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United States Department of the Interior

FISH AND WILDLIFE SERVICE
MONTANA FIELD OFFICE
100 N. PARK, SUITE 320
HELENA, MT 59601
PHONE (406) 449-5225, FAX (406) 449-5339

September 18, 2000

Susan Kelly
Area Manager
Bureau of Reclamation
Great Plains Region
Montana Area Office
P.O. Box 30137
Billings, Montana 59107-0137

Dear Ms. Kelly:

This letter is in response to several requests for information made by staff of the Bureau of Reclamation (Reclamation) Regional and Montana Area offices. The US Fish and Wildlife Service (Service) has had the opportunity to meet with Reclamation staff to discuss the operation and maintenance of the Reclamation facility, Intake Diversion, and its impacts on the listed endangered pallid sturgeon. Comments on the draft biological assessment were provided to Reclamation in a letter from the Service dated November 19, 1999. At that time, the Service provided rationale for the importance of fish passage at Intake and the recovery of pallid sturgeon. During further discussions the Reclamation staff were still unsure of the effects of the operation of the facility to the listed species and have asked for additional information. This letter and attachments are intended to provide additional information on why the Service believes that fish passage at Intake Diversion for pallid sturgeon is extremely important for the survival and recovery of that species.

Pallid Sturgeon were listed as endangered under the Endangered Species Act (ESA) on September 6, 1990 (55 FR 36641-36647). One of the factors for listing is cited as "the present or threatened destruction, modification, or curtailment of its habitat or range." Specifically, "alteration through river channelization, impoundment, and altered flow regimes has been a major factor in the decline of the species." Intake Diversion is an example of this type of habitat alteration and a remedy for fish passage would help alleviate some of the threats to pallid sturgeon populations in Montana.

The Service is confident that the Reclamation will embrace their responsibility under the Endangered Species Act (ESA) as it relates to this facility. As you know Section 7(a)1 of the act requires that " all Federal agencies shall, in consultation with, and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this act by carrying out programs for the conservation of endangered species..." In addition Section 7(a)2 requires that "each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded or carried out by such agency is not likely to jeopardize the continued existence of any endangered species..." Based on Section 7(a)2 of the Act, Intake Diversion and its effects to the listed species is an action that should have been consulted on immediately after the listing of pallid sturgeon in 1990. In a conversation with your staff on 28 September 1992, the Service recommended Reclamation initiate consultation on Intake and that fish passage may be required as a reasonable and prudent alternative in a jeopardy biological opinion. The Service appreciates the work Reclamation has done on the biological assessment and we look forward to resolving issue assocaited with the proposed action.

The Service feels strongly that fish passage at Intake Diversion is crucial to recovering the species for the following reasons.

First, historic databases detail pallid use in the Yellowstone River above Intake Diversion. Attachment A is a copy of the recorded citings of pallid sturgeon in the Yellowstone River. This database has records of 6 pallid sturgeon above Intake Diversion between 1920 and 1991, with the majority of the citings in the 1920's, indicating a sharp decline in pallid sturgeon above the diversion structure. In addition, this information is evidence that the Yellowstone River, above Intake and including the Tongue River, has historically been used by pallid sturgeon. The database also cites 15 documented occurrences of pallid sturgeon at the diversion structure itself between the years of 1977 to 1994, all in the months of May and June. This indicates that migration movement for spawning activities of pallid sturgeon is impeded by the diversion structure, thus restricting the fish from the upper Yellowstone River for reproduction.

Second, given that the Yellowstone is still a "free flowing" river, the 120 miles (80 river miles on the Yellowstone and 40 miles of the Tongue River) of pallid habitat that would become accessible with passage facilities at Intake are of extremely high quality and importance to the fish. Additional miles of habitat available for spawning may further the survival and recruitment of larval and juvenile fish. Studies by Kynard (1998, 1999) and follow up studies by the Missouri River Fish and Wildlife Management Assistance Office (June 2000, Attachment B) address the larval drift of pallid sturgeon. Given the issues with drift, providing additional upstream habitat and a longer drift section for those larval fish may be the only way to ensure successful recruitment into the population.

Third, current issues facing the future of the augmentation program for recovery of pallid sturgeon makes providing high quality habitat even more important to the population. The ultimate recovery of the pallid sturgeon relies on natural propagation in the wild of pallid sturgeon, quality habitat is critical to that goal. Providing passage at Intake will provide 120 river miles of additional habitat for a pallid population that currently has a projected life span of less than 10 years. Attachment C is a summary of those issues from the pallid sturgeon recovery coordinator.

Forth, fish passage would provide access to 120 miles of habitat for not only endangered pallid sturgeon, but also for other native fishes in the Yellowstone River. As you know, the Service is currently settling a lawsuit for listing of two additional Yellowstone River fishes, sicklefin and sturgeon chubs. Data collected by the Reclamation indicates that the Intake Diversion structure has significant impacts on those two chub species as well as other native fishes (Hiebert et al 2000).

The Service acknowledges that consultation was initiated on February 22 for the ongoing operations and maintenance of Intake Diversion. Staffing shortages have made it extremely difficult to address the magnitude of Section 7 workload that this office receives. We apologize for the delay in completing this consultation and look forward to the cooperative relationship with the Reclamation to resolve the issues.

The Service also recognizes that this diversion structure may be eligible for transfer to the Yellowstone Irrigation District under the title transfer program. We commend the Reclamation for addressing the ESA issues prior to the transfer of this facility.

It is our understanding that upon receipt of this information, the Reclamation will determine if they will incorporate fish passage and fish entrainment proposals into the current project description for Intake Diversion operation and maintenance. The Service will wait for that response before proceeding with the preparation of the biological opinion.

The Service appreciates the Reclamation response and cooperative working relationship that the staff has fostered between agencies. We look forward to your decision regarding this project. The implications for this project are exciting and we look forward to your continued participation in actions to further the recovery of the endangered pallid sturgeon.

If you have any questions about this project please contact Kate Walker at 406-449-5225 ext 216 or Lou Hanebury at 406-247-7366.

Sincerely,

Acting Field Supervisor

copies to: Lou Hanebury, Billings Suboffice, USFWS, Billings, MT.

Attachment A - Historic Database of Pallid Sturgeon Occurrences,
September 14, 2000
Missouri River Fish and Wildlife Management Assistance Office, Bismark, ND

LOCATION	RM	DATE	FORKLENGTH	CODE	YEAR	MONTH
Yellowstone River	5.1	5/19/1999	1245	YE		
YELLOWSTONE RIVER- INTAKE	71.0		0	YE	91	0
YELLOWSTONE RIVER- TONGUE RIVER	197.0		0	YE	22 *	0
YELLOWSTONE RIVER- TONGUE RIVER	197.0		0	YE	20 *	0
YELLOWSTONE RIVER- TONGUE RIVER	197.0		0	YE	24 *	0
YELLOWSTONE RIVER- TONGUE RIVER	197.0		0	YE	28 *	0
YELLOWSTONE RIVER- HWY 200 BRIDGE	9.0	4/25/1993	320	YE	93	4
YELLOWSTONE RIVER-1.5 M S. OF	1.5	4/24/1993	1365	YE	93	4
YELLOWSTONE RIVER-0.3 M S. OF	0.5	4/23/1993	1566	YE	93	4
YELLOWSTONE RIVER-0.3 M S. OF	0.5	4/22/1993	1373	YE	93	4
YELLOWSTONE RIVER- RAILROAD BRIDGE	9.5	4/27/1993	1317	YE	93	4
YELLOWSTONE RIVER- 1.5MI. ABOVE 200	10.5	4/30/1994	1405	YE	94	4
YELLOWSTONE RIVER	7.0	4/29/1994	1295	YE	94	4
YELLOWSTONE RIVER	3.0	4/24/1995	1430	YE	95	4
YELLOWSTONE RIVER	4.0	4/26/1995	1500	YE	95	4
YELLOWSTONE RIVER	4.0	4/26/1995	1630	YE	95	4
YELLOWSTONE RIVER	9.0	4/27/1995	1490	YE	95	4
YELLOWSTONE RIVER	9.5	4/27/1995	1412	YE	95	4
YELLOWSTONE RIVER	9.0	4/27/1996	1435	YE	96	4
YELLOWSTONE RIVER	6.0	4/26/1997	1390	YE	97	4
YELLOWSTONE RIVER	6.0	4/24/1997		YE	97	4
YELLOWSTONE RIVER	6.0	4/25/1997		YE	97	4
YELLOWSTONE RIVER	6.0	4/27/1997		YE	97	4
YELLOWSTONE RIVER	6.0	4/27/1997		YE	97	4
YELLOWSTONE RIVER	6.0	4/27/1997		YE	97	4

* AFTER CONSTRUCTION

LOCATION	RM	DATE	FORKLENGTH	CODE	YEAR	MONTH
YELLOWSTONE RIVER	6.0	4/26/1997		YE	97	4
YELLOWSTONE RIVER	6.0	4/26/1997	1442	YE	97	4
YELLOWSTONE RIVER-CONFLUENCE	0.5	4/22/1997	1424	YE	97	4
YELLOWSTONE RIVER-CONFLUENCE	0.5	4/23/1997	1527	YE	97	4
YELLOWSTONE RIVER-CONFLUENCE	0.5	4/23/1997	1470	YE	97	4
YELLOWSTONE RIVER	5.0	4/28/1998	1413	YE	98	4
YELLOWSTONE RIVER - CONFLUENCE	0.0	4/21/1998	1165	YE	98	4
MISSOURI RIVER - YE CONFLUENCE	0.0	4/14/1998	1435	YE	98	4
YELLOWSTONE RIVER - CONFLUENCE	0.5	4/16/1998	1450	YE	98	4
YELLOWSTONE RIVER - CONFLUENCE	0.5	4/15/1998	1375	YE	98	4
YELLOWSTONE RIVER	66.0	5/24/1988	0	YE	88	5
YELLOWSTONE RIVER- INTAKE	71.0		0	YE	87	5
YELLOWSTONE RIVER- INTAKE	71.0	5/13/1979	0	YE	79	5
YELLOWSTONE RIVER- INTAKE	71.0	5/18/1973	0	YE	73	5
YELLOWSTONE RIVER- INTAKE	71.0		0	YE	77	5
YELLOWSTONE RIVER- INTAKE	71.0	5/22/1955	0	YE	55	5
YELLOWSTONE RIVER- 3 M. FROM	3.0	5/16/1993	0	YE	93	5
YELLOWSTONE RIVER- HWY 200 BRIDGE	9.0	5/30/1993	0	YE	93	5
YELLOWSTONE RIVER- INTAKE	71.1	5/21/1993	0	YE	93	5
YELLOWSTONE RIVER- HWY 200 BRIDGE	9.0	5/15/1994	0	YE	94	5
YELLOWSTONE RIVER	5.0	5/18/1995	1353	YE	95	5
YELLOWSTONE RIVER	10.0	5/31/1995	1400	YE	95	5
YELLOWSTONE RIVER	10.0	5/31/1995	1204	YE	95	5
YELLOWSTONE RIVER	10.0	5/31/1995	1475	YE	95	5
YELLOWSTONE RIVER	9.5	5/15/1996	1377	YE	96	5

LOCATION	RM	DATE	FORKLENGTH	CODE	YEAR	MONTH
YELLOWSTONE RIVER	5.0	5/1/1996	1277	YE	96	5
YELLOWSTONE RIVER	9.5	5/14/1996	1450	YE	96	5
YELLOWSTONE RIVER	5.0	5/13/1996	1467	YE	96	5
YELLOWSTONE RIVER - INTAKE	67.1	5/18/1994	1384	YE	94	5
YELLOWSTONE RIVER - INTAKE	71.0	5/21/1994		YE	94	5
YELLOWSTONE RIVER	2.0	6/17/1992	1336	YE	92	6
YELLOWSTONE RIVER	16.0		0	YE	87	6
YELLOWSTONE RIVER	39.0	6/1/1988	0	YE	88	6
YELLOWSTONE RIVER- INTAKE	71.0	6/21/1984	0	YE	84	6
YELLOWSTONE RIVER- INTAKE	71.0	6/21/1984	0	YE	84	6
YELLOWSTONE RIVER- INTAKE	71.0		0	YE	75	6
YELLOWSTONE RIVER- INTAKE	71.0	6/11/1991	0	YE	91	6
YELLOWSTONE RIVER- SIDNEY	30.0		0	YE	86	6
YELLOWSTONE RIVER- TONGUE RIVER	197.0		0	YE	37 *	6
YELLOWSTONE RIVER- 1 MILE ABOVE BUS	5.5	6/14/1994	1450	YE	94	6
YELLOWSTONE RIVER- 1 MILE ABOVE BUS	5.5	6/15/1994	1366	YE	94	6
YELLOWSTONE RIVER- 1 MILE ABOVE BUS	5.5	6/15/1994	1373	YE	94	6
YELLOWSTONE RIVER- 1 MILE ABOVE BUS	5.5	6/15/1994	1240	YE	94	6
YELLOWSTONE RIVER	7.5	6/16/1994	1346	YE	94	6
YELLOWSTONE RIVER	6.5	6/16/1994	1219	YE	94	6
YELLOWSTONE RIVER - INTAKE	69.8	6/8/1994	1094	YE	94	6
YELLOWSTONE RIVER - INTAKE	70.0	6/14/1994	981	YE	94	6
YELLOWSTONE RIVER- FALLON	86.0	7/18/1991	1341	YE	91 *	7
YELLOWSTONE RIVER- TONGUE RIVER	197.0	7/24/1950	0	YE	50 *	7
YELLOWSTONE RIVER	2.0	9/23/1994	1222	YE	94	9

LOCATION	RM	DATE	FORKLENGTH	CODE	YEAR	MONTH
YELLOWSTONE RIVER-CONFLUENCE	0.0	9/25/1997	1438	YE	97	9
YELLOWSTONE RIVER-CONFLUENCE	0.0	9/23/1997		YE	97	9
YELLOWSTONE RIVER-CONFLUENCE	0.0	9/23/1997		YE	97	9
YELLOWSTONE RIVER-CONFLUENCE	0.0	9/25/1997		YE	97	9
YELLOWSTONE RIVER-CONFLUENCE	0.0	10/15/1997		YE	97	10
YELLOWSTONE RIVER-CONFLUENCE	0.0	10/15/1997		YE	97	10

Attachment B - Technical Notes - Estimated Drift Speed of Larval Sturgeon, June 2000
Missouri River Fish and Wildlife Management Assistance Office, Bismark, ND

Number: 2:2000

Date: June, 2000

TECHNICAL NOTES

from

Missouri River Fish & Wildlife Management Assistance Office
U.S. Fish & Wildlife Service
3425 Miriam Ave
Bismarck, ND 58501
(701) 250-4419
FAX: (701) 250-4400

Title: Estimated Drift Speed of Larval Sturgeon

Purpose: Pallid and shovelnose sturgeon post-hatch larvae have been observed to migrate/drift for several days following hatch, with an average of five days for shovelnose sturgeon and an average of eight days for pallid sturgeon (Kynard, 1998, 1999). Although the Scaphirynchus eggs are adhesive after fertilization an likely remain in the immediate vicinity of spawning activities, the larvae emerge from the egg sack and begin distribution downstream into available habitats. Sturgeon larvae are poor swimmers and have been observed in culture conditions, (Kynard (1998, 1999), (Holm, pers. comm. and Bollig, pers. comm) actively swimming up in the water column until exhaustion, settling out, and repeating. Like almost all fish larvae, they must rely on the yolk sac for nurishment for the first few days of life. Once the yolk sac is absorbed, the larvae must begin feeding or face starvation.

Larvae from shovelnose sturgeon and the paddlefish have been intensively sampled by various researchers with limited success (Liebelt, 1996, Gardner, 1995, Krentz, 1996). Sampling efforts have identified that the lower water column resulted in higher catches of larvae for the shovelnose sturgeon and paddlefish. Mean water velocities are difficult to assess in this part of the water column due to the variability of depths and substrate.

Due to difficulties in identifying specific sites for sturgeon and subsequently monitoring the travel of the larvae during the higher spring flows in a large river, other methods needed to be evaluated to determine the drift distance of larvae.

Pallid sturgeon recruitment has not been documented in the Missouri and Yellowstone Rivers of North Dakota or Montana for over 20 years. Identifying the reasons for the lack of recruitment is the link to future recovery efforts and will allow researchers to identify strategic management actions which will allow recovery of the species.

The null hypothesis of this study were:

1) larvae sturgeon drift is occurring in the lower part of water column and drift at lower rates than the surface water velocities

2) a range of the drift distance for free floating larvae can be determined by modeling current velocity

Methodology: Although it is impossible to develop models that would simulate larval behavior, this study attempted to document potential drift speed as it related to location in the water column. The study needed an object small in size to reduce the risk of hanging up on benthic debri, yet large enough to accommodate the transmitter. For purposes of this study I utilized sonic transmitters attached to a 1 ½ inch weighted Styrofoam bobbers with additional weight using steel shot to approximate a semi-neutral buoyancy. The transmitters were eight gram, 14-day expected life transmitters. Table 1 lists the weights of each buoy and frequencies of each transmitter.

Receiver	Bouyancy	Weight before transmitter	Frequency and Code
1	Floating	19.5	907 - 5-5-11
2	Sinking	20.2	915 - 8-8-8
3	Sinking	19.8	900 - 2-4-5-3
4	Floating	18.9	906 - 2-5-2-5
5	Sinking	19.4	884 - 2-3-4-5

Table 1. Weights and frequencies of each transmitter for each buoy.

Initial site selection was selected based on work conducted by Bramblett (1996), of a suspected pallid sturgeon spawning area near the Montana/North Dakota state line on the Yellowstone River at approximately river mile 16.

Time was recorded and initial location was recorded using a PLGR GPS receiver. Four transmitters were deployed on June 6, 2000 with two floating and two sinking. We confirmed operation of all transmitters and proceeded downstream to await their passage.

Initial concerns of the sinking transmitter were that the transmitter could stall on bottom debri or that the interstitial space at the bottom of the channel that has very low to no flow velocities, would affect drift speed.

Findings: Flows were increasing during the study period and ranged from 25,000 to 28,000 cfs (Figure 1) and followed the peak flows of approximately 40,000 cfs by about six days. This undoubtedly affected the performance of the bottom and surface transmitters due to the lower flow velocities, however, it is likely that the patterns observed would be similar during higher flow periods.

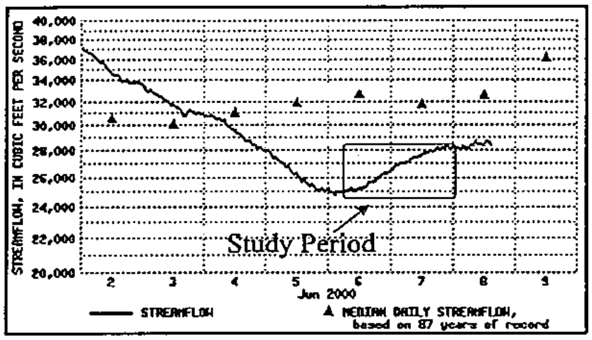

Figure 1. Flows on Yellowstone River at Sidney, Montana guaging station and period of time of study (USGS, web site, provisional data, 2000).

Transmitter	Distance (meters)	Time (minutes)	Velocity (m/sec)
#1-Floating	9642	137	1.17
	24980	365	1.14
#2-Sinking	lost		
#3-Sinking	lost		
#4-Floating	1420	11	2.15
	9965	157	1.05
	24980	375	1.11
#5-Sinking	147	39	0.06
	382	177	0.04
	616	368	0.03

Table 2. Drift velocity and distance travelled for each transmitter.

The floating transmitters were detected immediately downstream of the release sight and subsequent tracking indicated that they traveled about 25,000 meters and reached the confluence with the Missouri River in about 6 hours (Table 2). Location was lost on the first two sinking transmitters due to the decision to follow the floating transmitters. A subsequent release and intensive monitoring of transmitter #5 on the following day provided six hours of monitoring to determine travel distance. During the six hours of intensive tracking, the sinking transmitter traveled a total distance of about 600 meters. The purpose of this study was to determine if flow velocity could be used to determine drift speed of larvae and from the results observed, it does have possibilities. However, sand bars and main channel velocities could affect velocity and results will vary with depth.

Based on the results of this study, with discharges at approximately 27K in the lower Yellowstone River and surface velocities in the main channel at about 1 meter/second, the minimum distance Scaphirynchus sturgeon larvae would need to drift would be approximately 35 km, with a maximum distance of approximately 1123 km. Larval behavior will play an important role in the total distance traveled. Kynard (1998) found that larval sturgeon in hatchery conditions were traveling downstream at a rate of four times a surface float with a velocity of approximately 0.02 m/s. Using the estimated velocity of the larval pallid sturgeon used for Kynard's (1998, 1999) study ($\approx$0.08 m/s) and information obtained from this study, minimal drift distance is approximated to be in the range of 55 - 89 km and approximately 27 to 34 km for shovelnose sturgeon. Although it is assumed that most drifting occurs in the lower meter of water, traveling over shallow sandbar habitats, higher in the water column, or in areas with up-welling would increase the drift speed and total distance traveled due to the resuspensio of the larvae in the upper water column and increased water velocities.

> As a side note, it quickly became apparent that even while the last transmitter was still moving downstream, the velocities at and near the bottom were significantly lower than surface velocities and that this area provides juvenile and benthic fish species areas of velocity refuge. This was not a surprise and only supported earlier suspicions.

Recommendations: Incorporating expertise from hydrologists, modeling should be completed on the velocity of the lower 1 to 2 meters of the water column with various depths in order to further quantify the drift velocity of larval fish. Further work also needs to be completed to determine behavior of larval to fingerling size sturgeon, especially as it pertains to the influence innate behavior, temperature and flows may have on overall drift distance.

Contact Person(s): Steve Krentz, Missouri River Fisheries Assistance Office, Bismarck, North Dakota. 701-250-4419, Steven_Krentz@fws.gov

Literature Cited:

Bramblett, R.G., 1996, Habitats and Movements of Pallid and Shovelnose Sturgeon in the Yellowstone and Missouri Rivers, Montana and North Dakota: Biological Sciences. Montana State University. Doctoral Thesis.

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Kynard, B., Henyey, E., and Horgan, M., 1998, Studies on Early Life Behavior of Shovelnose Sturgeon: Turners Falls, Massachusetts: U.S. Geological Survey, Biological Resource Division, Conte Anadromous Fish Research Center.

Kynard, B., Henyey, E., and Horgan, M., 1998, Studies on Pallid Sturgeon: Turners Falls, Massachusetts: U.S. Geological Survey, Biological Resource Division, Conte Anadromous Fish Research Center.

Liebelt, J.E., 1998, Lower Missouri River and Yellowstone River Pallid Sturgeon Study, 1996 Report: Fort Peck, Montana: Montana Department of Fish, Wildlife and Parks. Grant Agreement No. 94-BAO-709.

U.S. Geological Survey web site, provisional data, 2000.

Attachment C - Notes from Steve Krentz, Pallid Sturgeon Recovery Coordinator Bismark, North Dakota

The Yellowstone River has been documented to be important to the pallid sturgeon for several reasons. First and foremost, this river has some of the best remaining known spawning habitat for this species. This is evidenced by the capture of broodstock in river itself and near the mouth of the Yellowstone River during staging that are used in the artificial propagation program the Service is conducting. The Pallid Sturgeon Recovery Plan (1993), addressed lowhead dams as one factor that affected pallid sturgeon populations by fragmenting habitats and posing difficulties in movements throughout the various habitats utilized by the pallid sturgeon. This is particularly true in the Yellowstone River in that two lowhead diversion structures occur in the mainstem Yellowstone River; Intake and Cartersville. Although Intake does not pose a complete blockage for sturgeon, it does make the upstream movement difficult. Pallid sturgeon, although accustomed to large river environments with high velocity currents, are not as capable of navigating turbulent waters and are not as strong as swimmers as salmonids or suckers. Pallid sturgeon are typically found in areas with velocity breaks from linear flows such as areas with "sand dune" substrate, downstream island tips, or on or near the bottom of the channel. These areas afford the pallid sturgeon with micro habitat characteristics that allow the fish to use it's body shape and morphology to it's full advantage. Turbulent waters can provide difficulty for a species such as the pallid sturgeon from navigating upstream.

Each year, at least two to three pallid sturgeon are incidentally snagged by paddlefish anglers during the months of May and June. It is widely acknowledged that the Intake structure concentrates paddlefish and shovelnose sturgeon below the structure during the spring flows.

Opening up passage for pallid sturgeon at Intake would allow this species to utilize the Yellowstone River up to the next diversion structure at Cartersville. Although the micro habitat characteristics have not been fully identified, some information has been learned. Using information obtained in the historical accounts of the species, it is evident that the primary use of the Yellowstone River by pallid sturgeon is for spawning purposes. This includes staging prior to and recovery after spawning as well as providing the habitat needed for the actual egg deposition.

Pallid sturgeon have a reproductive strategy that is characterized as dioecism, one of each sex required for reproduction. They are nonguarders and are open water/substratum egg scatterers with an adhesive egg. This characteristic requires the eggs to be scattered over an appropriate substrate that would allow the egg to adhere to and remain in the appropriate habitat. Dependant on temperature, the eggs hatch from three to eight days later and the sack fry is carried downstream into suitable rearing habitat. Studies conducted by Kynard (1998,1999) found that post-hatch larval sturgeon behave differently. Shovelnose sturgeon tend to migrate downstream during a shorter time period than pallid sturgeon. This difference is approximately 4-6 days shorter and may explain the successful reproduction and recruitment observed with shovelnose sturgeon in the Yellowstone and Missouri Rivers. Enhancing fish passage at Intake would open up approximately _____ kilometers of additional habitat as well as the confluences of two important tributaries of the Yellowstone River, the Powder and the Tongue Rivers. Observations throughout the time until the 1950's indicate that pallid sturgeon were observed at the mouth of the Tongue river during the spring spawning months.

References:

Kynard, B., Henyey, E. and Horgan, M. 1998. Studies on Early Behavior of Shovelnose Sturgeon: Turner Falls, MA. USGS, Biological Resource Division, Conte Anadromous Fish Research Center.

Kynard, B., Henyey, E. and Horgan, M. 1998. Studies on Pallid Sturgeon: Turner Falls, MA. USGS, Biological Resource Division, Conte Anadromous Fish Research Center.