Missouri River Recovery Program
Pallid Sturgeon Research and Monitoring

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US Army Corps of Engineers
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Pallid Sturgeon Research and Monitoring

- Background
- Overview of MRRP Pallid Monitoring and Research Activities
- What We Have Learned and What are the Important Knowledge Gaps for Pallids
- What MRRP Does/Doesn't Do With Regard to Pallid Monitoring in Tribs
- Future Monitoring Activities on the Missouri River and Tributaries

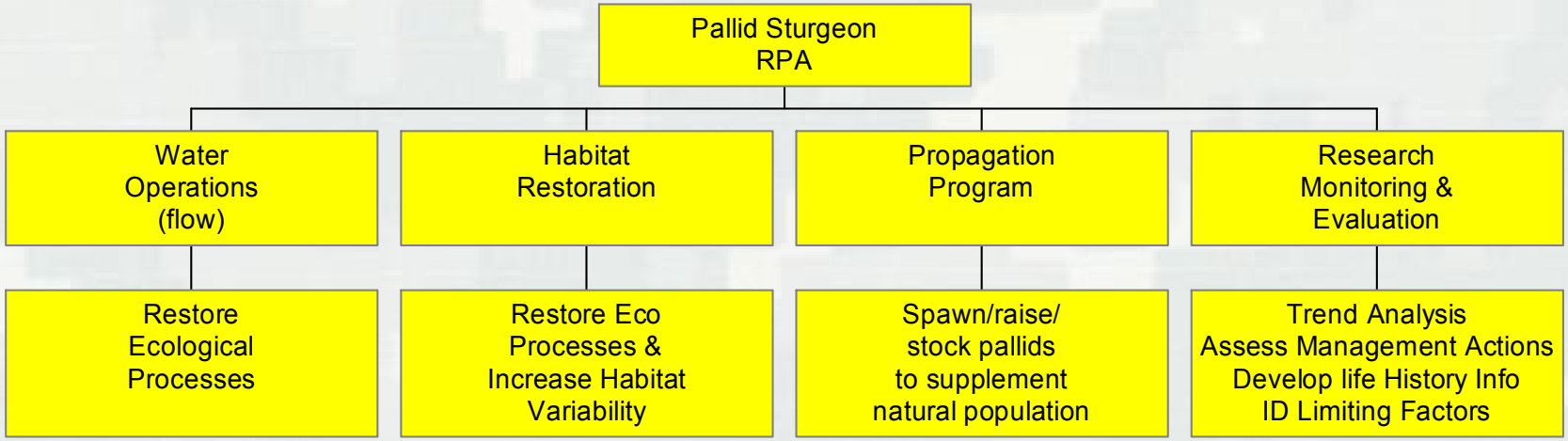
Background

Why is the Corps involved with monitoring pallid sturgeon populations in the Missouri River?

- Corps is responsible for operation of Missouri River Mainstem Reservoir System

- 2000 Missouri River Biological Opinion
- 2003 Amended BiOp
  - ► Provides guidance outlining the Corps' responsibilities
    - Emphasizes cooperative efforts between FWS and Corps
    - Outlines management actions/activities to benefit pallids (Flow, Habitat Creation, Propagation)
    - Research and Monitoring RPA elements are identified (knowledge gaps, measure pallid response)
    - Adaptive Management Framework

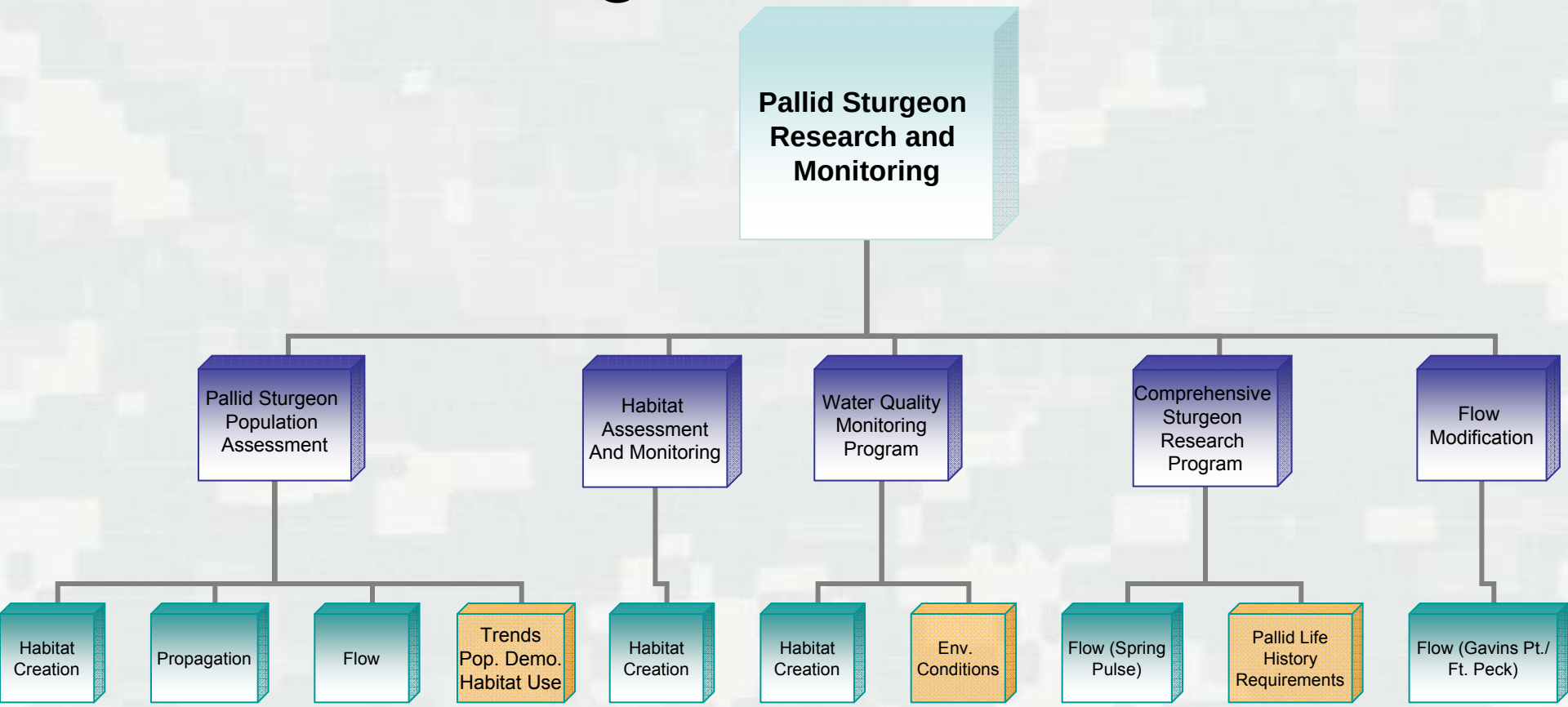
Conceptual Model of Sturgeon Biological Opinion RPA Elements



➢Flow management, habitat creation, and propagation are the three management actions (required through the BiOp) that we can utilize to improve conditions for pallid sturgeon in the Missouri River

- Monitoring is our opportunity to evaluate the effect of our management actions
- Research can provide the information to more effectively implement our management actions

Pallid Sturgeon Research and Monitoring Under the MRRP

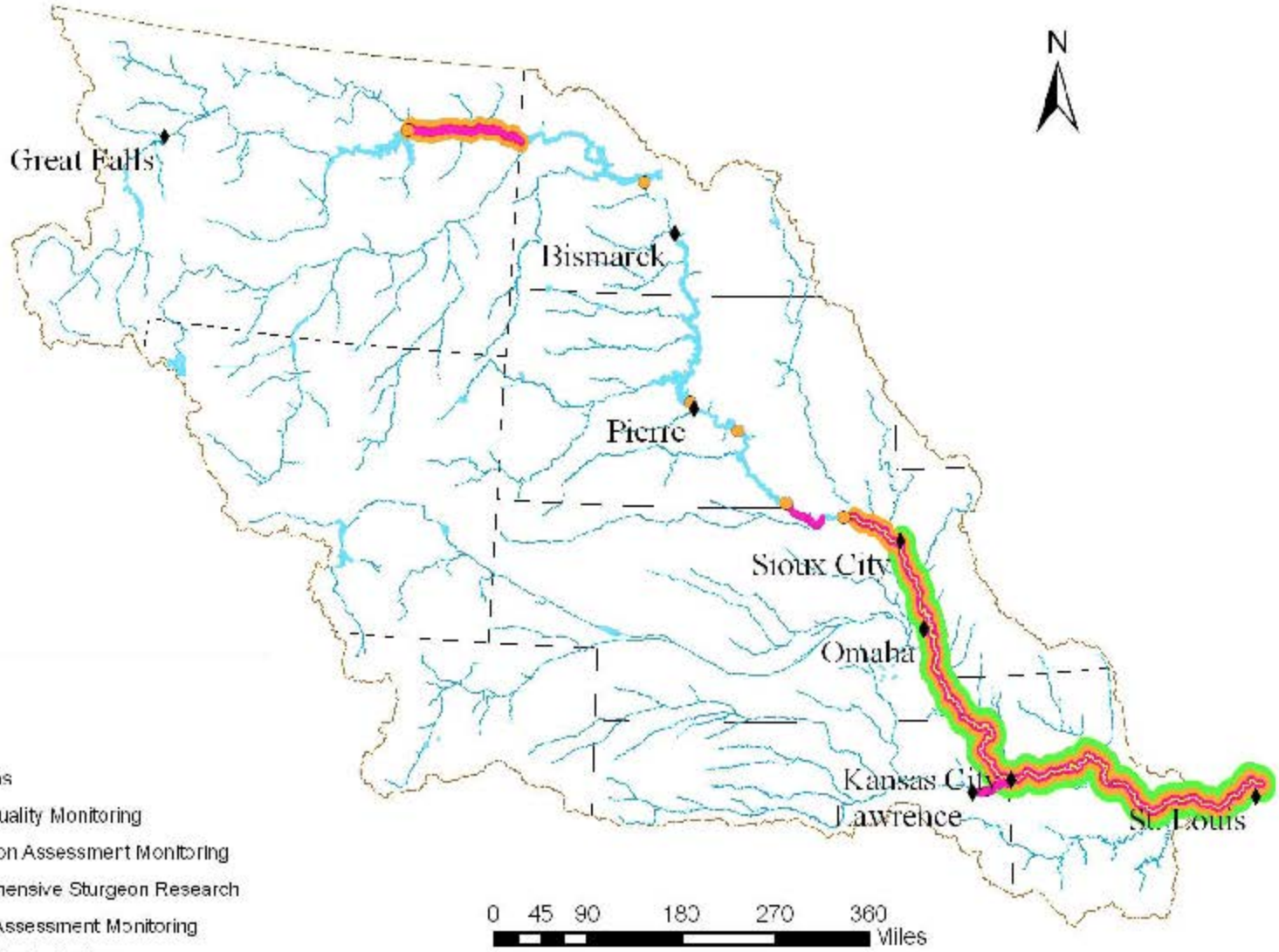


Four Research and Monitoring Programs for Pallid Sturgeon in the Lower MR

Monitoring and Research Programs are BiOp RPA Elements or are designed to monitor RPA Elements (management action)

1. **Habitat Assessment and Monitoring Program**
   - **Monitors the success of Shallow Water Habitat creation at the site or reach level**
2. **Comprehensive Sturgeon Research Program**
   - **Monitors influence of flow on pallid sturgeon biology/ecology; improves fundamental understanding of reproductive ecology and life history of the pallid sturgeon**
3. **Missouri River Restoration Water Quality Monitoring Program**
   - **Measures and monitors water quality parameters in the lower MR; site-level monitoring for constructed Shallow Water Habitat**
4. **Pallid Sturgeon Population Assessment**
   - **System-level monitoring program for fish; monitoring collective effect of all BiOp management actions (Flow, Propagation, Habitat Creation)**

Pallid Sturgeon Monitoring through the Missouri River Recovery Program



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Four Monitoring and Research Programs for Pallid Sturgeon the Lower MR

Habitat Assessment and Monitoring Program

- **Objectives**
  - Assess and monitor the biological (target fishes) and physical processes/changes (water quality; primary/secondary productivity) at control bends and modified sites.
  - Evaluate overall effects of habitat creation and provide information necessary for adaptive management.

Four Monitoring and Research Programs for Pallid Sturgeon in the Lower MR

Comprehensive Sturgeon Research Program

- **Objectives**
  - Systematically address potential critical ecological factors for pallid sturgeon (Wildhaber and others, 2007) including:

    1. Spawning environmental cues, habitat availability, habitat quality.

    2. Egg deposition, fertilization, hatch.

    3. Drift, “settling”, nutrition and habitat requirements of free embryo and feeding larvae.

    4. Growth, survival, habitat requirements of juvenile and non-reproductive adult sturgeon.

    5. Growth, survival, habitat requirements, reproductive physiology, and migration of reproductive adult sturgeon.

Four Monitoring and Research Programs for Pallid Sturgeon in the Lower MR

Missouri River Restoration Water Quality Monitoring Program

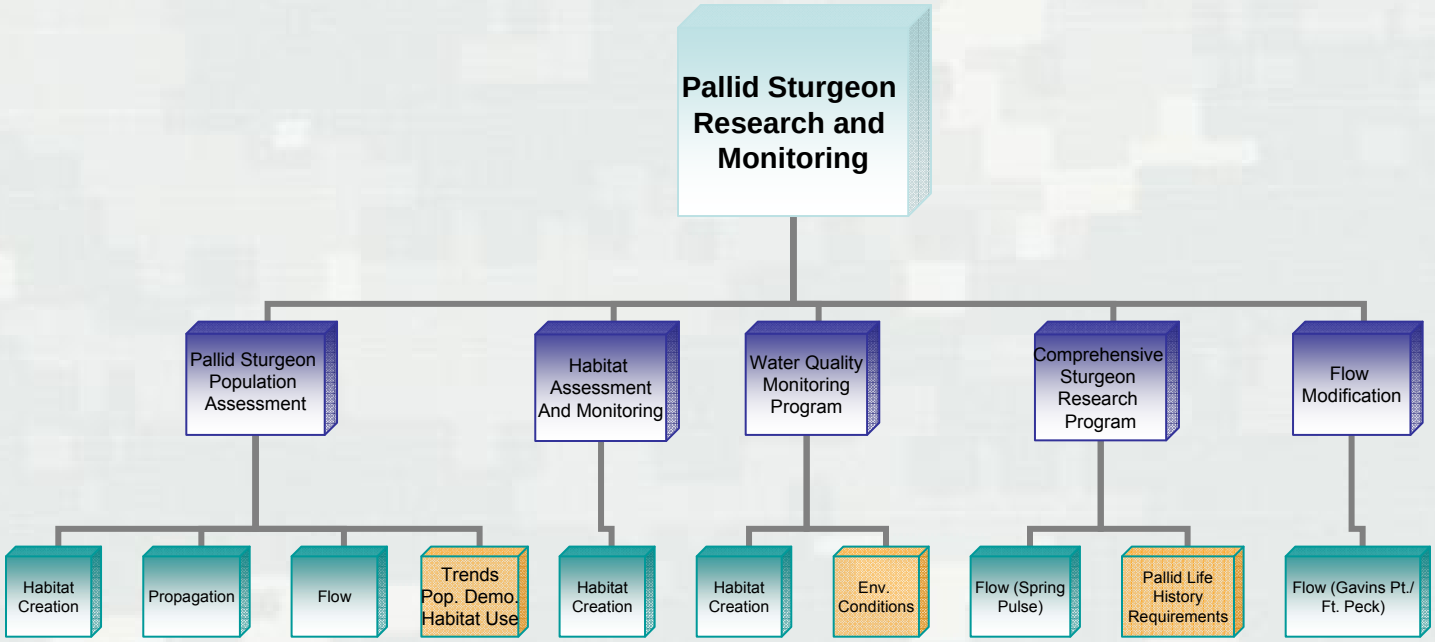
- **Objectives**
  - Determine if water quality is a potential limiting factor for the recovery of fish and wildlife populations along the Missouri River.
  - Monitor the current status and long-term trends of water quality within the mainstem Missouri River, tributary inflows, and created habitats.
  - Assess chemical parameters at mitigation and restoration sites before and after habitat creation.

Four Monitoring and Research Programs for Pallid Sturgeon

Pallid Sturgeon Population Assessment

- **Objectives**
  - Evaluate current and long-term trends in pallid sturgeon population abundance, distribution and habitat use throughout the MR system.
  - Evaluate survival, growth and habitat use of stocked pallid sturgeon in the MR system.
  - Document and evaluate pallid sturgeon reproduction and recruitment in the MR system.
  - Evaluate current and long-term trends in native MR fish species abundance, distribution and habitat usage, with emphasis on warm water benthic fish community.

Sturgeon RPA Elements



Research and Monitoring is focused on assessment of our management actions, evaluation of population trends, and collection of important life history information on factors that limit pallid recovery.

What We Have Learned About Pallid Sturgeon Through our Monitoring and Research Activities

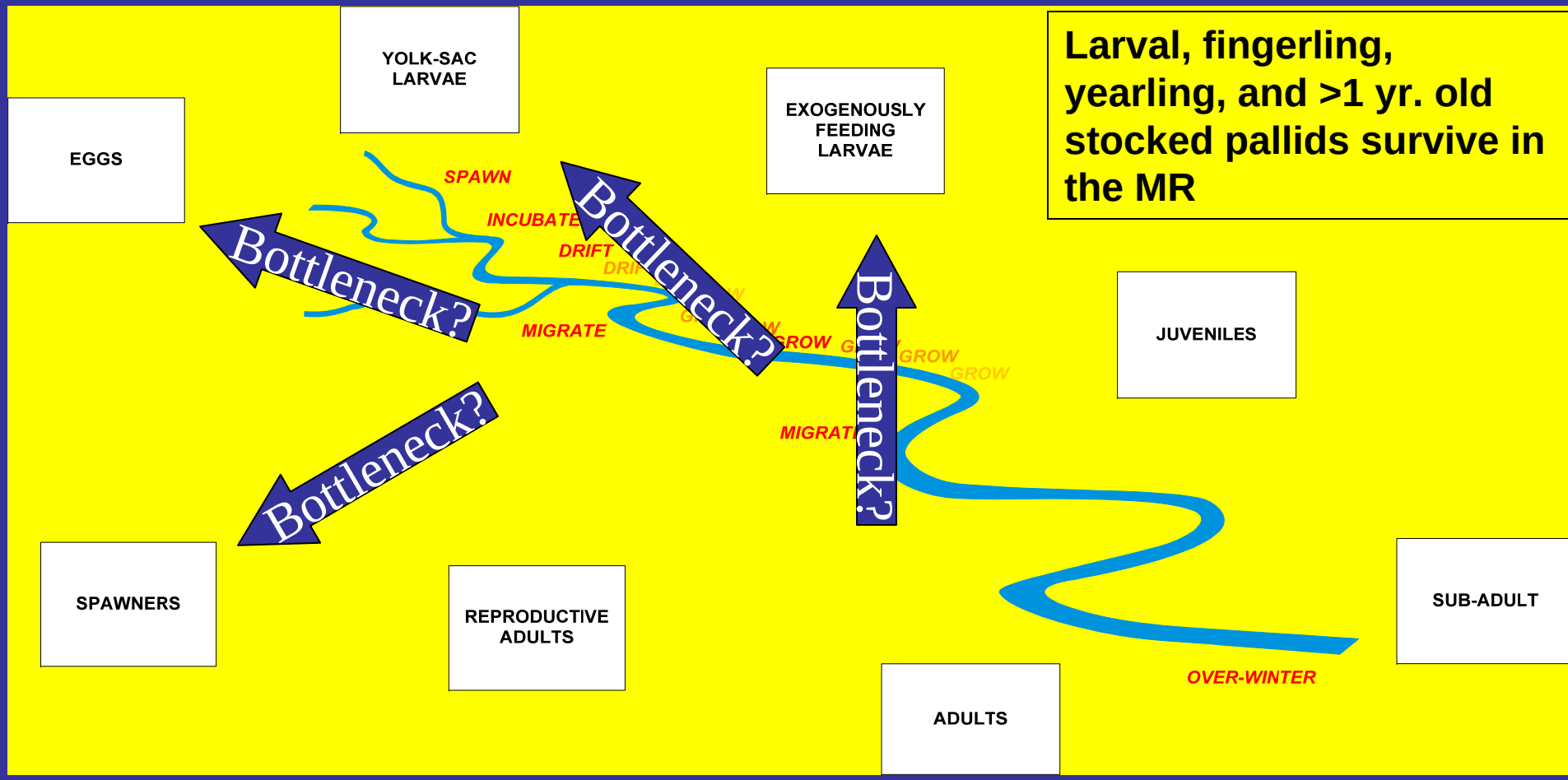
- Adult
  - Prespawn – Pallid sturgeon mature, become reproductive and exhibit extensive migratory movements in the MR.
  - Spawn – Pallid sturgeon can spawn in the MR. Deposited eggs or larvae associated with documented spawning events have not been found.
- Egg to 1 yr.
  - Egg development – Wild and hatchery adults become reproductive, have been successfully spawned in the hatchery, and their progeny have hatched and become larvae.
  - Hatch to yolk absorption – Hatchery born larvae have been successfully moved to feeding on external food sources.
  - Hatchery larvae have been shown to drift hundreds of km in the wild.

What We Have Learned About Pallid Sturgeon Through our Monitoring and Research Activities

- Egg to 1 yr.
  - Larvae – In the upper MR basin, hatchery-released larvae have recruited to the juvenile stage.
  - Post-larvae to 1 yr. – Post-larvae to age 1 pallid sturgeon have not been documented in the MR.
- Juvenile to Adult
  - Pallid sturgeon released from hatcheries as juveniles have relatively high survival (70-80% for age 1 fish).
  - Juvenile pallid sturgeon eat primarily macroinvertebrates and adults eat primarily fish.
  - Few juvenile wild fish have been recently documented in the lower MR.
- Major tributaries may be important habitats for pallids
  - Pallids have been captured in the Platte, Kansas, Big Sioux, and Osage Rivers.
  - The tributary mouths are also areas utilized by pallids.

What does our research and monitoring tell us?.....Recruitment bottleneck for MR pallid sturgeon occurs somewhere between spawning and the larval stage

Research and Monitoring



Larval, fingerling, yearling, and >1 yr. old stocked pallids survive in the MR

Important Information Gaps for Pallid Sturgeon Ecology/Life History

- What is the factor(s) limiting recruitment in the Missouri River?
  - Which early life history component(s) are impacted?
    - Are there physiological factors affecting pallid spawning?
    - Are there sufficient numbers of pallid sturgeons that males and females can find each other during spawning times?
    - Are eggs viable, and are they fertilized?
    - Are environmental conditions sufficient to promote successful hatching of eggs?
    - Do hatched larvae enter the drift in the Lower Missouri River?
    - Do larval pallid sturgeons have sufficient habitat and forage to grow?
    - After year 1, do juvenile pallid sturgeons have sufficient forage and habitat to recruit to the population?

Important Information Gaps for Pallid Sturgeon Ecology/Life History

- What habitats, habitat conditions, and/or prey types and amounts are optimal for growth, survival, and reproductive maturation?
    - Do optimum levels exist in the MR?

Important Information Gaps for Pallid Sturgeon Ecology/Life History

- How is hybridization between shovelnose and pallids affecting pallid populations?
  - Do habitat alterations play a role in the level of hybridization?
  - Does it occur naturally with no long-term implications to the persistence of pallids?
- Are gonadal abnormalities a factor that limit pallid populations (intersex, hermaphroditic gonads)?
- Is water quality a parameter that limits survival, recruitment, and persistence of pallid populations?

Important Information Gaps for Pallid Sturgeon Ecology/Life History

- **What is/are the relationship(s) between Missouri River and Mississippi River pallid populations?**
- **What is the importance of tributaries to MR pallid populations?**
  - **Rearing habitat for juveniles?**
  - **Nutrient inputs that promote survival of pallids?**
  - **Spawning habitat?**
  - **Flow and hydrograph influences on the mainstem?**
  - **Are they an important ecological element for survival and persistence of pallid populations?**

Addressing Information Gaps for Pallid Sturgeon Ecology/Life History

- Systematically addressing potential critical ecological factors (information gaps) through the Comprehensive Sturgeon Research Program
  - USGS-CERC – Early life history and reproductive ecology of *Scaph.* Sturgeon
  - USGS COOP & University of South Dakota – Early life history of pallid sturgeon
    - Predation, larval drift, early life history habitat preference/requirements


Addressing Information Gaps for Pallid Sturgeon Ecology/Life History

- Pallid Sturgeon Population Assessment, Habitat Assessment and Monitoring, Water Quality Monitoring
- Upper Basin Pallid Sturgeon Workgroup
  - Annual funding from WAPA to address knowledge gaps

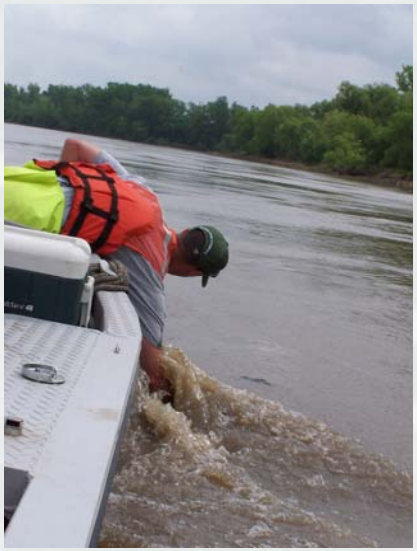
Monitoring in Missouri River Tributaries

- **Monitoring and research focus is the mainstem Missouri River**
  - 2000 BiOp is for the operation of the Mainstem Missouri River Reservoir System, the Kansas River Reservoir System, and the MR Bank Stabilization and Navigation Project
  - Congressionally authorized funding each FY is allocated for restoration of the MR mainstem (Yellowstone R. Intake)

- **Pallid Sturgeon Population Assessment**
  - Tributary mouths and confluence areas are habitat types within the sample design
  - Lower Kansas River is a Segment within the sample design

Monitoring in Missouri River Tributaries

- **Missouri River Restoration Water Quality Monitoring Program**
  - Lower tributaries near the mouths (inflows) are sample locations
  - Platte River – bridge crossing on Highway 75 (RM 2.4)
    - Sampled monthly March/April through October



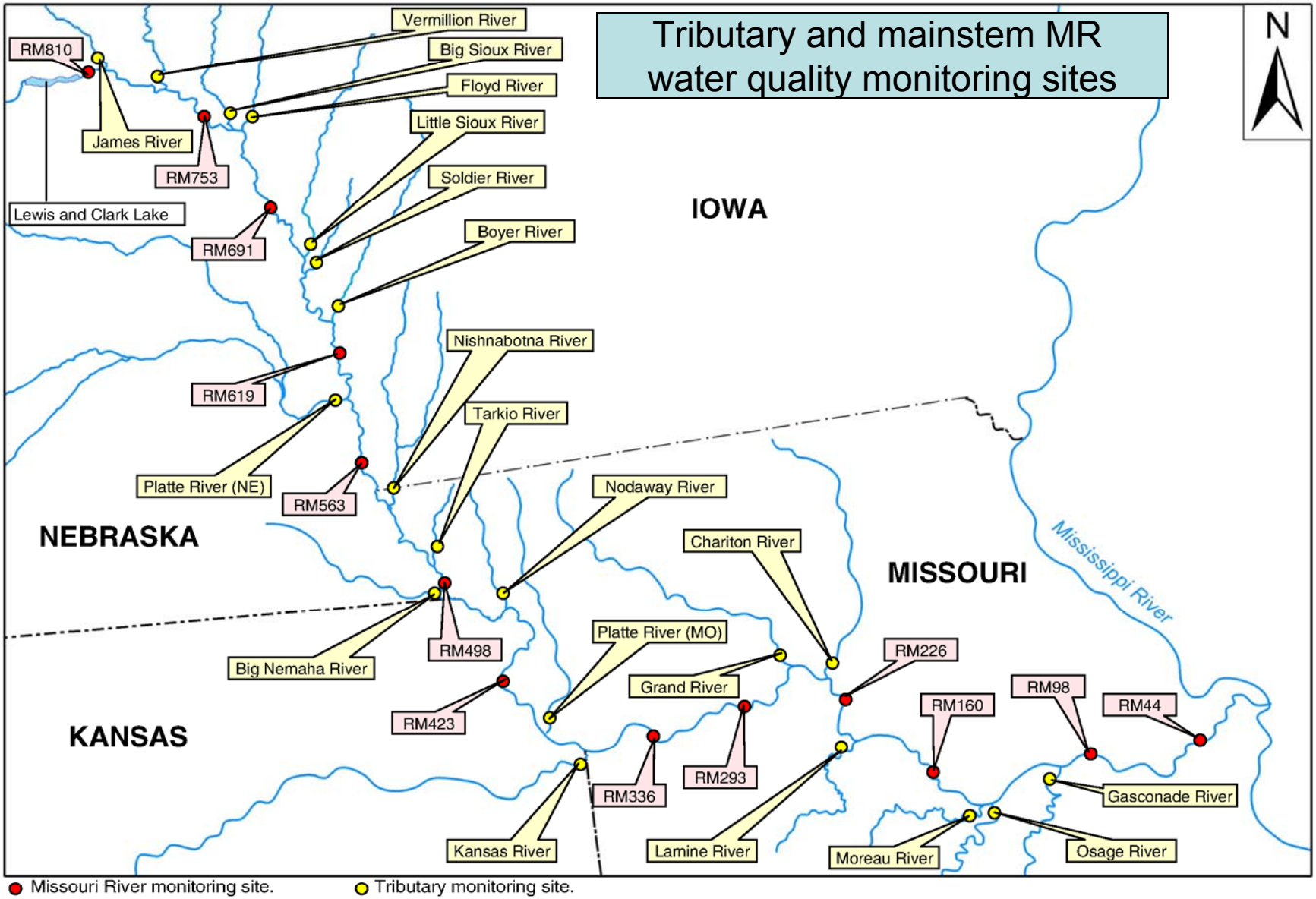


Figure 2. Location of Missouri River and tributary sites to be sampled.

Parameters	Ambient Monitoring	Created Habitat Site Monitoring	Site Characterization Assessment
Alkalinity	X	X	
Ammonia as N, Total (mg/L)	X	X	X [1]
Carbonaceous Biochemical Oxygen Demand -- CBOD (mg/L)			X
Chlorophyll A	X	X	
Hardness (mg/L)			X
Herbicide Scan	X [2]	X [2]	
Metals -- Dissolved Cadmium, Copper, Chromium, Lead, Nickel & Zinc			X [3]
Metals -- Total Cadmium, Copper, Chromium, Lead, Nickel & Zinc	X [1]	X [1]	X [4]
Nitrogen -- Nitrate / Nitrite as N (mg/L)	X	X	X [1]
Nitrogen -- Total (mg/L)	X	X	X [1]
Nitrogen -- Total Kjeldahl Nitrogen (mg/L)	X	X	X [1]
Orthophosphorous (mg/L)	X	X	X [1]
Particle Size			X [4]
Pesticides (ug/L): Chlordane, Dieldrin, DDT&metabolites			X
Phosphorus -- Total (mg/L)	X	X	X
Total Organic Carbon -- TOC (mg/L)	X	X	X [1]
Total Suspended Solids (mg/L)	X	X	X [3]
Zooplankton Community		X	

[1] River water, sediment, and elutriate

[2] Collected once annually

[3] River water and elutriate

[4] Sediment only

Parameters collected by field crews at each water quality monitoring site.

Monitoring in Missouri River Tributaries

- **Comprehensive Sturgeon Research Program**
  - Telemetered fish are tracked into lower reaches of tributaries
- **Habitat Assessment and Monitoring Program**
  - No monitoring in tributaries

Future Pallid Sturgeon Research and Monitoring on the Missouri River

- Pallid sturgeon monitoring and research through MRRP will continue on the MR mainstem
  - BiOp RPA Elements
- Monitoring and Research Components of the MRRP are continually evolving
  - As we continue to learn and our information needs change, the programs will evolve to provide the information needed to better recover the river and the species
  - Research needed to fill information gaps are prioritized
    - Importance of tributaries such as the Platte River may become a future priority

Future Pallid Sturgeon Research and Monitoring on the Missouri River

- Management actions and RPA elements legislatively restricted to mainstem
  - Drives monitoring and research focus
- Missouri River Ecosystem Restoration Plan
  - Purpose and need:
    - Mitigate losses of aquatic and terrestrial habitat
    - Recover federally listed species under the ESA
    - Restore the ecosystem to prevent further declines among other native species
  - Pallid Sturgeon are a key component
  - Geographic scope includes tributaries (to what degree?)
  - Monitoring needs may change after adopted (post 2016)

Questions

- How does the Platte River and other tributaries fit into the “big picture” of pallid sturgeon recovery?
- Are tributaries, like the Platte, an important element of pallid sturgeon recovery?
  - ►Only monitoring and research can help address these questions

Summary

- Current monitoring focus is the Missouri River mainstem
- Monitoring programs are providing the information to assess management actions and restoration activities on MR mainstem
- Research program is priority-need based
  - Current focus is early life history and reproductive ecology
    - Recruitment bottleneck
- Knowledge of pallid sturgeon ecology and life history has improved greatly in the last 10 yrs….many more questions need answers

Summary

- Monitoring in tributaries through the MRRP is limited to the lower reaches (mouths)
  - Fish, water quality
- No plans to expand monitoring of pallids in the near-term
  - Priorities may change in the future

Monitoring and Research Program Contacts

- Pallid Sturgeon Population Assessment Program
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