

RESEARCH NEEDS FOR PALLID STURGEON

USGS is involved in research to improve understanding of the life-history requirements of pallid and shovelnose sturgeon, and relations of life-history requirements to Missouri River management. Our research effort has been structured to address critical information needs identified by various stakeholder groups, including Pallid Sturgeon recovery team work groups, the Quist et al. report, and input from the Pallid Sturgeon Working Group and stakeholders participating in the summer 2005 Spring Rise negotiation. In addition, our prioritization takes into account additional fundamental science questions that -- in our judgment -- will be critical to resolution of long-term management of the species and the Missouri River. As shown by the following documentation, there is broad general agreement among these viewpoints on research priorities.

Research Needs For Pallid Sturgeon In The Missouri River: Quist et al. 2004

A multi-agency workshop was held on May 18-20, 2004 in Bloomington, Minnesota titled "Research and Assessment Needs for Pallid Sturgeon Recovery in the Missouri River". The workshop was facilitated by the University of Wyoming's William D. Ruckelshaus Institute of Environment and Natural Resources. The workshop process was managed by a steering committee composed of representatives of USGS, Army Corps of Engineers, US Fish and Wildlife Service, and US Environmental Protection Agency. The final report was authored by Quist et al. (November 2004). The goal of this workshop was to identify research needs that could improve management and assist recovery of the endangered pallid sturgeon in the Missouri River. Sturgeon experts from the Missouri River basin and other basins were convened to discuss and synthesize critical ecological and other factors that influence pallid sturgeon in the Missouri River and how those factors are affected by river operations and management. Research needs were not ranked during the workshop process. The results of the workshop were printed as a technical report and distributed to stakeholders throughout the basin.

Agency Prioritization of the Quist et al. Report

The Quist et al. report contains two types of lists of research needs:

- 1) Based on breakout group reports and a thorough review of the discussion summaries the research needs that were considered critical or high priority were noted in the **boxes** for each section, (See pages 11-27).
- 2) Again, based on breakout group summaries research needs or information gaps related to pallid sturgeon. After each participant provided their input, research needs and information gaps were **categorized** as belonging to one of six topical areas: (1) hatchery propagation, (2) physiology and nutrition, (3) fish health and disease,

(4) natural reproduction and recruitment, (5) genetics and hybridization, and (6) other issues (See Appendix C, pages 41-62).

The Middle Basin Pallid Sturgeon Work Group has ranked these two lists of research needs. The ranking of the 31 “**boxed**” items from high priority to lower priority are attached. The yellow highlight indicates research needs presently being addressed by USGS research funded by the US Army Corps of Engineers in FY04 and FY05. The green highlight indicates suggested focused research topics for USGS research in FY06. The second list of 108 “**categorized**” research needs and information gaps that were ranked is attached. Because this list contains considerable redundancy and a much broader context USGS has not highlighted the relevance to the ongoing or future research effort at this time, especially in regard to evaluation of the spring rise.

Guidance for the Spring Rise Plenary Process

Attached is an unranked list of activities and suggestions related to pallid sturgeon research in relation to the potential 2006 spring rise. The bulleted activities are not necessarily in priority order.

Middle Basin Pallid Sturgeon Work Group, July 8, 2005

Boxed Categories from "Research and Assessment Needs for Pallid Sturgeon Recovery in the Missouri River"

RESEARCH NEED	RANK ORDER
Determine factors that elicit spawning and egg deposition.	3.4
Key factors cueing the spawning migration of pallid sturgeon include discharge, photoperiod, water temperature and water quality	4.2
Determine the specific locations and microhabitat features associated with spawning.	7
Identify use and availability of spawning habitat in the Missouri River and its	8
Develop a better understanding of environmental factors influencing maturation and spawning movements including homing.	8.2
Key factors influencing the selection of spawning sites and area for egg deposition are substrate characteristics, depth, water velocity, turbulence, water temperature, moon phase, and discharge patterns	8.4
Examine seasonal habitat requirements and use by larvae and age-0 juveniles	11
Determine which habitats are limiting the larvae and age-0 juveniles.	12.8
Survival and successful hatching of pallid sturgeon eggs are related to sediment dynamics and substrate characteristics, water temperature, water velocity, bedload movement, predation and the amount of contaminants in the sediments.	13.6
Evaluate the role of discharge for creation and maintenance of habitat for all life history stages of pallid sturgeon.	13.8
Survival and growth of pallid sturgeon from age 0 to 1 are related to predation and competition, discharge, water temperature, hydraulic patterns and diversity, food availability and selection, habitat availability and selection and contaminants	14
Develop a framework and methodology for habitat classification.	14.2
Survival and growth of larval and juvenile pallid sturgeon are related to predation and competition, discharge, water temperature, hydraulic patterns and diversity, food availability and selection, habitat availability and selection and contaminants .	15.2
Survival and growth of pallid sturgeon from age 1 to age-at-maturity are related to predation and competition, discharge, water temperature, hydraulic patterns and diversity, food availability and selection, habitat availability and selection and	15.2
Describe food habitats and determine ontogenetic diet shifts of larvae and age-0	16.6
Adopt formal protocols for collecting tissue samples and measurements for genetic analyses and systematic studies.	16.8
Evaluate the role of sediment transport for creation and maintenance of habitat for all life history stages of pallid sturgeon.	17.2
Evaluate the interaction between flow manipulations and habitat improvement activities for creating habitat.	17.6
Determine environmental factors influencing egg survival.	18
Determine an optimal mosaic of habitats for rehabilitating river biodiversity.	18.4
Develop a better understanding of factors related to egg quality.	19
Determine if imprinting occurs, and if so, its significance.	19.4
Evaluate the effects of contaminants on reproduction.	20.2
Trends in presence-absence, population density, age structure, growth, mortality, and recruitment are similar among regions and do not vary through time.	20.8
Obtain genetic information for wild and broodstock populations of pallid sturgeon.	21
Use genetic analysis to maximize genetic variability in fish included in propagation	22.2
Identify factors contributing to hybridization between pallid sturgeon and shovelnose	22.6
Document the occurrence and distribution of habitat relative to ecological structure	23.8
Evaluate the role of prey production and contaminants on growth and survival of larvae and age-0 juveniles.	24.6
Determine the influence of predators and competitors on larvae and juveniles.	24.8
Determine the influence of predators on egg survival.	25
Identify the occurrence and frequency of hybridization between pallid sturgeon and shovelnose sturgeon.	26

Middle Basin Pallid Sturgeon Work Group, July 8, 2005

Broad Categories from "Research and Assessment Needs for Pallid Sturgeon Recovery in the Missouri River"

RESEARCH NEED	RANK ORDER
Determine the cues required to elicit spawning by pallid sturgeon including whether homing occurs.	9.8
Determine the factors that elicit pallid sturgeon spawning and the specific habitat used for spawning.	11.3
Determine factors influencing survival and growth (e.g., nutrition) of larval pallid sturgeon.	13.0
Determine where and when pallid sturgeon spawning occurs in the Missouri River system.	16.8
Determine the extent and effects of iridovirus on pallid sturgeon.	18.5
Evaluate the environmental factors affecting spawning.	19.0
Determine the specific locations and microhabitat features associated with spawning.	22.3
Evaluate the interaction between flow and habitat improvement activities in creating or eliminating habitat for pallid sturgeon.	24.0
Determine the effects of flow magnitude, frequency, and duration on habitat characteristics in the Missouri River system.	26.0
Develop a reliable method for isolating iridovirus and its effects on pallid sturgeon.	26.0
Determine habitat requirements and use of larval and juvenile pallid sturgeon.	26.5
Develop an iridovirus assay.	26.8
Determine whether the lack of recruitment in pallid sturgeon populations is a failure to successfully spawn or whether larvae and juvenile fail to grow and survive.	27.0
Examine the seasonal habitat requirements and use of pallid sturgeon at all life history stages.	27.3
Develop a habitat classification system for evaluating the effects of flow on habitat characteristics.	27.5
Determine whether iridovirus is vertically transmissible.	30.0
Evaluate the contribution of hatchery-reared pallid sturgeon to the population.	30.3
Evaluate the role of habitat productivity, spatial and temporal diversity of habitats, and the benefits and function of different seral stages to each life stage of pallid sturgeon.	32.5
Evaluate the contribution of hatchery-reared fish to wild populations.	33.0
Determine the availability of habitat for each life history stage under different flow regimes	33.3
Determine the effects of iridovirus on the health of adult pallid sturgeon.	33.8
Conduct long-term monitoring of pallid sturgeon population dynamics (i.e., abundance, recruitment, stocking success) and the associated fish assemblage.	34.8
Evaluate the selection of different habitats by pallid sturgeon, particularly with regard to microhabitat and macrohabitat characteristics.	35.0
Evaluate whether the lack of larval and small juvenile pallid sturgeon in most samples is due to our inability to adequately sample fish (e.g., gear efficiency) or a lack of fish.	35.3
Examine methods and recommendations for managing fish and populations infected with iridovirus.	35.3
Evaluate and enhance techniques to maximize the survival and health of broodstock (e.g., handling stress, physiologic and health tools) including developing a diet that provides for healthy growth.	36.5

Define the population characteristics of a self-sustaining population of pallid sturgeon in the Missouri River system.	38.0
Determine the amount of habitat for larval pallid sturgeon, particularly downstream habitat for drifting fish	38.3
Determine whether there is an optimal mosaic of habitats, particularly those related to post-depositional habitats within the context of seral stages.	38.5
Identify the availability and use of spawning habitats in the Missouri River and its tributaries.	39.3
Determine the habitat factors that have resulted in a decline in pallid sturgeon, while at the same time have not had a detrimental influence on shovelnose sturgeon. In addition, determine whether habitat alterations have caused hybridization to occur more readily.	39.5
Determine whether an iridovirus-recovered fish has the same survival success as an unaffected fish.	39.5
Document the occurrence of different habitats in the system prior to the release of test flows from mainstem reservoirs.	40.0
Determine the traits of a successful hydroscape (form + flow) for all life history stages of pallid sturgeon.	40.0
Develop health baselines for larval and juvenile pallid sturgeon, including an iridovirus assay, use of antibiotics, immunocompetency, and the role of contaminants.	40.8
Determine whether there is a "critical mass" required for successful spawning, recruitment, and genetic diversity in pallid sturgeon populations.	41.8
Determine the optimal size for stocking hatchery-reared pallid sturgeon.	41.8
Develop health baselines for reproductive adults, including an iridovirus assay (and effect of infections), use of antibiotics, immunocompetency, and the role and transfer of contaminants.	42.5
Evaluate the role of processes related to sediment transport that create and eliminate habitat for all stages of pallid sturgeon.	42.8
Determine prey selection and ontogenetic shifts in diet, particularly the switch to piscivory.	43.5
Evaluate the best methods for sampling larval pallid sturgeon and determine their habitat use.	43.5
Determine the role of floodplain connectivity or lack thereof in the Missouri River system.	43.5
Evaluate the use of recent physical habitat modifications (e.g., wing dike removal) by all life history stages of pallid sturgeon.	43.5
Determine the role of flow variability in the formation of habitat.	44.0
Acquire the necessary parameter estimates to adequately model population dynamics of pallid sturgeon.	44.8
Determine which habitats are limiting for each life history stage and provide recommendations as to which habitats need to be constructed.	45.8
Prioritize the location and extent of relatively natural areas that can be used to provide baseline knowledge on habitat use and selection by pallid sturgeon.	46.0
Evaluate the effects of iodine treatment of eggs on survival, hatch rates, and iridovirus.	47.0
Determine whether downstream migration is an active or passive process.	47.3
Develop a framework and methodology for habitat classification that focuses on the seral stage of post-depositional habitats.	47.5
Obtain robust and reliable estimates of population size (e.g., using capture-recapture methods).	47.8
Examine the role of habitat characteristics as related to the energy resources of pallid sturgeon.	48.0
Improve physiological and health tools for maximizing production and survival of eggs including staging of female pallid sturgeon to determine the optimal time for spawning.	49.8

Determine whether difference exist in population dynamics among river segments in response to difference hydrographs and physical habitat characteristics.	50.3
Determine the influence of low flow conditions on the ecology and recovery of pallid sturgeon.	50.8
Obtain input variables for developing a bioenergetics model and conducting population viability analyses (PVA).	52.3
Evaluate methods that can be used to improve egg quality in propagation programs	53.0
Evaluate the ability of managers to recreate a natural hydrograph that includes not only flow, but also thermal characteristics and sediment transport.	53.5
Obtain validated length-age relationships.	54.0
Determine the mechanisms by which shovelnose sturgeon and pallid sturgeon locate and recognize each other, particularly with regard to spawning (e.g., pheromones).	55.0
Evaluate the effects of power peaking on habitat characteristics in the Missouri River system.	55.0
Describe habitat use, home ranges, and interbasin movement of pallid sturgeon.	55.0
Examine how prey production relates to habitat dynamics (e.g., flooding, backwater habitat) and the construction of shallow-water habitats.	55.8
Evaluate whether pallid sturgeon will reproduce naturally in a hatchery environment and whether it can be used to increase the production of fish. In addition, natural reproduction in a hatchery can provide important information on the reproductive ecology of pallid sturgeon in the Missouri River system.	56.0
Determine whether iridovirus is equally prevalent in all management units.	56.3
Determine the minimum spatial unit and the organization of units required by pallid sturgeon to complete their life cycle.	56.8
Evaluate the role of movement barriers (e.g., impoundments, low flow) on pallid sturgeon recovery.	57.0
Coordinate sampling and recording methods that enable for standardized collection of genetic and morphological information.	57.8
Determine whether mucous cell and sensory cell counts are indicative of survival of pallid sturgeon.	59.3
Obtain robust baseline data on hybridization, broodstock genetics, and genetics of wild fish throughout their distribution. Furthermore, methods of collecting genetic samples and morphological measurements should be standardized.	60.0
Determine the best methods of cryopreservation and whether it can be a useful tool in propagation and recovery efforts.	61.0
Integrate policies, issues, and concerns related to genetics into current and future propagation activities.	63.3
Determine the specific habitat alterations that have enabled hybridization.	64.8
Define requirements for a sound an successful hatchery propagation program.	65.0
Determine whether fatty livers is indicative of survival	67.8
Develop methods to maximize the efficacy of cryopreservation.	69.5
Develop techniques for evaluating the overall health of pallid sturgeon, particularly those in reproductive condition.	70.0
Identify genetic baselines.	70.5
Evaluate the efficacy and side effects of different antibiotics on cultured pallid sturgeon.	71.0
Evaluate methods (e.g., beta-glucans) to enhance the immune system of pallid sturgeon.	73.3
Learn and implement techniques used to successfully propagate other sturgeon species.	73.3

Determine whether mortality of broodstock can be reduced by alternate methods of hormonal spawning induction and ovarian follicle collection.	74.0
Determine whether current methods of ovarian follicle collection affect health of spawning female pallid sturgeon and egg quality.	74.5
Evaluate the role of diet and/or exercise in the incidence of fatty livers.	75.5
Evaluate the effects of commercial harvest of shovelnose sturgeon and recreational angling on pallid sturgeon recovery.	76.0
Evaluate whether large hatchery-reared pallid sturgeon have greater survival in the wild than smaller fish.	77.0
Determine the occurrence and extent of hybridization, and the life history characteristics of hybrids.	78.8
Obtain samples from wild fishes to assess potential effects of inbreeding and outbreeding depression.	79.0
Evaluate the efficacy, mortality, and side effects of anesthetics used in propagation programs.	80.3
Evaluate the role of contaminants on egg quality and hatching.	80.8
Because natural recruitment of pallid sturgeon appears to be absent or extremely low, must remain cognizant of the potential genetic consequences of hatchery-reared fishes (i.e., swamping natural genetic diversity).	82.0
Determine baseline blood chemistry and hematology parameters for healthy wild and hatchery adults.	82.0
Determine the occurrence of hybridization and the role of hybrids for preserving the pallid sturgeon phenotype.	82.3
Evaluate potential prey items for contaminants.	83.0
Determine whether cryopreservation can be used for a production scale.	83.0
Evaluate whether hybridization can be overwhelmed by stocking genetically-pure pallid sturgeon.	83.3
Determine which blood chemistry and hematology parameters are diagnostic for broodstock health and survival.	84.8
Conduct a systematic review on the potential effects of contaminants and determine their presence and magnitude in the water and sediments.	85.0
Determine whether currently defined management units are valid given the underlying genetic variation.	85.0
Determine the viability (i.e., longevity) of cryopreserved sperm.	85.0
Evaluate whether an increased abundance of pallid sturgeon leads to increased prevalence of hybrids.	86.3
Monitor movements and habitat use of hybrids to determine how they overlap with pallid sturgeon.	88.0
Determine whether commercial trout chow is optimal for various sturgeon life stages.	88.3
Determine whether the current cryopreservation protocol is optimal for viability and fertilization.	89.3
Determine whether the intermediate (morphologically) fish are truly hybrids.	89.5
Develop techniques and assess reliability of photographic vouchers.	91.8
Determine which blood parameters can be indicative of response to ovarian follicle collection method.	93.0
Evaluate the effects of power peaking on follicular quality and spawning performance.	99.0

Document from the Pallid Sturgeon and Fish and Wildlife Technical Group of the Spring Rise Plenary Group

Pallid Sturgeon research and monitoring (spring rise in 2006 or not)

- Population assessment
- Track fish
- Catch fish that are believed to have spawned
- Nets below likely spawning areas to try and catch larvae
- Habitat assessment
- For pallid sturgeon activity, try and determine relative importance of flow, turbidity, temperature, and photoperiod

- In the short term, need team of experts to lead this – two people are necessary: a program administrator, and a science administrator (Corps/FWS/USGS); once recovery committee is on line, need to develop integrated monitoring and research program and an adaptive management program tied to independent science and including multi-stakeholder involvement

- Expert group needs to develop a 10-year study design for pallid sturgeon; we need ongoing research, but also focused projects that answer specific questions related to pallid sturgeon life history

- Need to focus on Gavins Point reach AND reach in Missouri where there is already a “natural” spring rise to address concerns from public meeting; need to be able to make comparisons and to be able to address issue of what’s happening in reach where there is already a spring rise due to precipitation and substantial tributary input; this may require additional resources and manpower over and above ongoing research and monitoring

- Team of experts should develop recommendation that Pallid Sturgeon Recovery Team allow a percentage of sexually mature adults in river to track and catch them; try to get some adults left in river instead of all going immediately into propagation facilities

- Open and transparent process to prioritize monitoring objectives; we need to focus on pallid sturgeon, but we can’t sacrifice ongoing monitoring on things like tern & plover habitat and other projects for increased pallid sturgeon monitoring

- Outreach of information on a continual basis to stakeholders should be a priority