LOWER MISSOURI AND YELLOWSTONE RIVERS
PALLID STURGEON STUDY
2004 REPORT

by

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ABSTRACT

Status of the endangered pallid sturgeon *Scaphirhynchus albus* population in the Missouri and Yellowstone river of RPMA #2 was studied by (1) capture wild adult pallid sturgeon for broodstock, (2) estimate adult pallid sturgeon abundance (3) project adult pallid sturgeon extirpation date (4) quantify hatchery reared pallid sturgeon (HRPS) survival (5) quantify HRPS growth (6) quantify retention rates of passive integrated transponder (PIT) tags of HRPS captured in RPMA #2, (7) examine the relation between HRPS presence and turbidity, (8) quantify the weight-length relation for captured HRPS, (9) quantify mean distance moved by captured HRPS, and (10) determine HRPS net movements either upstream, downstream, or equally distributed. Forty-seven individual adult pallid sturgeon were captured during broodstock efforts in 2004, with nine new fish. A current abundance estimate for RPMA#2 is 158 individuals with a projected extirpation date of 2024. Ninety-three HRPS were captured during 2004 and survival rates were estimated for ages 1-2, 43.9% and 5-6, 67.7%. Eighty-nine captured HRPS grew an average of 55.3 mm in fork length (FL), with an average daily growth of 0.36 mm/d. Sixty-six of 86 scanned HRPS retained their PIT tags, resulting in a 76.7% retention rate. Mean turbidity at sampling sites where HRPS were not sampled were statistically different from sites where HRPS were sampled ($P < 0.0001$, df = 630). The weight-length relation for 67 captured HRPS was quantified as, $W = 10\text{^}[-4.56 + 2.63 * \log_{10}(FL)]$. Total distance moved by HRPS averaged 33.4 river kilometers (rkm), and time at liberty averaged 404d, yielding an average movement rate of 0.25 rkm /d. Hatchery-reared pallid sturgeon net movements were downstream in direction.

BACKGROUND

The pallid sturgeon *Scaphirhynchus albus* is a long-lived (> 50 years; S. Krentz, U.S. Fish and Wildlife Service, unpublished data), late maturing (females may spawn for the first time at ages 15-20; Keenlyne and Jenkins 1993) species indigenous to the Missouri and lower Mississippi rivers, and large tributaries entering these river systems (Bailey and Cross 1954). Habitats have been extensively altered throughout the historical range of pallid sturgeon, causing declines in growth, reproduction, and survival, and ultimately resulting in the designation of pallid sturgeon as an endangered species in 1990 (Dryer and Sandvol 1993).

One of the few remaining concentrations of pallid sturgeon is in the lower Yellowstone River below the Tongue River and in the Missouri River between Fort Peck Dam and Lake Sakakawea (recovery-priority management area #2, RPMA #2; Dryer and Sandvol 1993). Similar to populations in other regions, long-term viability of pallid sturgeon in RPMA #2 is in jeopardy. It is hypothesized that habitat fragmentation coupled with regulated flows from Fort Peck Dam and suppressed water temperatures during the spring and early summer spawning period have failed to provide adequate spawning cues for pallid sturgeon. In addition, cold water releases from Fort Peck Dam have limited the amount of riverine habitat suitable for spawning and rearing. As a consequence, there has been no documented recruitment for decades as evidenced by a population composed of large (e.g., > 1200 mm; > 8 kg; Liebelt 1996, 1998) and presumably old individuals (≥ 35 years; S. Krentz, U.S. Fish and Wildlife Service, personal communication). Larval pallid sturgeon have been sampled in RPMA #2 during 2002, 2003, and 2004 (Braaten and Fuller 2004), but wild age-1 to sub-adult pallid sturgeon have yet to be sampled.

Lack of natural recruitment in the RPMA #2 pallid sturgeon population has warranted remedial actions to prevent extirpation. First, the U.S. Army Corps of Engineers proposes to modify operations of Fort Peck Dam following specifications outlined in the Missouri River Biological Opinion (U.S. Fish and Wildlife Service 2000). Modified dam operations are proposed to increase discharge and enhance water temperatures during late May and June to provide spawning cues and enhance environmental conditions for pallid sturgeon and other native fishes. Modified dam operations scheduled to begin during 2001, have yet to be enacted.

The second remedial action involves a stocking and population supplementation program. The goal of this program is to "reconstruct an optimal population size within the habitat's carrying capacity while preserving and maintaining the gene pool to the greatest extent possible" (Upper Basin Pallid Sturgeon Workgroup Stocking Team 1997). The stocking and augmentation plan was implemented in 1998 when 295 age-1 hatchery-reared pallid sturgeon (HRPS; 1997 progeny) were stocked in the lower Missouri River below Fort Peck Dam, and 485 age-1 HRPS were stocked in the lower Yellowstone River. Additional HRPS were stocked in RPMA #2 during 2000 (679), 2002 (3,061), 2003 (4,124), and 2004 (1,845). Although initially successful in enhancing numbers of pallid sturgeon in the population, the recovery directive of the stocking and augmentation plan continues to be hindered by a lack of information on post-stocking critical rates (survival, growth, etc.) of HRPS (Upper Basin Pallid Sturgeon Workgroup Stocking Team 1997). As a consequence, it is not known if current stocking strategies will ensure adequate survival of HRPS to sexual maturity (e.g., 15 years) and perpetuate a self-sustaining, genetically viable population. The stocking and augmentation plan assumes a minimum annual survival rate of 60% for stocked HRPS (Upper Basin Pallid Sturgeon Workgroup Stocking Team 1997).

The stocking and augmentation plan specified that a monitoring program would be implemented to thoroughly evaluate stocking success and survival. An appropriate monitoring program has been enacted. Initial sampling efforts for stocked HRPS suggest survival rates may be less than 60% as assumed in the stocking and augmentation plan. Inconsistency in captures and stockings of year classes has made survival estimation difficult.

Specific study objectives were to: 1) capture wild adult pallid sturgeon for broodstock; 2) estimate adult pallid sturgeon abundance; 3) project adult pallid sturgeon extirpation date; 4) quantify HRPS survival; 5) quantify HRPS growth; 6) quantify retention rates of passive integrated transponder (PIT) tags of HRPS captured in RPMA #2; 7) examine the relation between HRPS presence and turbidity; 8) quantify the weight-length relation for captured HRPS; 9) quantify mean distance moved by captured HRPS; and 10) determine HRPS net movements either upstream, downstream, or equally distributed. Results from these study objectives will be used to provide comments on or propose changes to current propagation, stocking, and monitoring efforts. The project was designed for a minimum of two field seasons, and this report summarizes the findings of the second field season (2004), which was funded by the Western Area Power Administration. A final report summarizing all five years of agreement number 94-BAO-70 is due out in December 2005.

METHODS

Study Area

The Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea confluence and the Yellowstone River between Sidney bridge and the confluence with the Missouri River was partitioned into nine 37-66 rkm study reaches: 1) Fort Peck Dam to Oswego; 2) Oswego to Wolf Point; 3) Wolf Point to Poplar; 4) Poplar to Brockton; 5) Brockton to Culbertson; 6) Culbertson to Bainville; 7) Bainville to Confluence; 8) Confluence to Lake Sakakawea; and 9) Sidney to Confluence (Table 1 and Figure 1). Within each study reach, five inside bend-outside bend-channel crossover habitat complexes (Sappington et al. 1998) were randomly selected for sampling with trammel nets and benthic beam trawls (45 total complexes). Gardner and Stewart (1987), Tews (1994), Liebelt (1996), and Bramblett and White (2001) have previously described these river reaches.

Adult Pallid Sturgeon Sampling

Drift trammel nets were used to capture adult pallid sturgeon near the confluence of the Missouri and Yellowstone rivers, ND, and upstream to the Fairview Bridge area in the Yellowstone River during April 20-29 and 9 November (Figure 2). Nets used for sampling were 30.5 or 45 m in length with two panels (15.2 cm and 25.4 cm mesh), a floating core nylon top line, and a lead core bottom line (22.7 kg). Drift trammel nets were attached to a float on one end and secured to a boat on the opposite end with 4.6-12.2 m of nylon rope. Nets were set perpendicular to the current and were drifted with the aid of a boat for up to 15 minutes, depending on current velocities and snags encountered. Drifts were timed using a stopwatch. All species other than pallid sturgeon were enumerated. Catch-per-unit-effort (CPUE) rates were determined for pallid sturgeon by calculating the mean number sampled per drift h.

All adult pallid sturgeon were handled according to established protocol. Adult pallid sturgeon not used for propagation purposes were released immediately as possible in order to reduce the stresses associated with capture and handling. Biosonic 125 kHz passive integrated transponder (PIT) tags were implanted in base of the dorsal fin on unmarked adult pallid sturgeon.

Hatchery-reared Pallid Sturgeon Sampling

Drift trammel net and beam trawl tows were used to capture HRPS in the nine study reaches of the Missouri and Yellowstone rivers from May 2004 to October 2004 (Figure 3). Nets used for sampling were 45 m in length and contained three panels. Inner panels were 2.5 cm mesh (bar measure) with 15.2 cm mesh outer panels a floating core nylon top line, and a lead core bottom line (22.7 kg). Trammel nets were attached to a float on one end and secured to a boat on the opposite end with 5.6-12.2 m of rope, and were set perpendicular to the current. Trammel nets were drifted with the current for at least 75 m when possible. Benthic beam trawls used for sampling had a 0.5 m x 2 m opening with rock hoppers along the bottom lip, a bag length of 5.5 m with a inner mesh size of 32 mm and an outer mesh size of 200 mm. Benthic beam trawls were secured to the bow of the boat with 10 m of rope and towed in a down stream direction. Each trawl tow will be at least 75 m when possible. Sampling sequence of study reaches and sites was randomly assigned sampling sites within reaches were sampled according to accessibility.

Within each study reach, the channel crossover (CHXO) at the upstream and downstream end of each bend, the outside bend (OSB), the inside bend (ISB), and secondary channels (where possible; SCC) were each sampled with two trammel net drifts. Three benthic beam trawl tows were conducted at each bend, one from the upstream CHXO to the bend, one in the bend, and one from the bend to the downstream CHXO. Channel crossovers considered part of two adjacent complexes were sampled only once. When a HRPS was sampled, two additional trammel net drifts or benthic beam trawls were conducted at the same specific location.

Wildcat surveys were conducted sporadically from May 2004 to November 2004. Surveys were conducted in areas where HRPS have consistently bee been captured , areas where HRPS seemed to congregate from telemetry data, and areas that were not originally included in the sampling schedule (e.g. the Milk River). Gear types used include drift trammel nets and benthic bean trawls as described above with the addition of 22.5m drift trammel nets and hook and line sampling. The 22.5m drift trammel nets had the same mesh panels as the 45m nets with the only difference being length, to accommodate narrow channels where 45m nets were impractical. Hook and line sampling consisted of circle hooks (size 2 or 4) baited with nightcrawlers on standard fishing gear were used when hook and line sampling. Angling hook hours were timed with a stopwatch and recorded.

All fish sampled were counted, many were weighed, measured, sexed, and tagged, and all HRPS were screened for PIT tag identification, weighed to the nearest gram, measured to the nearest millimeter in fork length (FL), and released. Information recorded at each capture location included RKM, GPS coordinates at the beginning and end of each trammel net drift, macrohabitat type (CHXO, ISB, OSB, or SCC), water temperature, and turbidity (nephelometric turbidity units; NTUs). Trammel net and benthic trawl efforts were recorded as time (total minutes), and drift or tow distance (m) was calculated from GPS coordinates. Catch-per-unit-effort of HRPS was calculated as the mean number sampled per sampling h.

DATA ANALYSIS

Population estimation were calculated with an Jolly-Seber estimator in program MARK (White and Burnham 1999). The simplest model of program MARK was used to get an abundance estimate by year. This analysis assumes that: 1) all animals in the population at the time of capture are captured with equal probability, 2) all animals survive between capture occasion with equal probability, 3) survival and capture of an animal is independent of the survival and capture of all other animals, 4) captured animals and previously uncaptured animals survive equally well, and 5) all tagged animals retain their tags and are correctly identified (Pollock et al. 1990).

Survival of HRPS in the study area was to be estimated from catch per unit effort (CPUE) data of specific year classes as described by Ricker (1975), but consistent data from successive years has been inadequate, so I used a Cormack-Jolly-Seber (CJS) open population survival model in program MARK. The CJS model estimates apparent survival, as it is virtually impossible to distinguish between losses due to emigration from mortality. This analysis assumes that: 1) every marked animal in the population at time *t*, has the same probability of capture. 2) every marked animal in the population immediately after time *t*, has the same probability of surviving to time *t*+1, 3) marks are not missed or lost, and 4) all samples are instantaneous, relative to the interval between time *t* and *t*+1, and each release is made immediately after the sample.

Growth was estimated as an average daily growth rate for HRPS of known time at liberty and known FL at the time of stocking and capture:

$$\frac{L_r - L_s}{T},$$

where L_r is FL at the time of capture, L_s is the FL at the time of stocking, and *T* it time at liberty (days).

PIT tag retention was estimated:

$$PIT\ tag\ retention = \frac{Number\ of\ PIT\ tags\ present}{Number\ tagged} * 100,$$

where the *Number of PIT tags present* represents the number of functioning PIT tags detected in fish, and *Number tagged* represents the number of HRPS sampled that were known to have been PIT tagged before being stocked.

A power function describing the weight-length relation for captured HRPS was quantified:

$$W = aL^b,$$

where *W* is weight (g), *L* is FL (mm), and *a* and *b* are parameters. The parameters *a* and *b* were estimated from linear regression of logarithmically transformed weight-length data and the formula:

$$\log_{10}(W) = a` + b * \log_{10}(L),$$

where *W* is weight, *L* is FL, *a`* is $\log_{10}a$ and is the y-axis intercept, and *b* is the slope of the equation.

Mean distance moved (rkm) by HRPS was estimated in from GPS coordinates, and 95% confidence intervals were constructed:

$$LCL = \overline{X} - t_{\alpha/2} S / \sqrt{N}$$
$$UCL = \overline{X} + t_{\alpha/2} S / \sqrt{N},$$

where *LCL* is the lower 95% confidence limit, *UCL* is the upper 95% confidence limit, $\overline{X}$ is the sample mean distance moved, *S* is the sample standard deviation, $t_{\alpha/2}$ is the critical value from a T distribution with N-1 degrees of freedom, and *N* is the sample size (Milton and Arnold 1995).

To test whether HRPS movements were upstream, downstream, or equally distributed while at liberty, the observed proportion of HRPS that made net upstream movements was compared to the expected proportion of 0.50 (Milton and Arnold 1995):

$$Z = \frac{P_U - 0.50}{\sqrt{\frac{P_U(1-P_U)}{N}}},$$

where Z is the test statistic, P_U is the observed proportion of HRPS that made net upstream movements from their stocking site, and N is the number of HRPS sampled. Hatchery-reared pallid sturgeon net movements would be downstream in direction when the test statistic Z is less than -1.96, upstream in direction when the test statistic Z is greater than 1.96, and equally distributed when the test statistic Z is between –1.96 and 1.96.

RESULTS AND DISCUSSION

Adult Pallid Sturgeon Sampling

Broodstock collection efforts of our Pallid Sturgeon Study crew, the Fort Peck Flow Modification crew, and the USFWS resulted in the capture of 58 adult pallid sturgeon, consisting of 49 individuals, in 2004. Forty-one individual pallid sturgeon were captured in broodstock collection efforts in the spring (20 April to 29 April), with eight new fish. Six individual pallid sturgeon were captured in broodstock collection efforts in the fall (9 November), with one new fish. Three individuals were captured incidentally during HRPS sampling efforts, with one new fish. Of the 49 adults captured for broodstock, seven were transported to the Miles City State Fish Hatchery, 16 were transported to Garrison Dam National Fish Hatchery, and three were transported to Gavins Point National Fish Hatchery for possible use in the propagation program. All other pallid sturgeon were released in the vicinity of their capture site, some after measurement data were collected. Unfortunately, one of the post-spawn females pallid sturgeon transported to Garrison Dam National Fish Hatchery died. This female pallid sturgeon likely died due to accumulated stresses associated with capture, transportation, and induced spawning.

We, (the Pallid Sturgeon Study Crew) captured 18 HRPS during broodstock efforts, 177 in drift trammel nets at 1,417 mins for a CPUE of 0.76. Fifteen individual pallid sturgeon were captured in broodstock collection efforts in the spring (20 April to 29 April), with three new fish in . Three individual pallid sturgeon were captured in broodstock collection efforts in the fall (9 November), with zero new fish.

Relatively low and stable flows in both the Missouri and Yellowstone rivers resulted in optimal netting conditions during the broodstock collection effort. All adult pallid sturgeon were scanned for PIT tags when captured. Ten of the 49 adult pallid sturgeon captured during 2004 were unmarked fish and 39 were recaptures from previous years. This recapture rate (79.6%) was much lower than the 89.5% recapture rate observed during 2003 (Kapuscinski and Baxter 2004) and relatively high compared to recapture rates observed in previous years (53% during 2000 and 2001; Yerk and Baxter 2001; Yerk and Baxter 2002).

Most adult pallid surgeon captured during 2004 were released immediately and not measured in order to reduce the stresses associated with capture and handling.

Previous work indicated pallid sturgeon were concentrated at the confluence area of the Missouri and Yellowstone rivers in the spring and fall (Tews 1994). Liebelt (2000) suggested that the confluence area of the Missouri and Yellowstone rivers is a staging area for spawning adult pallid sturgeon prior to their migrating upstream into the Yellowstone River in response to a rising hydrograph. Bramblett and White (2001) reported that aggregations in late spring and early summer suggested that pallid sturgeon might spawn in the lower nine river miles of the Yellowstone River. All adult pallid sturgeon captured during spring 2004 broodstock efforts were captured near the Confluence (Figure 2). Relatively cool surface water temperatures ranged from 8.5 to 13.9 °C during the broodstock collection effort suggesting that these fish were staging for their spawning run.

A current population estimate was calculated at 158 individuals (SE = 16.2, 95% confidence interval [CI] = 129-193). Linear regression of abundances and time (years) resulted in the following:

$$P = -8.3284 * \mathrm{Y} + 16856$$

Where *P* is the estimated abundance, -8.3284 is the slope, *Y* is the year, and 16856 is the intercept (Figure 4). By substituting 0 for abundance *P* and solving the equation for year *Y*, we can see that if wild pallid sturgeon in RPMA #2 continue to decline in abundance at the rate described by the above function, they will be extirpated from RPMA #2 during 2024. The population of wild pallid sturgeon in RPMA #2 may be extirpated before 2024, however, if pallid sturgeon reach an old-age threshold before 2024, if fishing mortality is acting on the population, or if pallid sturgeon collected in future propagation efforts die. Also, we have certainly violated the following assumptions; that all animals in the population at the time of capture are captured with equal probability, since the data is a by product of our broodstock collection efforts that are generally limited to an area right around the confluence neglecting fish that may hold in other areas of the Missouri and Yellowstone rivers and that all tagged animals retain their tags. Tag retention in adult fish is currently unknown and it is very likely that tag loss is occurring, or that tags and readers have malfunctioned, violating the assumption that all tagged animals retain their tags, leading to an overestimate of the current population. To get a more accurate estimate of the current adult pallid sturgeon population a more comprehensive sampling effort coupled with a double tagging scheme (e.g. PIT tag and a coded wire tag) needs to take place.

The window of opportunity for recovering wild pallid sturgeon in RPMA #2 is closing rapidly. Aggressive measures should be taken to maximize recovery efforts during the next 10 years. Habitats must be rehabilitated immediately if wild pallid sturgeon in RPMA #2 are expected to contribute to future generations. Rapid population recovery is improbable, even in protected sturgeon populations, given that strong year-classes are widely separated periodic phenomena in natural populations (Sulak and Randall 2002).

<u>HRPS</u>

A total of 93 HRPS individuals were captured in RPMA #2 during 2004 sampling efforts. Fifty-one HRPS were captured during monitoring efforts, 45 in drift trammel nets at 15,300 mins for a CPUE of 0.18 and six in benthic beam trawl tows at 4,573 mins for a CPUE of 0.078 (Table 2). Forty-five HRPS were captured during wildcat surveys, 34 in 45 m drift trammel nets at 4,444 mins for a CPUE of 0.46, nine in 22.5 m drift trammel nets at 936 mins for a CPUE of 0.58, zero in benthic beam trawl tows at 70 mins, and two in 3,744 mins of angling for a CPUE of 0.032 (Table 2).

Hatchery reared pallid sturgeon were captured at 24 of 90 different bend complexes from May-November 2004. Forty-seven were captured in the Missouri River between study reaches two and eight and 46 were captured in the Yellowstone River, three of these between the Confluence (rkm 0) and Fairview (rkm 9) and 43 below Sidney at rkm 41.8 (Figures 5 and 6). Captured HRPS included individuals from all available year classes (1997,1998, 1999, 2001, 2002, and 2003).

Survival estimates are difficult due to the inconsistency stocking events and lack of consistent year class captures. Consequently it was only possible for MARK to estimate annual survival estimates between ages 1-2, 43.9% (SE = 0.266, 95% confidence interval [CI] = 8.6-86.7) and ages 5-6, 67.7% (SE = 0.170, 95% CI = 31.3-90.6). Because of the wide CI's neither estimate may be very useful; however, the age 1-2 estimate indicate lower survival than stated in the stocking plan (60%) while the age 5-6 estimate is supportive of the survival than stated in the stocking plan (60%). Stocking rates will need to be adjusted as more information on HRPS survival in the wild becomes available. If an appropriate monitoring effort continues to be conducted annually, survival rates for multiple age intervals can accurately be estimated with a CJS model in program MARK.

Eighty nine HRPS captured averaged 343.6 mm (range, 172-652 mm) in FL and 151.6g (range, 24-1075g) in weight. Sixty three HRPS grew an average of 55.3 mm while at liberty 30-2208 d, and had an average daily growth rate of 0.36 mm/d .

Eighty eight of the 93 captured HRPS were PIT tagged before being stocked. Sixty six out of 86 HRPS (2 fish not scanned) held functioning PIT tags, resulting in a 76.7% retention rate. When a captured HRPS is lacking a PIT tag, it is not possible to quantify vital information on growth rates, movements, or potential stocking site related mortality. Gardner (2003) observed a 65.5% PIT tag retention rate for 55 HRPS captured in RPMA #1 during 1998-2003. These observed PIT tag retention rates require that alternative tagging locations (e.g. behind the head, etc.) should be explored. Estimated retention rates for PIT tags injected into the musculature beneath the armor of the head near the dorsal midline in juvenile white sturgeon *Acipenser transmontanus*, range 92-99% (K. Kappenman, USFWS and S. McKenzie, Golder Associates; personal communication). Laboratory studies examining alternative approaches for tagging HRPS and improving retention rates are currently being conducted at the BFTC.

Turbidity ranged from 2.1 to 801 NTUs at all sites sampled, but ranged from 13.4 to 427 NTUs at HRPS capture sites. Mean turbidity at sampling sites where HRPS were not sampled (97.3 NTUs) were statistically different from sites where HRPS were sampled (116.9 NTUs; t-test assuming equal variances, $P < 0.0001$, df = 630). Pallid sturgeon historically occupied turbid river systems (Kallemeyn 1983; Dryer and Sandvol 1993), but the relation between site turbidity and HRPS presence is unknown in RPMA #2.

The weight-length relation for 67 captured HRPS was quantified as:

$$W = 10\wedge[-4.56 + 2.63 * \log_{10}(FL)]$$

Where *W* is weight (g), *L* is FL (mm), and -4.56 and 2.63 are parameters estimated by linear regression of logarithmically transformed weight-length data (Figure 8). It is unclear at this time if the observed weight-length relation for HRPS captured in RPMA #2 is related to growth, survival, or recruitment. Compared to shovelnose sturgeon *Scaphirhynchus platorynchus* have a higher predicted weight-length than captured HRPS in the same length range ($P < 0.0001$, df = 64). More research into how weight-length data is related to other population characteristics is necessary and could benefit recovery efforts where HRPS are stocked.

Sixty five captured HRPS were at liberty for an average of 404 d. Movements of 12 captured HRPS ranged from 3.2 to 169.8 rkm in total distance. These 12 HRPS moved an average of 33.5 rkm while at liberty or 0.25 rkm /d. During 1999-2002 twenty three HRPS captured moved an average of 0.08 rkm /d while at liberty (K. Kapuscinski, Montana Fish, Wildlife & Parks, unpublished data). The upper and lower 95% confidence limits about the average distance moved by HRPS were 27.1 and 14.5 rkm. Captured HRPS net movements were downstream in direction ($Z = -4.05$); eighteen HRPS made net upstream movements of 437.9 rkm, and the remaining 47 of 65 HRPS made net downstream movements of 1535.0 rkm. Six captured HRPS moved between the rivers, four of these were stocked at Fairview and one at Intake on the Yellowstone River and migrated 10.5-55.5 rkm up the Missouri River over the course of at least one year. One happy wanderer HRPS appears to have traveled from rkm 2609 on the Missouri River to rkm 42 on the Yellowstone River, a distance of 105.4 rkm in six weeks. This seems highly unlikely as the fish also had a growth rate (0.66mm/d) nearly double the average, and is more likely due to an error in the database or a mix up at the hatchery. Overall it appears that HRPS seem to be located in the lower reaches of the study area due to their propensity to move downstream in search of suitable habitat. From 1999-2003, 26 of 34 HRPS captured in RPMA #2 made net downstream movements (M. Klungle, Montana Fish, Wildlife & Parks, unpublished data). The propensity of pallid sturgeon to move downstream after being stocked is an important factor when determining stocking sites. Upstream stocking sites are currently given preference over downstream sites in order to ensure that HRPS have the opportunity to settle in all habitats located between Fort Peck Dam and Lake Sakakawea and Intake Diversion Dam and the Confluence.

On 26 August, 70 HRPS were released at Sidney bridge (rkm 48) of the Yellowstone River with Lotek NTC 3-1 nanotag 37 day transceivers. These transceivers were implanted into HRPS to determine fidelity of fish stocked in the Yellowstone River. Nineteen tracking runs were made on the Yellowstone River between rkm 113 and rkm 0 and the Missouri River between rkm 2564 and rkm 2482. Tracking runs ranged from 10 to 113 rkm's and were made bi-weekly from 27 August to 7 October (42d) relocating sixty nine of the 70 fish at least once (Figure 9). Telemetered fish were relocated from 39.4 rkm above to 38.6 rkm below the Sidney bridge stocking site (Figure 9). The 69 relocated HRPS were at liberty an average of 5d (range, 1 – 35d) between relocations. These telemetered HRPS moved an average of 2.4 rkm (range, 0-20.6 rkm) between relocations or 0.52 rkm/d. The upper and lower 95% confidence limits about the average distance moved were 2.2 and 2.8 rkm. Relocated HRPS net movements were downstream in direction (Z=-3.41); 21 telemetered HRPS made a net upstream movement of 303.8 rkm, and the remaining 49 made net downstream movements of 450.7 rkm. Half of these telemetered HRPS were relocated at rkm 41.8 and eight were recaptured with drift trammel nets at this location.

One thousand eight hundred and fifty six HRPS were stocked in RPMA #2 this year at site on the Milk River, two sites on the Missouri River and two sites on the Yellowstone River. 410 stocking plan equivalents were stocked up the Milk River, 391 Wolf Point, and 339 Culbertson on the Missouri River and 809 stocking plan equivalents were stocked at 360 Intake and 356 Sidney on the Yellowstone River.

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Table 1. Nine study reaches of the Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea confluence and the Yellowstone River between Sidney bridge and the confluence with the Missouri River.

Reach	Top	Bottom	rkm[a]	rkm[a]
1	Fort Peck Dam	Oswego	2848.5	2782.5
2	Oswego	Wolf Point bridge	2782.5	2741
3	Wolf Point bridge	Poplar River	2741	2704
4	Poplar River	Brockton	2704	2655
5	Brockton	Culbertson bridge	2655	2610
6	Culbertson bridge	Bainville	2610	2575
7	Bainville	Confluence	2575	2546
8	Confluence	Lake Sakakawea	2546	2490
9	Intake	Sidney bridge	113	48

[a] river kilometers

Table 2. Number of HRPS captures, total minutes sampled and CPUE for gear types drift trammel nets (45 and 22.5 m), benthic beam trawl tows, and hook and line sampling effort on 2004.

Effort[a]	Gear type	# HRPS	# mins	CPUE[b]
MON	DTN[c]	45	15,300	0.18
MON	BT[d]	6	4,573	0.078
WC	DTN[c]	34	4,444	0.46
WC	DTN[e]	9	936	0.58
WC	BT	0	70	-
WC	H&L[f]	2	3,744	0.032

[a]Effort as either MON-monitoring or WC-wildcat surveys.
[b]Catch-per-unit-effort in HRPS per h.
[c]Drift trammel net, 45 m in length.
[d]Benthic beam trawl.
[e]Drift trammel net, 22.5 m in length.
[f]Hook and line sampling with size 2 or 4 circle hooks baited with nightcrawlers.

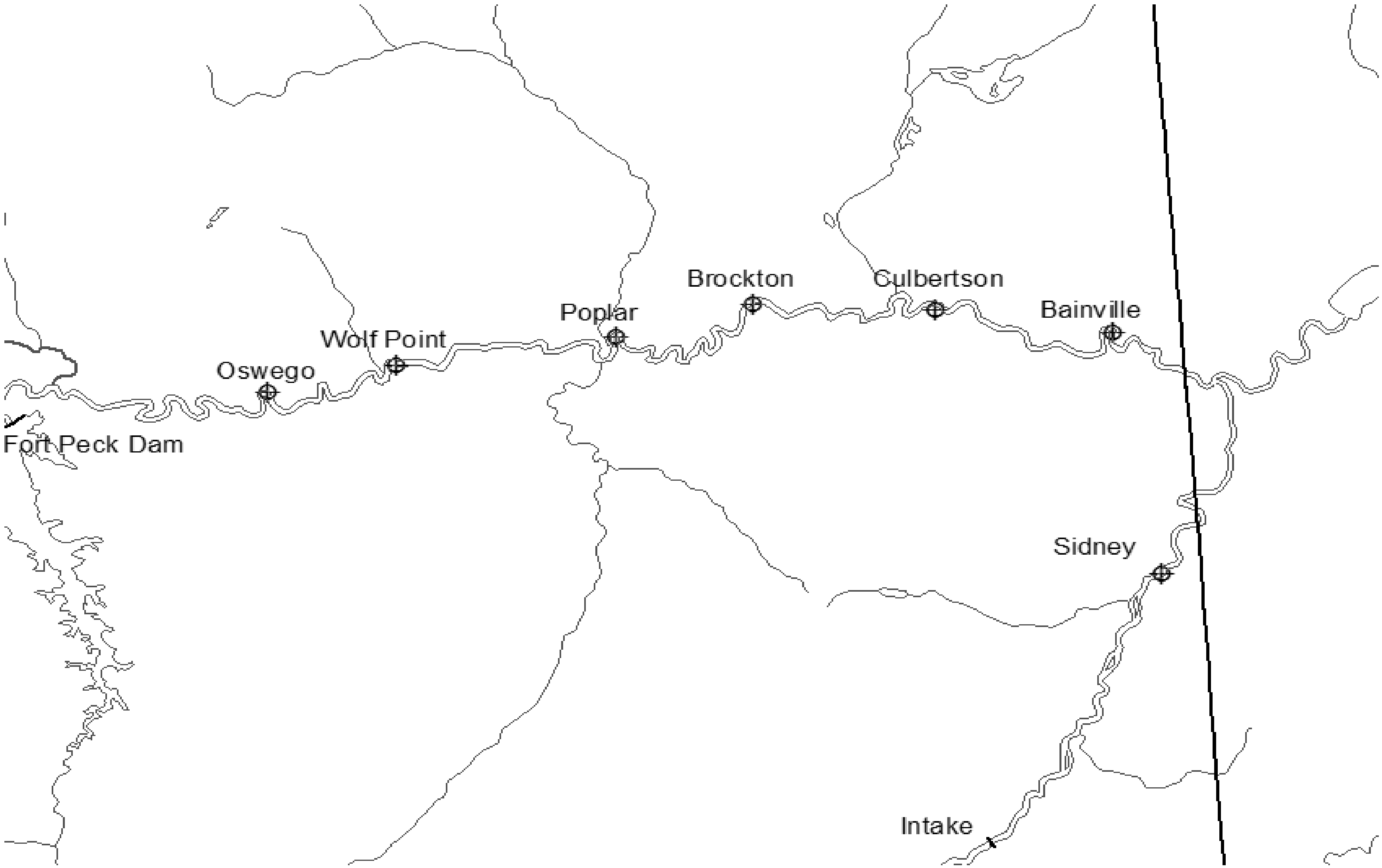

Figure 1. Study reaches of the Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea confluence and the Yellowstone River between Sidney bridge and the confluence with the Missouri River.

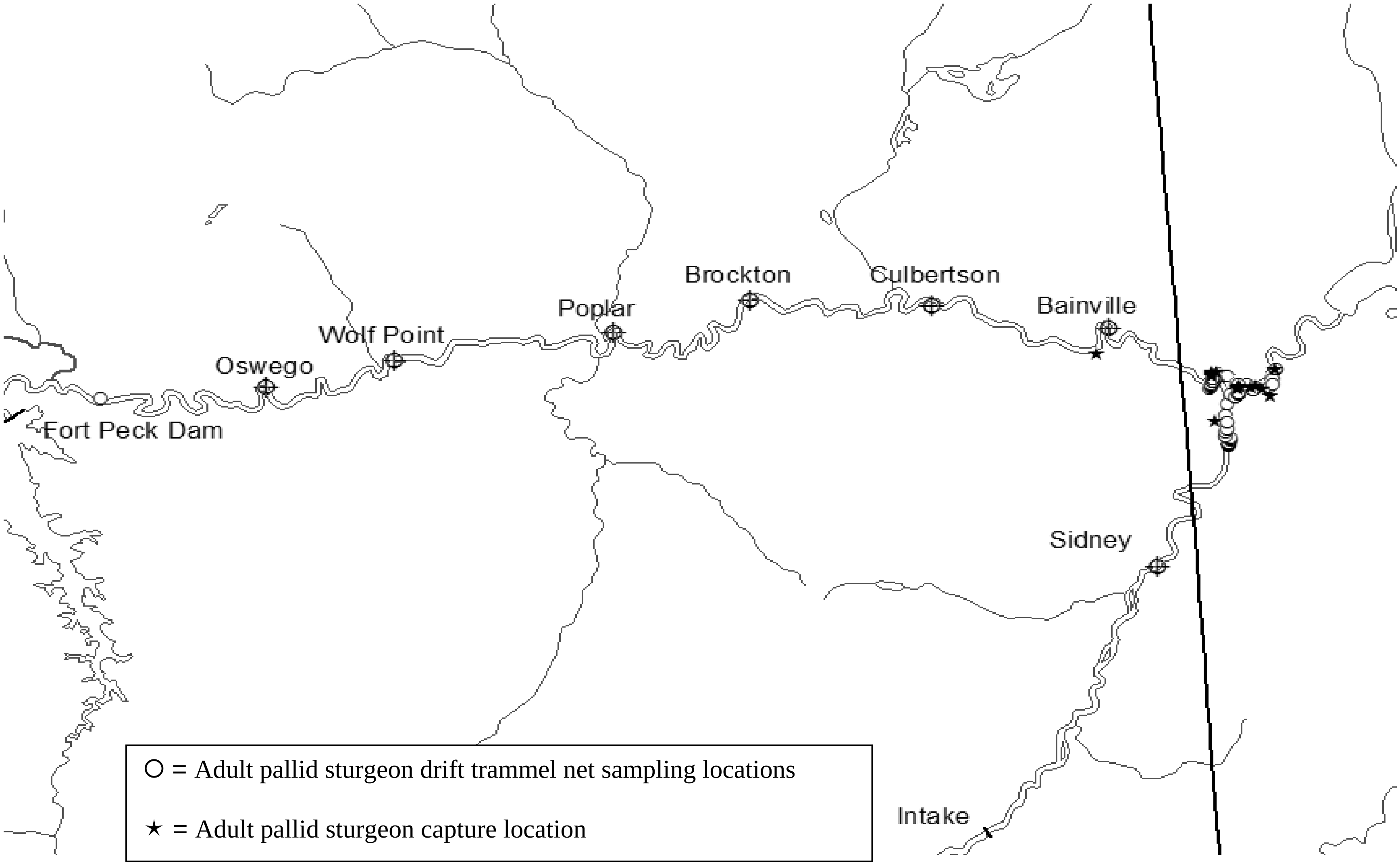

Figure 2. Drift trammel net sampling and capture locations for adult pallid sturgeon along the Missouri and Yellowstone rivers with capture locations, 2004.

Figure 3. Drift trammel net and benthic beam trawl tow sampling locations for HRPS along the Missouri and Yellowstone rivers, 2004.

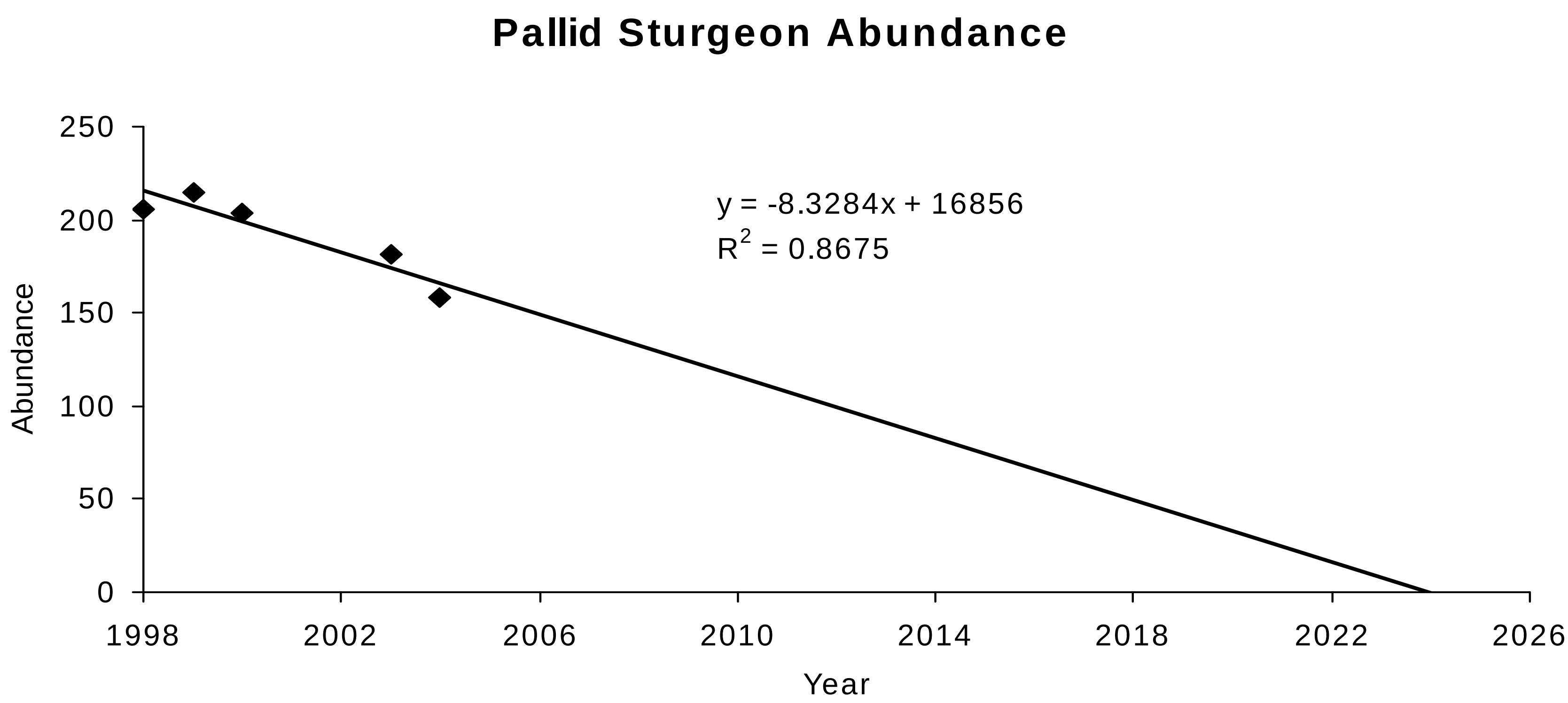

Figure 4. Pallid sturgeon abundance estimates for years 1998, 1999, 2000, 2003, and 2004 with trend line predicting an extirpation date of 2024.

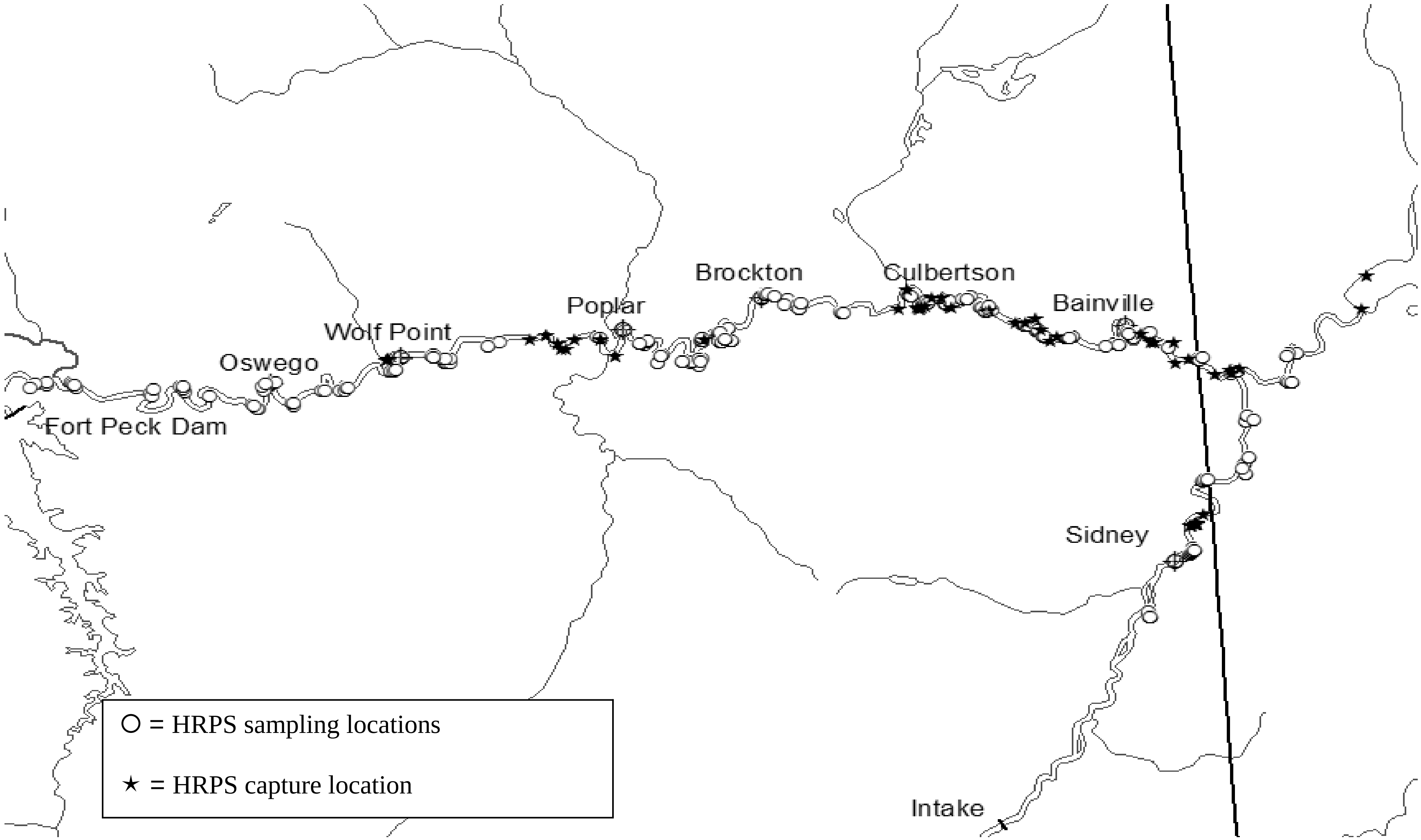

Figure 5. Drift trammel net sampling and HRPS capture locations along the Missouri and Yellowstone rivers, 2004.

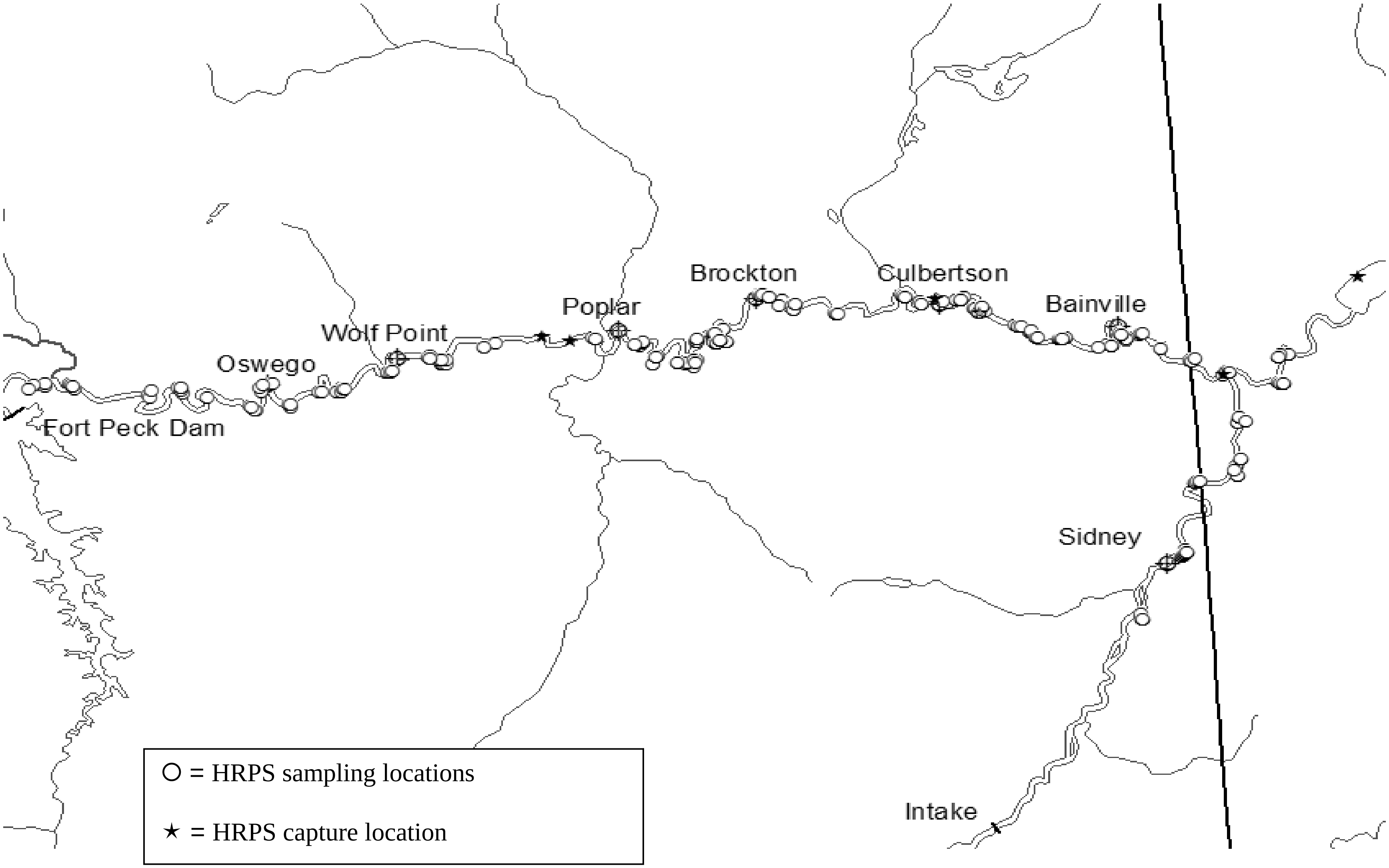

Figure 6. Benthic trawl tows and HRPS capture locations along the Missouri and Yellowstone rivers, 2004.

Figure 7. Hook and line sampling and capture locations for HRPS along the Missouri and Yellowstone rivers, 2004.

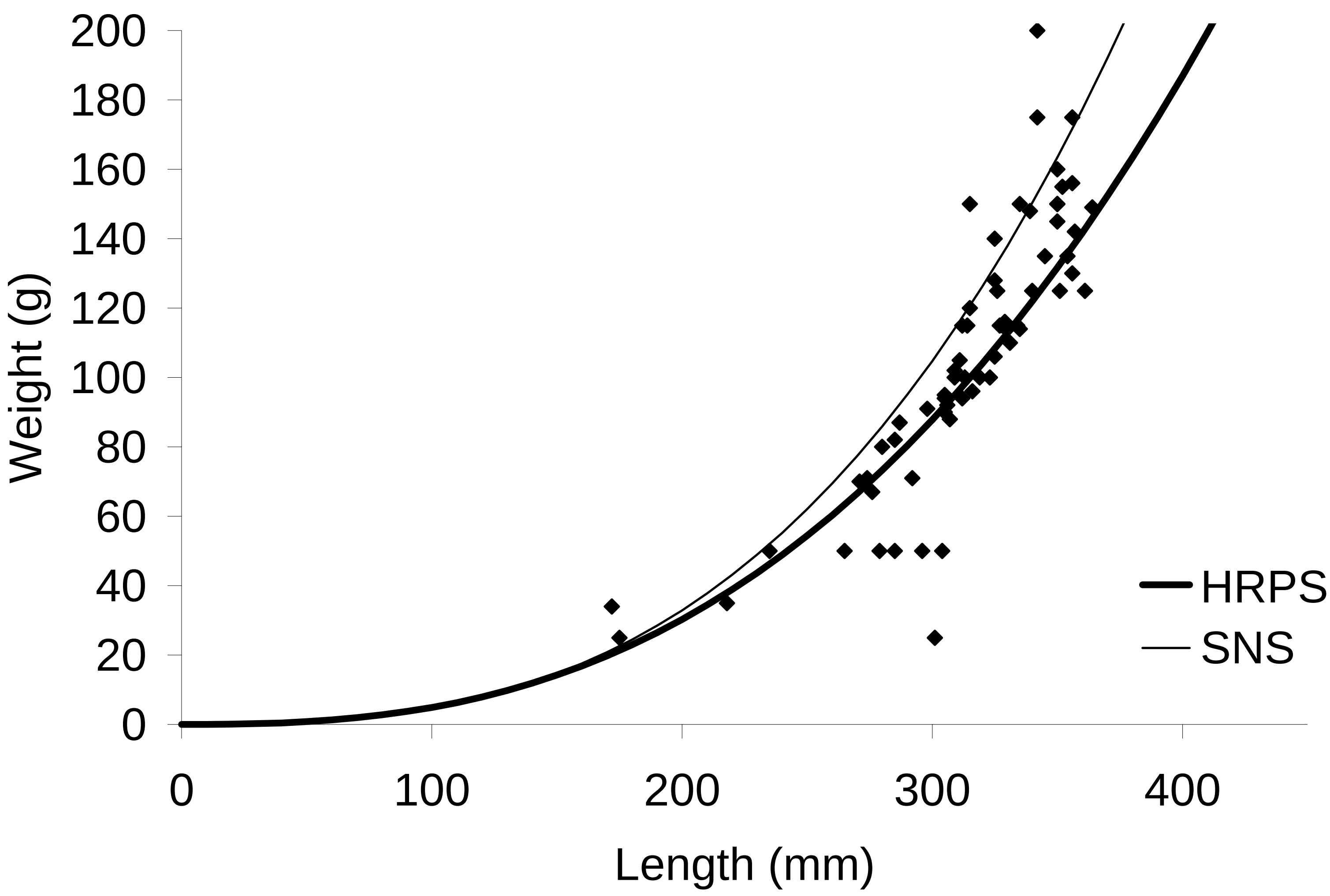

Figure 8. Weight-length relations plotted as a function of length for 68 hatchery-reared pallid sturgeon and 111 shovelnose sturgeon (<365 mm) captured in the study area during 2004.

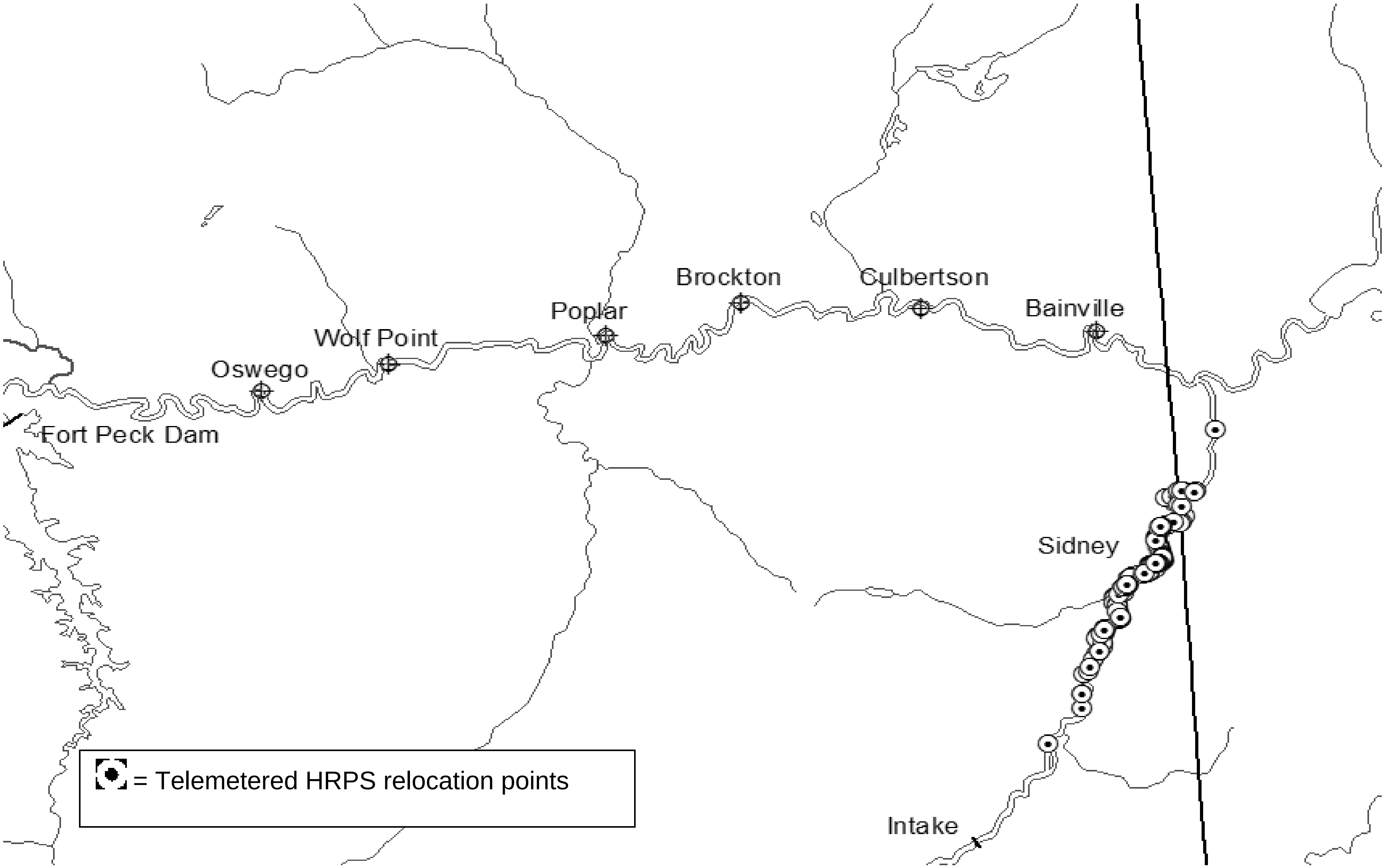

Figure 9. Relocation points of 69 of the 70 telemetered HRPS released at Sidney Bridge, MT, on 26 August.