean 95% use distribution for 2008 was 107.7 ( $n = 73, SE = 15.6$ ) river miles. The mean 95% use distribution for males in 2009 was 67.1 ( $n=42, SE=13.8$ ) river miles and the mean 95% distribution for females in 2009 was 29.5 ( $n=17, SE=10.9$ ) river miles. Pallid sturgeon with large use distributions likely undertook spring spawning migrations. These analyses highlight the mobility of this species and the necessity to manage the pallid sturgeon at a range-wide scale.

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**Title:** Cottonwood Seedling Demography along the Upper Missouri River

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**Abstract:** Stands of riparian cottonwood forest along Missouri River in Montana between the confluence with the Marias River and Fort Peck reservoir are not extensive, but are highly valued in a landscape that is generally too dry to support widespread upland forests. In 1996, we initiated annual monitoring of cottonwood seedlings at eight sites with a range of grazing intensities in order to help resolve the interacting factors controlling the recruitment of new cottonwood forest. Cottonwood seedlings consistently establish in the bare, moist zone between the high and low water line during the period of cottonwood seed dispersal in early summer each year. Very few of these seedlings survive long enough to become saplings. Side valley constraints on lateral channel movement mean that the physical disturbance from the river creating suitable germination sites also tends to remove seedlings established in previous years. This situation is exaggerated by episodic disturbance from mechanical breakup of ice dams that further restrict safe establishment sites to high bank positions wetted only during relatively infrequent high-flow years. Herbivory interacts with these physical controls. Intense, extended (summer-long) grazing reduces densities of new and surviving seedlings, and most notably limits recruitment of seedlings to taller size classes. The best physical locations for cottonwood forest recruitment in this generally constrained reach of the Missouri River are those with the most potential for channel movement, including locally wide valley sections, around islands, and near tributary junctions.

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**Title:** Conservation genetics of sicklefin and sturgeon chubs in the Missouri River Basin

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**Abstract:** Dams along the Missouri River basin have effectively minimized the natural variation in temperature, turbidity, and flow regimes. As a result, many native fishes have experienced declines in population sizes due to altered hydrological conditions or restricted access to spawning and nursery grounds necessary for recruitment. Decreasing effective population sizes, loss of habitat, and restricted spawning migrations have effectively yielded isolated populations in the Missouri River Basin and potentially exposed them to greater risk of extirpation. Population sizes of both sicklefin (*Macrhybopsis meeki*) and sturgeon chubs (*M. gelida*) have declined prompting the Nebraska Game and Parks Commission (NGPC) to list them as "Tier 1", a category highlighting their imperiled and threatened status. Our objective is to assess the population viability of sicklefin and sturgeon chubs using molecular data to quantify genetic diversity, describe population structure, and estimate effective population size. With the cooperation of NGPC, Montana Fish, Wildlife, and Parks, Missouri Department of Conservation, Open Rivers and Wetlands Research Station and United States Fish and Wildlife Service offices in ND and MO, chubs were collected during the summer of 2008 and 2009. We present initial findings of this research and plans for future work.

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**Title:** Missouri River Education Initiatives at the University of South Dakota's Missouri River Institute

**Author(s):** Tim Cowman, Mark Dixon, Dan Soluk

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**Abstract:** The University of South Dakota established the Missouri River Institute (MRI) to develop and promote research, education, and public awareness related to the natural and cultural resources of the Missouri River Basin. The MRI is developing new curricula and academic programs for introductory and advanced river studies at USD, including undergraduate courses and graduate programs centered on riverine and environmental studies. In 2008, the MRI began offering "Introduction to River Studies", a 3 credit hour course focusing on important topics concerning large river systems, including geomorphology, ecology, history and culture of the river, and water law and policy. Field trips to observe issues, processes, and projects on the Missouri River take place throughout the semester. In 2009, MRI faculty began teaching "Missouri River Science and Ecosystem Management", under the U's Interdisciplinary Education and Action (IdEA) program. This class includes guest speakers from various stakeholder groups. Students role-play as individual stakeholders representing Native American, economic development, recreation and tourism, private landowners and biodiversity conservation interests and seek to develop consensus approaches for achieving ecosystem restoration and species recovery. In 2010 the MRI will offer a week-long summer course targeting K-12 teachers. This course will use a team of instructors to examine how topics on the science, culture, and history of the Missouri River can be integrated into the classroom. The course will be based out of the research and education wing at Ponca State Park and will consist of a combination of lecture sessions and field trips.

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**Title: Bathymetric and Thalweg Mapping on the 59-mile Segment of the Missouri National Recreational River**

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**Abstract:** The Missouri National Recreational River (MNRR) represents one of the few unimpounded and unchannelized reaches of the Missouri River, and still exhibits elements of natural channel morphology and dynamics. To better understand the channel morphology and dynamics, bathymetric and thalweg mapping was conducted on the 59-mile MNRR in 2009. Bathymetric data was collected between RM 753.5 and RM 756.0, located just upstream of Ponca State Park in Nebraska, and also between RM 778.0 and RM 783.0 near Clay County Park in South Dakota. A jon boat and a gps-enabled depth finder were used to collect bathymetric data points consisting of latitude, longitude, and depth along a 200-meter sampling interval. These data points were used to create a grid in ArcGIS Spatial Analyst that portrayed the contours of the river bed. Two thalweg mapping events were conducted on the entire 59-mile segment during June and October of 2009. A jon boat and depth finder were used to find the thalweg and a GPS point of the thalweg was collected every 100 meters along with attributes for depth and degree of braiding. Results of this study show the braided and dynamic nature of the river bed, portray the movement of dune formations on the river bed, and identify areas where the thalweg changes significantly and areas where it is relatively stable. A continuation of this study will provide valuable input into locating sites for ESH sandbars, evaluating turtle hibernaculum, and may provide useful input for modeling channel dynamics.

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**Title: Identifying Characteristics of Young of Year Chubs (*Macrhybopsis* spp.) of the Missouri River**

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**Abstract:** Big river chubs of the *Macrhybopsis* genus are target species for the Pallid Sturgeon Population Assessment Program (PSPAP) because they are thought to be major diet components of the federally endangered pallid sturgeon. The three main species of interest are shoal chub, sicklefin chub, and sturgeon chub, and approximately 40% of these species captured by the PSPAP in the lower Missouri River are less than 30 mm. The traditional key characteristics to distinguish these fish to species are not usually present until the fish reach 30 mm. This poster illustrates other characteristics that can be used to identify these fish to species during their first year of development (17 to 30 mm). Identifying these fish to species is important in order to study population trends among each species.

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**Title: A Comparison of Select Water Quality Parameters Collected from the Missouri River Main Channel, Tributaries, and Created Habitats**

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**Abstract:** The US Army Corps of Engineers (USACE) initiated a comprehensive Water Quality Program (WQP) in 2008 as part of the Missouri River Recovery Program. The WQP was initiated to address questions related to endangered species recovery, habitat modifications, and overall ambient conditions of the lower Missouri River. For example, does ambient water quality impact endangered species recovery? How does ambient water quality impact plankton and macroinvertebrate populations (ie, prey) within the Missouri River? How does mainstem river water quality compare with that of tributaries and within created habitats? To help answer these questions, select water quality parameters were compared between the mainstem, tributaries, and created habitat along the lower Missouri River. Samples were collected during both high flow events and during base flow conditions. This poster will discuss water quality trends in the Missouri River, associated tributaries, and created habitats.

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**Title: Ecology and Management of Channel Catfish *Ictalurus punctatus* and Flathead Catfish *Pylodictis olivaris* in the Middle Missouri River**

**Author(s):** Cameron W. Goble

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**Abstract:** In 2009 the University of Nebraska began a project to assess population dynamics of channel catfish *Ictalurus punctatus* and flathead catfish *Pylodictis olivaris* populations in the section of the Missouri River bordering Nebraska. Four study segments were designated based on prior research conducted by the Nebraska Game and Parks Commission. Within each study segment, 12 randomly selected river bends were sampled with hoopnets (6 bends) or 15 Hz pulsed DC electrofishing (6 bends). A total of 3,186 fish were collected in 248 gear deployments with flathead catfish dominating the catch. The majority (61 %) of flathead catfish collected were < 350 mm while the majority (54 %) of channel catfish collected was  $\geq$  280 mm. Differences in catch and length frequency distributions were identified for flathead catfish in five of the six segment level comparisons. Analysis of channel catfish data revealed few differences in catch or length frequency distributions.

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**Title: Developing Community Profiles for Establishing Restoration Targets: The Role of Reference in Missouri River Restoration Efforts**

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**Abstract:** Planning and coordinating restoration activities in large, complex ecosystems requires clearly defined restoration targets and thorough knowledge of the underlying natural processes required for their establishment and maintenance. However, planning restoration activities for regulated rivers and highly altered floodplains can be particularly challenging due to uncertainty surrounding the natural extent and distribution of native habitats, alterations to key ecological processes, and a lack of functional extant communities to serve as reference sites. The objective of this study was to develop community profiles for natural plant communities of the central Missouri River Valley by aggregating separate vegetation, soils, hydrology and geomorphology data. Contemporary and historic plant community descriptions were reviewed and the principle plant communities associated with the central Missouri River Valley were listed. General affinity of plant communities to hydrological and geomorphic parameters were derived from historic literature, historic maps, SSURGO data and historic flood frequency maps. The community profiles developed from these data represent a first approximation of the interrelationships between plant communities, hydrological and edaphic factors for the central Missouri River Valley. Furthermore, these profiles could and serve as benchmarks for assessing restoration potential of specific plant communities or determining attainable restoration targets for given lands.

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**Title: Creating a River Forecast**

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**Abstract:** The Missouri Basin River Forecast Center (MBRFC) is one of 13 National Weather Service (NWS) hydrologic centers in the United States. This office specializes in flood and water resource forecasting, river modeling, and hydrologic system development within the Missouri River drainage. MBRFC's area of responsibility encompasses 530,000 square miles and includes portions of 10 states and 2 Canadian provinces. In addition to issuing daily river stage and discharge forecasts for the Missouri and Kansas Rivers, MBRFC also issues stage forecasts for approximately 400 additional event-driven locations. MBRFC also issues reservoir inflow forecasts, water supply forecasts, and long-range probabilistic outlooks. MBRFC produces snowmelt flood outlooks each spring. The hydrologic forecast system utilized by MBRFC in meeting its mission consists of data retrieval and processing, hydrologic and hydraulic model execution, and forecast preparation and delivery. Observed precipitation, temperature, reservoir pool levels and releases, and snow cover conditions are continuously received and processed within the hydrologic forecast system in real-time. Future precipitation and temperature information is also assimilated. Conceptual models simulate the physical processes occurring within the soil column, channel routing, streamflow regulation activities (such as irrigation diversions and reservoir operations) and when applicable, the accumulation and ablation of snow cover. A graphical user interface to the hydrologic forecast system enables the hydrologist to use their expertise and judgment to interactively update model states and forcings, and to subsequently prepare forecasts and longer-range probabilistic outlooks for delivery to the user.

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**Title:** Geologic Mapping and Research along the Missouri National Recreational River, Nebraska and South Dakota: Integration of Results and Significance to Hydrogeologic and Ecologic Issues

**Author(s):** Scott Lundstrom, Tim Cowman, John Holbrook, James Paces, Paul Hanson, Mark Sweeney, Bruce Heise, Robb Jacobson, Jared Abraham

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**Abstract:** Ongoing geologic research, including new geologic mapping, geochronology, and geochemistry, has focused on the river corridor area of the reach of the Missouri National Recreational River (MNRR) downstream from Gavins Point Dam. This work is supported by the USGS National Cooperative Geologic Mapping Program, the National Park Service, two State Geological Surveys, and three university geology/river studies departments. Central to this work is geologic mapping of the floodplain to delineate and test depositional facies models, and to map past positions of a very dynamic river system in postglacial time with scores of 4-7 m deep auger holes and age control from optically stimulated luminescence dating. Postglacial deposits of the valley floor are bounded on the north and underlain by late Wisconsin glacial and glaciofluvial deposits of the James lobe of the Laurentide ice sheet that advanced to this part of the MNRR area across a partly forested parkland that has yielded many 14C ages on wood of ~12,500 14C years BP. The re-advance was followed closely by calcite precipitation from groundwater discharge. There is particular interest in understanding the relation of buried Pleistocene glaciofluvial gravel to the modern river channel; these gravel deposits may be a primary control on groundwater/surface water interactions as well as a source of gravel-cobble substrate needed for spawning of endangered sturgeon. Our geologic work is designed to provide data for adaptive management of this segment of the Missouri River, including information to help guide restoration of habitats for native fishes and shorebirds.

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**Title:** Morphodynamic Progress Towards Restoration of Shallow Water Habitats in Minimally Engineered Side-Channel Chutes of the Lower Missouri River: Jameson Island and North Overton Bottoms

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**Abstract:** One major effort towards restoring shallow water habitat along the Lower Missouri River has been the construction of side-channel chutes. Here we document the evolution of two minimally engineered chutes, at Jameson Island and at North Overton Bottoms. Their current states are compared to the geomorphically stable Lisbon Bottom chute, and an estimate of the time required for them to approach a stable morphology is made. Terrestrial surveys were conducted using RTK GPS technology to define edges of the widening active chute channels. Multibeam acoustic bathymetry was used to determine the elevations of the channels' beds. These two datasets are used to quantify changes of surface topography between 2007 and 2009 for each active chute. Over the past two years, a significant amount of channel bed material has been transported from both Jameson and Overton chutes. Water discharge measurements collected with the acoustic Doppler profilers are used to estimate changes in the rate at which the chutes capture discharge from the mainstem Missouri River. This rate of capture is likely change as a function of stage/discharge in the mainstem Missouri River and has increased at both locations over the observation period. With data for water discharge and sediment volume loss from the chutes, we assess the geomorphic progress and estimate timescales for these shallow water habitats to reach geomorphic stability.

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**Title: Applying a Predictive Model of Management Implications for Terns and Plovers on the Lower Platte River, Nebraska**

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**Abstract:** Within the field of natural resource management, adaptive management is appropriate for complex problems with high levels of uncertainty. Adaptive management emphasizes stakeholder involvement, decision-making, and predictive models. The Lower Platte River (LPR) in Nebraska is a complex ecosystem where resource management decisions affect endangered and threatened species such as the Interior Least Tern (*Sternula antillarum* *athalassos*) and Piping Plover (*Charadrius melodus*). Because there is high uncertainty associated with the responses of these two avian species to habitat restoration and other resource uses, a predictive model for an adaptive management plan is useful. We developed a predictive population model for terns and plovers on the LPR modified from a similar existing model for the Missouri River ecosystem. Our model estimates population characteristics for two areas of the LPR: on-channel (i.e. sandbars) and off-channel (i.e. sandpits) breeding and nesting habitat. The population model is a valuable tool in measuring and managing adaptively the annual status of the two avian species on the LPR. With multiple management objectives and competing management alternatives, this model will aid in testing implications of alternatives based on avian population's responses to various habitat alterations. This predictive model will be a useful technical tool for resource managers to select the best management alternative by comparing outcomes predicted by the model for a set of alternatives. The model can be updated as monitoring of avian populations on the LPR continues. The ability of this quantitative model to adapt to new information makes it ideal for predicting management implications for terns and plovers on the LPR within an adaptive management context.

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**Title: Invertebrate Biodiversity of the Benedictine Bottoms**

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**Abstract:** In 1993 the U.S. Army Corps of Engineers initiated a mitigation project near the Rushville bend of the Missouri River to restore 930 hectares of farmland back to its natural floodplain habitat. The site is named the Benedictine Bottoms due to its proximity to the campus of Benedictine College. Biology Department students and faculty have undertaken a study to monitor the biodiversity changes of the Benedictine Bottoms. As a part of this study, terrestrial invertebrate sampling was initiated in May 1995, along randomly chosen transects, each within a different habitat. Because of their trophic position, invertebrates offer a wealth of knowledge about the ecosystem as a whole. The purpose of this project was to determine a baseline value of invertebrate biodiversity, to determine what factors affect variation in abundance and biodiversity patterns of various habitats, and to examine class distributions of invertebrates on the Benedictine Bottoms. Since 1995, over 66 thousand invertebrates spanning over fifteen taxonomic orders have been collected and identified. These data have been used to assess biodiversity trends that occur across years, months, and habitats. These data will be useful in indicating the overall efficacy of the mitigation effort.

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**Title: Missouri River Ecosystem Restoration Plan Draft Focal Natural Resources: Aquatic Ecosystems**

**Author(s):** Wayne Nelson-Stastny, Randy Sellers, Curtis Hoagland, Paula Gagnon, Rob Sutter, Paul Bonaventura

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**Abstract:** MRERP aquatic ecosystem focal natural resources are the Missouri River ecosystem types that that will be the focus of restoration, recovery, and mitigation planning. Five aquatic ecosystem types have been identified that encompass and represent the aquatic habitats and species within the Missouri River and its floodplain. In combination with six terrestrial ecosystem and three species focal natural resources, the aquatic ecosystem focal natural resources are intended to encompass and represent the entire Missouri River system. Aquatic ecosystem focal natural resources were developed by identifying patterns of biotic composition, physical processes and conditions along the longitudinal continuum of the Missouri River mainstem. Each aquatic ecosystem includes sub-bankfull inundation areas (e.g., channel, backwaters, oxbows). One-page descriptions of each focal natural resource are provided to detail the distribution, key physical processes and drivers and characteristic species of each focal natural resource.

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**Title: Missouri River Ecosystem Restoration Plan Draft Focal Natural Resources: Corridor Ecosystems**

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**Abstract:** MRERP riparian/river corridor ecosystem focal natural resources are the Missouri River terrestrial ecosystem types that that will be the focus of restoration, recovery, and mitigation planning. Six riparian/river corridor ecosystem types have been identified that encompass and represent the terrestrial habitats and species within the Missouri River floodplain and blufflands. In combination with five aquatic ecosystem and three species focal natural resources, the terrestrial ecosystem focal natural resources are intended to encompass and represent the entire Missouri River system. Riparian/river corridor ecosystem focal natural resources were developed by identifying vegetation alliances that co-occur and share similar ecological processes on the Missouri River floodplain and blufflands. One-page descriptions of each focal natural resource are provided to detail the distribution, key physical processes and drivers and characteristic species of each focal natural resource.

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**Title: Missouri River Ecosystem Restoration Plan Draft Focal Natural Resources: Species**

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**Abstract:** MRERP species focal natural resources are the Missouri River native species that that will be the focus of restoration, recovery, and mitigation planning. These species were selected as focal natural resources because they are rare and vulnerable; restoration planning for ecosystem focal natural resources would not ensure the recovery of the species; and a large portion of the species habitat or critical life history needs were historically or are currently provided by the Missouri River system such that the Missouri River system is pivotal to the persistence of the species. One-page descriptions of each focal natural resource are provided to detail the distribution, key physical processes and drivers and characteristic species of each focal natural resource.

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**Title: Distribution of Selenium, Mercury, and Methylmercury in Surficial Missouri River Sediments**

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**Abstract:** Sediment deposition into Lewis and Clark Lake, an impoundment of the Missouri River, has caused substantial storage capacity reductions. Current proposals to hydrologically flush sediment would disturb river and reservoir sediment that may contain heavy metals. We quantified existing concentrations of selenium (Se), mercury (Hg), and methylmercury (MeHg) in surficial sediments upstream of and in Lewis and Clark Lake. We found elevated levels of Se (range 0.12-9.62 ug/g) and Hg (range 0.02-1.55 ug/g) at several sites throughout the study area; however, few sites contained levels of MeHg above detection limits. Sites with highest MeHg concentrations were found in Lewis and Clark Lake and ranged from below detection limit to 0.79 ng/g. We conclude that further investigation of sediment-sequestered contaminants in Lewis and Clark Lake should be conducted.

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**Title: Spider Distribution and Abundance on the Benedictine Bottoms**

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**Abstract:** Benedictine College Biology Department faculty and students have undertaken a long-term comprehensive study monitoring the changes in biodiversity of a variety of plant and animal biotypes including spiders. Spiders are one of the most predominate terrestrial invertebrate groups throughout the world. They are found in virtually every habitat, and are the leading consumers of insects. This study is designed to determine the community structure of spiders including the specific feeding guilds that occur on the Benedictine Bottoms Fish and Wildlife Mitigation Site; thereby showing the effect they have on the insect population. The project consisted of the enumeration of spider families collected during the summers of 2007, 2008, and 2009 from the Benedictine Bottoms. Spiders were collected using pitfall traps and a sweep net. Specimens were identified to family. Spiders belonging to 9 families and 4 feeding guilds (ground web weavers, aerial web weavers, ground hunters, aerial hunters) have been collected on the bottoms. The most common spider family found was Lycosidae, the wolf spider. Their primary method of prey capturing is through pursuit and ambush. Ambush predation was the most common method of prey acquisition. The data have enabled us to determine the ecological impact of spiders on a Missouri River flood plain ecosystem.

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**Title: Assessing the Role of a Natural Flow for Early Life History Survival of Scaphirhynchus Sturgeon in Lower Missouri River**

**Author(s):** Clayton J. Ridenour, Jonathan J. Spurgeon, Tracy D. Hill

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**Abstract:** Departure from historic hydrological variation in large regulated river systems is a popular explanation in the literature for declining native fish populations. The natural flow regime was altered on lower Missouri River (LMOR) when six dams were constructed along the middle one-third of its length (years 1930-1963), which was followed by a decline in many obligate fluvial species. Our objectives were to 1) model annual survival of young Scaphirhynchus sturgeon in LMOR as a function of mean annual discharge and 2) characterize intra-annual flow patterns that promote survival. Catch data were collected from a stern-towed otter trawl between 2003 and 2008. The trawl mesh-size was selective against sturgeon ca. <60-mm FL, but was the only trawl gear with a record of data greater than three years. Our model predicted young sturgeon survival was highest in years with intermediate mean annual discharge. Flow characteristics within years we predicted low survival were different from natural flows, but years we predicted high survival better mimicked natural flows. Like the low flow recruitment hypothesis (LFRH) predicts, we hypothesize sustained higher annual flows, highlighted by elevated summer flows to support current authorized purposes, limits Scaphirhynchus sturgeon recruitment. Our gear bias resulted in unrealistically high estimates of survival. However, because we minimized variation in catchability among years by using a single gear, the pattern produced by our model is likely real while the absolute values produced are likely inflated. Future work should focus on improving catchability of <60-mm FL sturgeon to improve estimates of survival in the wild.

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**Title: What Age is Best for Stocking Pallid Sturgeon? Modeling Stocking Strategies**

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**Abstract:** Evaluating different stocking strategies relative to age, lot size, and hatchery limitations are high priority needs to aid the recovery of pallid sturgeon Scaphirhynchus albus. We developed an interactive demographic model in Microsoft® Excel incorporating stochastic age-specific survival estimates, the proportion of fish that are female/male, and the number of fish by age-class available to stock in order to estimate the number of fish that will survive to maturity (females = 15 years, males = 6 years). Three scenarios were considered: 1) produce maximum number of fish surviving to maturity when the hatchery is at maximum capacity, 2) a fixed number of fish that reach maturity (i.e., genetic conservation), and 3) hold over fish additional years if hatchery is not at capacity. When at capacity (scenario 1), stocking fish at age-1 would increase the number of females that survive to maturity by 16 times (1,620 total females) over those stocked as fingerlings. To reach a goal of 500 mature females (scenario 2), either 80,000 fingerlings, 4,500 age-1, 2,900 age-2, or 2,550 age-3 fish would need to be stocked. When the hatchery is not at capacity (scenario 3), holding fish additional years will increase the number of fish that survive to maturity, but the magnitude of increase is dependent on the number of fish available and hatchery mortality. This pallid sturgeon stocking model is an appropriate tool to guide decisions because it is quantitative and transparent, adaptable to current hatchery stocks, and parameters are modified easily.

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**Title: Sedimentation and Shoreline Erosion in Embayments of Lake Francis Case, South Dakota**

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**Abstract:** Sedimentation and shoreline erosion are symptoms of reservoir ageing, and have potential to change aquatic habitat. We used aerial imagery to quantify changes in surface area of 100 embayments in Lake Francis Case, South Dakota from the 1990's to 2008. Surface areas were quantified by digitizing the water's edge in a Geographic Information System (GIS). Changes in surface area ranged from 2.51% decreases to 1.36% increases per year during the study period. Embayments located in upper Lake Francis Case lost considerably more surface area per year than embayments located in the lower reservoir. This trend may be due to the differing characteristics of embayments in the upper versus the lower reservoir (e.g., shallower depths and less steep shorelines). Accordingly, changes in upper embayments are likely due to sedimentation, whereas changes in lower embayments are likely due to shoreline erosion. Embayments in the upper reservoir also tended to support higher macrophyte abundance than lower reservoir embayments. The ageing of reservoirs may alter aquatic habitat (e.g., expansion of macrophyte communities and development of shallow habitat) and influence fish assemblages. Predicting these changes will allow managers to implement strategies to protect important habitat.

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**Title: Variability in Incubation Period of Piping Plover and Least Tern Nests on the Missouri River**

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**Abstract:** Monitoring reproductive success of federally listed Piping Plovers (*Charadrius melodus*) and Least Terns (*Sterna antillarum*) is a critical need for recovery of these species. Correct prediction of hatching date is essential for obtaining accurate data on nest success. Uncertainty in incubation period length can lead to incorrect estimates of hatch dates, thereby decreasing the accuracy of nest fate data. We studied incubation periods of Piping Plovers and Least Terns on the Garrison Reach (2006-2007), Lake Sakakawea (2006-2009), Lewis and Clark Lake (2007-2008), and the Gavins Point Reach (2006-2009) of the Missouri River. Intensive nest monitoring allowed us to examine incubation length in nests found during the laying stage and fated successful ( $\geq 1$  egg hatched) with known hatch dates (i.e. visited the day the first egg hatched). We used linear regression to investigate whether incubation period length was related to nest initiation date. Incubation period (defined here as the laying of the last egg to the hatching of the first egg) was 22 to 30 days ( $\bar{x}=24.86 \pm 0.1340[SE]$ ,  $n=137$ ) for Piping Plovers and 17 to 26 days ( $\bar{x}=20.75 \pm 0.0883$ ,  $n=260$ ) for Least Terns. Incubation period of Piping Plovers declined  $2.00 (\pm 0.0091)$  days over the range of nest initiation dates, whereas incubation period of Least Terns declined in some years ( $\hat{\beta}=-0.034 \pm 0.0150$  days; 2008) and increased in others ( $\hat{\beta}=0.049 \pm 0.0266$  days; 2009). Incubation periods may be shorter and more variable than previously thought, and we suggest that future research and monitoring account for these patterns.

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**Title: Pollinators of the Big Muddy National Fish and Wildlife Refuge**

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**Abstract:** Pollinators, such as, native bees and wasps (Hymenoptera) and butterflies and moths (Lepidoptera), provide several important ecosystem services. Pollinators are sensitive to environmental change, and changes in their abundance and diversity can directly influence plant species and bird species abundance and diversity. Because of this, pollinators have the potential to be valuable in monitoring ecosystem health and climate change. Seasonal as well as long-term changes in pollinator diversity and abundance, compared with similar short-term and long-term changes in vegetation, may provide valuable information on the health of a given ecosystem. The Overton Bottoms North unit of the Big Muddy National Fish and Wildlife Refuge (approximately 2,000 acres, within the Missouri River floodplain) is being restored from agricultural to native habitats. Three distinct habitats wet prairie (a weedy herbaceous community with scattered trees and woody vines), early succession bottomland forest (willow, cottonwood, box elder and silver maple) and upland (fescue pasture/old field)) were sampled for butterflies and moths from April-September of 2006, 2007 and 2008. Bees and wasps were sampled from May- September of 2009. Volunteers from the Missouri Master Naturalist program (Boone's Lick Chapter) worked with the refuge biologist and with the support and cooperation with the Missouri Department of Conservation (Mike Arduser (natural history biologist), USGS (Sam Droege from Patuxent Wildlife Research Center), and University of Missouri – Columbia, to conduct a baseline survey of the Overton Bottoms North unit. Over 130 species of moths and butterflies were identified in three years of surveying, and over 50 species of bees and wasps were identified after the first field season of surveying. The refuge plans to continue surveying for native bees and wasps through 2011. This base line data will be used along with existing data on vegetation and migratory birds in developing a comprehensive conservation plan and habitat management plans for the refuge, as well as monitoring ecosystem change over time.

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**Title: Use of a Tripod-Mounted Light Detection and Ranging (LiDAR) Sensor to Measure Bank Erosion**

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**Abstract:** The use of Light Detection and Ranging (LiDAR) is a common surveying method. LiDAR is a remote sensing system that transmits laser pulses towards a surface and records the time it takes for the pulse to return to the sensor. Determining the return time enables the distance from the sensor to a surface to be calculated, this information coupled with the known laser angles makes it possible to know the exact position of the point of reflectance in relation to the sensor. Different surfaces absorb and reflect the laser pulse differently, so with each return, the sensor also records intensity. Information consisting of location in relation to the sensor and intensity for millions of laser pulses creates a group of points called a point cloud. This point cloud creates an accurate 3-dimensional image of the surfaces surveyed. LiDAR surveys can be conducted from a number of platforms including airplanes, vehicles, boats, and tripods. The USGS Nebraska Water Science Center currently is using a tripod-mounted LiDAR sensor to measure bank erosion of mining-contaminated bank sediments along the Belle Fourche River, in South Dakota. This technique is being used to survey stream banks and bars containing mine tailings, pre- and post-season high flows. These two surveys will then be matched together using established reference marks. The differences are then measured to estimate the volume of sediment gain and loss.

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