MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
JOB PROGRESS REPORT

State: Montana Title: Northcentral Montana Fisheries Study

Project No.: F-46-R-7 Title: Missouri River Pallid Sturgeon Inventory

Study No.: III

Job No.: D Title: Planning Inventory, Fisheries

Period Covered: July 1, 1993 through June 30, 1994


## ABSTRACT

A study to evaluate the status of the pallid sturgeon in the middle Missouri River was continued. A total of 9 pallid sturgeon were captured during 1993. Six of the pallids were "new " fish and the 3 others were recaptures from previous years. A character index evaluation was used to test for hybridization. Twenty-one pallids scored between 389 and 523, while the remaining 3 pallids had lower scores ranging between 323 and 354, indicating possible hybridization. Fourteen pallids were radio tagged and monitored during 1992 and 1993. Their home range averaged 39 miles, with maximum and minimums of 21 and 61 miles. A total of 104 micro-habitat observations were recorded during 1992 and 1993. For most habitat parameters pallids used the predominant habitat found in the section, however, they did select for deep water areas in the Stafford Ferry section. The Tiber Dam tailwater trout fishery was evaluated for population improvements that have been anticipated since the Bureau of Reclamation began providing recommended instream flows in 1985. The trout standing crop was estimated at 267 fish/mile. Fall and spring stocking of fingerling and advanced-fingerling rainbow trout did not appear to contribute directly to the population of yearling rainbow trout.


## INTRODUCTION

Pallid sturgeon are found in the Wild and Scenic portions of the Missouri River in Montana. They exist in low numbers throughout their geographic range (Pflieger 1975) as is probably the case in this section of the Missouri River. In 1990 the U.S. Fish and Wildlife Service listed the pallid as "endangered" under the Endangered Species Act 1973. Reasons for listing are habitat modification and apparent lack of reproduction. Reports of pallid sturgeon sightings have also declined dramatically in the last 20 years (U.S. Fish and Wildlife Service, 1989). The pallid sturgeon has been listed as a class A "species of special concern" in Montana since 1973 (Holton, 1980).

The Montana Department of Fish Wildlife and Parks (MDFWP) initiated a fisheries study during 1989 to determine the past and present status of the pallid sturgeon in the 175 mile reach of river between Fort Benton and Fort Peck Reservoir. Results from the study will be used to develop a status report. This report will aid in devising management and recovery plans to maintain and enhance the pallid population in the river.

## OBJECTIVES AND DEGREE OF ATTAINMENT

1. **To determine current status (abundance and distribution) of pallid sturgeon in Missouri River upstream of Fort Peck Dam.** Sampling for pallid sturgeon was continued and carried out throughout the study area.

2. **To enhance trout populations and trout fishing opportunity in Marais River immediately downstream from Tiber Dam.** Trout populations in the Marias were monitored and wild rainbow trout fingerlings of Madison River origin were stocked in the Marias.

3. **To maintain streambanks and beds in a stable and near-natural condition in Chouteau and Liberty counties** (state funded). Six stream alteration projects were evaluated and recommendations were submitted to the applicants.

## PROCEDURES

Setlines and trammel nets were used to capture sturgeon. The setlines were 100 - 200 ft long with 7 - 15 hooks. Circular-type hooks were attached to the one-quarter inch diameter groundline by 16 inch long staging lines. The hooks ranged in size from 11/0 to 14/0. The setline was anchored in position with a 40 lb cement block at each end; a steel stake and block were used as anchors when the lines were set from the river bank. The terminal end was usually marked with a buoy. Setlines were positioned in the river either parallel, perpendicular or angled to the current and left overnight. Catch per unit effort for setline sampling was expressed as number of fish caught for an overnight set. This sampling method has been used with satisfactory results for white sturgeon in the Kootenai River (personal communication, Kim Apperson, Idaho Fish and Game Dept.).

Trammel nets were 150 ft. long and 6 ft. deep. Two mesh sizes were used: 1 inch inner walls with 10 inch outer walls, and 2 inch inner walls with 12 inch outer walls. Mesh material for both inner and outer walls were light-weight for better fish tangle characteristics and to insure that the net could be retrieved off submerged objects in the event that net material had to be torn free. The trammel nets were set in snag-free areas of the river and allowed to drift with the current along the bottom. Distances of the drift varied from 50 to 400 yds. Catch per unit effort for drift netting was expressed as number of fish caught per drift.

Radio telemetry was used to monitor general movements of individual sturgeon along with collecting micro-habitat information at relocation sites. The telemetry system used consisted of an ATS model 2100 receiver, both omni-directional and loop antennas, and two types of radio transmitters. The first type of transmitter was the smallest size and was attached externally to the base of the dorsal fin. The other type of transmitter was surgically implanted in the body cavity of the sturgeon. This transmitter was slightly larger and had an internal antenna encapsulated in the transmitter body. Both of these transmitters had a battery life rated for 90 days, however, it was common for the transmitters to work for 6 months.

All sturgeon were measured to the nearest 0.1 inch and weighed to the nearest 0.1 pound. A numbered plastic cinch tag was attached to the keel of the dorsal fin for identification purposes. Morphometric measurements recorded from sturgeon were: total, fork and standard lengths, head length, barbel lengths, mouth width, distance between inner barbel and mouth; and distance between outer barbel and snout tip. These measurements were then used for a Character Index, as modified by Carlson and Pflieger (1981), to test for hybridization. This index gives a single expression of how each sturgeon used in the analysis compares with every other sturgeon in the composite for the characters studied. It can be used to objectively rank the sturgeon with the most shovelnose-like characteristics at one extreme of the ranking and the most pallid-like characteristics at the other extreme.

Physical characteristics of the river channel in the study area was surveyed. Depth was measured using a depth finder; distance was determined using a range finder; velocity was measured with a Marsh-McBirney model 201 current meter; substrate type was determined by probing the bottom with a 10 ft metal pole or dragging a tethered 5 lb. weight along the bottom in the deeper water areas. The Brusven index of substrate code (Bovee, 1982) was used for describing rock size classes and is listed in Table 1.

Table 1. Substrate code for describing size classes in conjunction with the Brusven index method. After Bovee (1982).

| Code | Substrate description |
|---|---|
| 0 | Muck, hardpan |
| 1 | Sand |
| 2 | Small gravel (4-25 mm) |
| 3 | Medium gravel (25-50 mm) |
| 4 | Large gravel (50-75 mm) |
| 5 | Small cobble (75-150 mm) |
| 6 | Medium cobble (150-225 mm) |
| 7 | Large cobble (225-300 mm) |
| 8 | Small boulder (300-600 mm) |
| 9 | Large boulder (>600 mm) |
| 10 | Bedrock |

Cross-section locations were located by drawing 70 numbers from a random numbers chart that corresponded to the 350 possible river mile locations in the study area. (175 miles X 2; nearest ½-mile). The number of cross-sections were stratified according to study section so that each section was represented equally according to its length. A minimum of 10 depth and substrate points were taken at each cross-section, and average current velocity readings were measured at three points; at 25, 50 and 75 percent the distance out from the waters edge.

The electroshocking system used to capture trout and whitefish was a boom-type and mounted on a 14-foot aluminum McKenzie style driftboat powered by a 10 hp outboard motor. Power was supplied by a 3500-watt AC generator. The alternating current was delivered to a Coffelt Model VVP-10 rectifying unit which changes the alternating current to continuous direct current. The positive electrode consisted of two circular hoops with twelve 16-inch stainless steel droppers fastened on each hoop. These electrodes were supported by fiberglass booms and were positioned about six feet in front of the boat. The hull of the boat served as the negative. The unit was typically operated at 2-7 amps, 100-215 volts and continuous direct current.

The Peterson mark/recapture technique as described by Ricker (1975) was used to estimate the trout populations in the Marias River. The following formula as modified by Chapman (1951) was used:

$$N = \frac{(M+1)\ (C+1)}{(R-1)}$$

Where:

N = population estimate
M = number of marked fish
C = number of fish in the recapture sample
R = number of marked fish in the recapture sample

## DESCRIPTION OF STUDY AREA

The pallid sturgeon study area consists of a 175 mile reach of the mainstem middle Missouri River in northcentral Montana between Fort Benton and the headwaters of Fort Peck Reservoir near Lewistown (Fig. 1). There are two major tributaries entering the Missouri in this reach; the Marias River from the north and Judith River from the south. The present flow regimen of the Missouri River in the study area is not entirely natural because of regulation and storage at several upriver dams. The study area was divided into 5 study sections and the boundaries for each are given in Table 2.

Table 2. Locations of study sections on the middle Missouri River.

| SECTION | RIVER MILE upper | RIVER MILE lower | LOCATION |
|---|---|---|---|
| Fort Benton | 0 | 21 | T24N R8E Sec26 to T25N R10E Sec18 |
| Loma | 21 | 48 | T25N R10E Sec18 to T26N R12E Sec13 |
| White Rocks | 48 | 87 | T26N R12E Sec13 to T23N R16E Sec26 |
| Stafford F. | 87 | 126 | T23N R16E Sec26 to T23N R22E Sec6 |
| Robinson Bg. | 126 | 175 | T23N R22E Sec6 to T21N R27E Sec10 |

The study area for the Tiber Dam tailwater study is a 21 mile reach of the Marias River extending from the dam near Chester to the Circle Bridge at Highway 223. Tiber Reservoir is a water storage reservoir with no hydroelectric power generation. Flows in the river downstream are completely controlled by discharges from the dam.

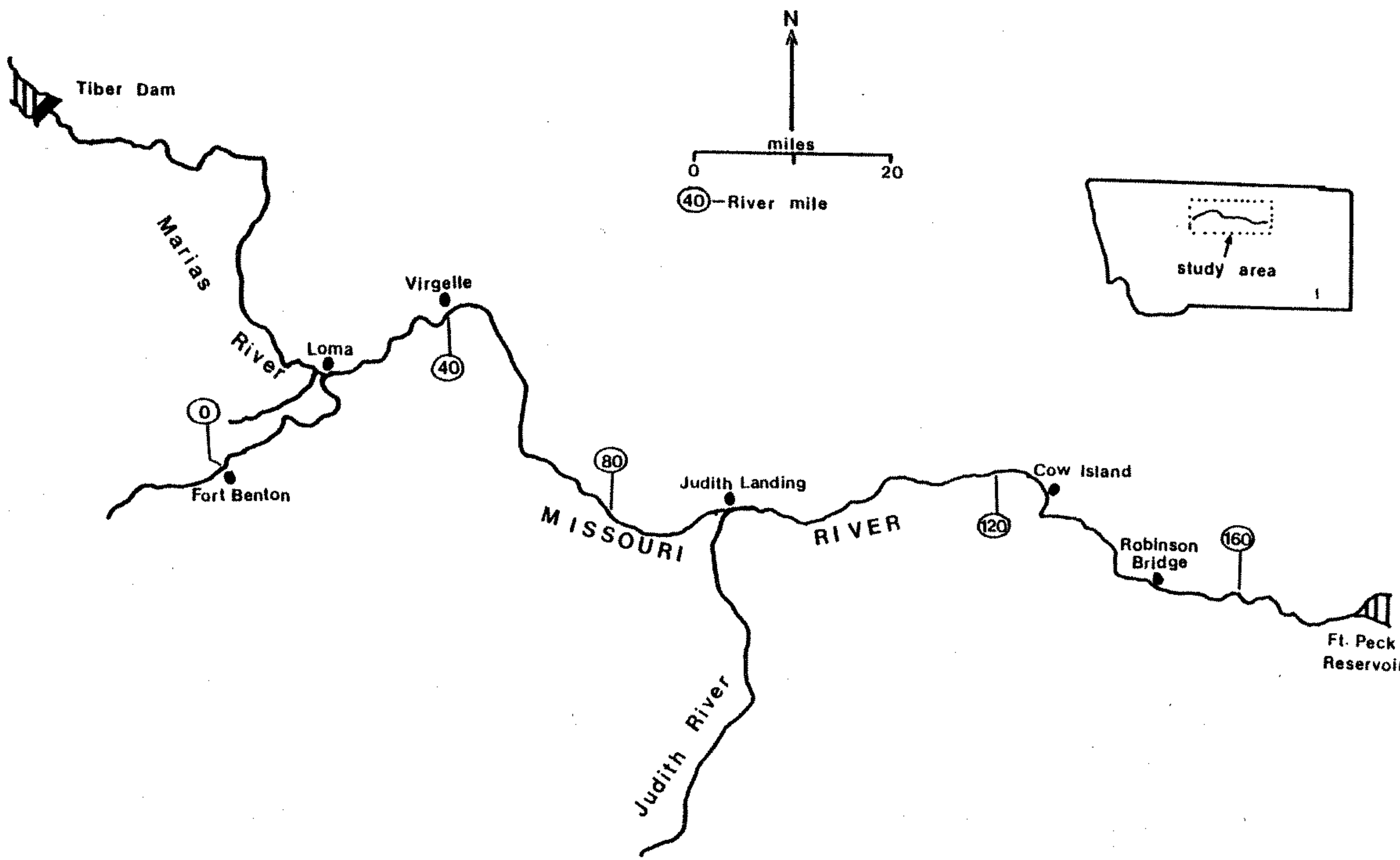



Figure 1. Map of the study area.

# FINDINGS

## Present Status of the Pallid Sturgeon Population

A total of 6 pallid sturgeon, not previously caught before, were captured in the study area. In addition to this total, 3 other pallid sturgeon that had been caught in previous years were also captured, equalling a total of 9 pallids captured during the 1993 field season. Appendix Table A lists all the pallid sturgeon captured since 1990 and a record of the recapture history. Thus far a total of 24 different pallid sturgeon have been captured since this study commenced in 1989. Recapture rates of these tagged pallids are fairly high. Six of the 25 pallids have been recaptured at least once and two have been recaptured twice. (None of the recaptures counted here are with the aid of radio telemetry.) There were 2 confirmed sightings of pallid sturgeon in the study area by fishermen in addition to the 9 pallids sampled by this study in 1993. These fishermen caught and released the 2 pallids while snagging for paddlefish in the Robinson Bridge section.

Both sampling methods caught pallids in 1993, with trammel nets used in the capture of 5 pallids and setlines used in the capture of 4 pallids. The difference in catch between gear types is probably related to the more intensive use of the trammel nets compared to setlines. A total of 134 trammel net drifts were completed during the year compared to 73 setline sets. Setlines could not be used after July because of the large amounts of drifting filamentous algae present in the river after this date. The algae would collect on the lines, covering and burying them, thereby making the setlines ineffective.

Trammel net sampling and setline fishing was especially effective for catching shovelnose sturgeon. Tables 3 and 4 summarizes the results for the period 1990-93. Ninety-seven percent of the 2,602 shovelnose sampled were captured using trammel nets. The average composite catchrate using trammel nets was 3.8 shovelnose compared to 0.3 with the setlines. It appeared that setline fishing was more selective for larger shovelnose. Comparing the sizes of shovelnose captured by both methods in the Robinson Bridge section show that shovelnose caught on setlines averaged 2.7 lbs more than the ones caught in trammel nets. This difference in catch sizes was probably related to the tendency of larger shovelnose to feed on minnows.

Figure 2 depicts the size distributions of pallid sturgeon that have been captured in the study area since 1990. Pallid sturgeon averaged 52.5 inches fork length and 33.4 pounds. These pallid sturgeon were caught in the lower 60 miles of the study area between Stafford Ferry and a point located 14 miles upriver from the headwaters of Fort Peck Reservoir. All the pallids were captured in pool areas 6-12 ft. deep, with sandy channel substrates.

Table 3. Trammel netting results (all years combined) for shovelnose sturgeon sampled in the middle Missouri River, MT, April - October, 1990-93.

| Study Section | Total No. of Sets | Number Caught | Average Number/Set | Average Sizes [1/] FL | WT |
|---|---|---|---|---|---|
| Fort Benton | 39 | 73 | 1.9 | 32.8 | 7.1 |
| Loma | 100 | 591 | 5.9 | 31.2 | 5.6 |
| White Rocks | 48 | 160 | 3.3 | 28.7 | 4.4 |
| Stafford Ferry | 116 | 330 | 2.8 | 28.2 | 4.4 |
| Robinson Bridge | 364 | 1364 | 3.8 | 26.9 | 3.6 |
| Total | 667 | 2518 | | | |

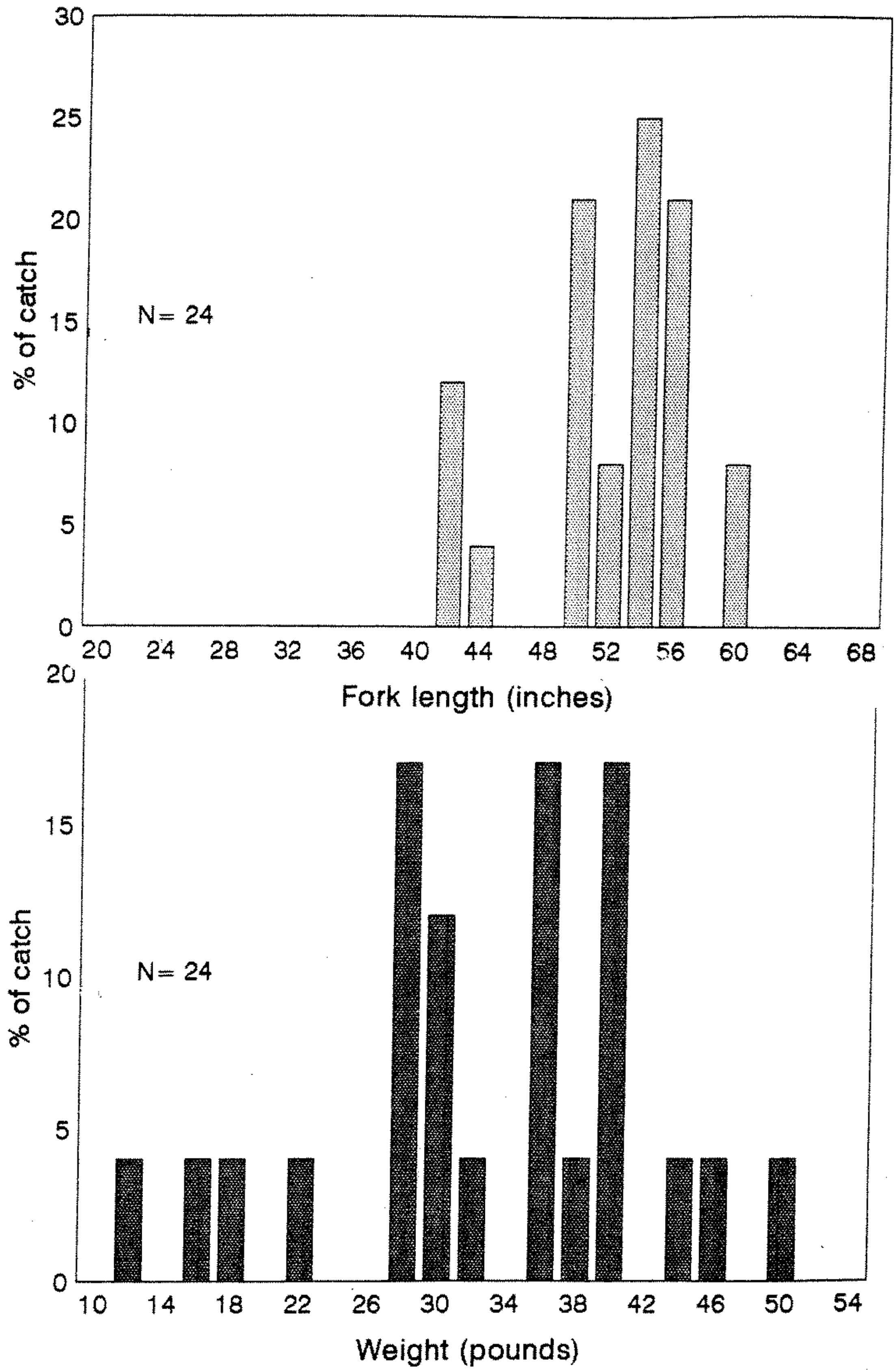
[1/] in inches and pounds

Table 4. Setline fishing results (all years combined) for shovelnose sturgeon sampled in the middle Missouri River, MT, April - October, 1990-93.

| Study Section | Total No. of Sets | Number Caught | Average Number/Set | Average Sizes [1/] FL | WT |
|---|---|---|---|---|---|
| Fort Benton | 5 | 1 | 0.2 | --- | --- |
| Loma | 48 | 11 | 0.2 | 31.9 | 5.9 |
| White Rocks | 24 | 2 | 0.1 | 33.2 | 7.8 |
| Stafford Ferry | 6 | 4 | 0.8 | 28.5 | 4.0 |
| Robinson Bridge | 160 | 66 | 0.4 | 31.9 | 6.3 |
| Total | 243 | 84 | | | |

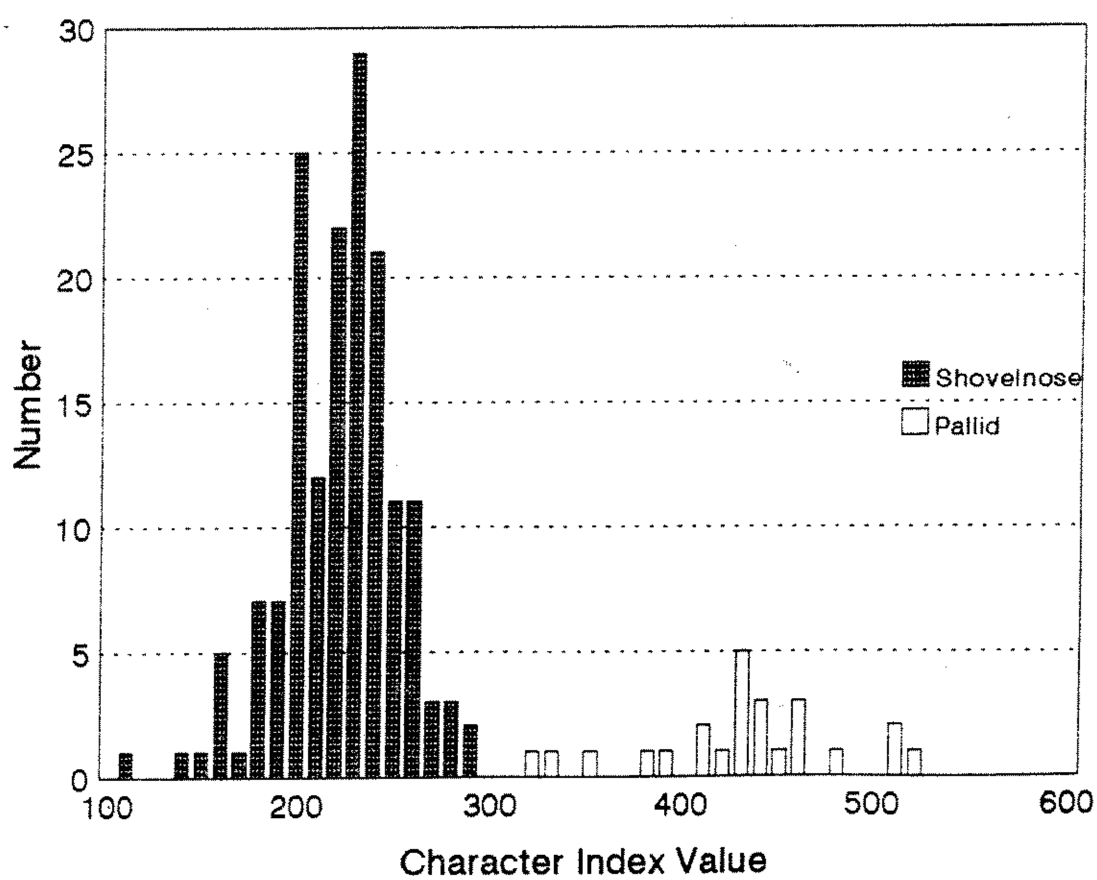
[1/] in inches and pounds

Figure 2. Length and weight frequencies for pallid sturgeon sampled in the middle Missouri River, MT, 1990-93.



Hybridization between pallid and shovelnose sturgeon has been reported by Carlson et al. (1985) and Bobby C. Reed (personal communication, Louisiana Dept. of Wildlife and Fisheries) and it may present a threat to survival for pallids sturgeon populations. Three of the 2,626 sturgeon examined since 1990 in this study area appeared to exhibit noticeable hybrid characteristics. The three sturgeon were suspected as being hybrids based on general appearance and by taking 6 measurements for a character index analysis. A sturgeon character index based on morphometric measurements (Carlson and Pflieger 1981) was used to evaluate for possible hybridization of a sample of shovelnose ( N=131) and all 24 pallid sturgeon (Figure 3). Sturgeon with strong shovelnose characteristics score on the low end of the scale at 100, and a fish with strong pallid characteristics score in the 500 range. Twenty-one of the 24 pallids sampled in the study area had scores between 389 and 523, while shovelnose scores ranged from 115 to 293. This demonstrates there is a substantial separation between these two species. However, the 3 sturgeon having scores 323, 334 and 354 are indicative of fish that share characteristics of both sturgeon species, and are likely hybrids.

**Figure 3. Character indices scores for shovelnose and pallid sturgeon sampled in the middle Missouri River, MT, 1993.**



Unfortunately this finding cannot yet be confirmed by genetic analyses because genetic studies of these two species have not been able to distinguish between them using DNA analysis (Mark Dryer, personal communication, USFWS). Tews (1993) evaluated 608 shovelnose and 55 pallids for possible hybridization using the character index method and found no evidence of hybridization. The shovelnose scores ranged between 164 to 307, compared to the pallid scores which ranged between 368 to 478.

Six pallid sturgeon were equipped with radio transmitters during 1992 and 8 pallids were transmittered during 1993. A variety of transmitter placements were tested for performance and effects on the individual fish behavior (Table 4). Nine of the 14 transmittered pallids were equipped with small 10-16 gm external transmitters that were attached to the base of the dorsal fin. White sturgeon researchers in Idaho have used this sort of attachment and reported favorable success (Kim Apperson, Idaho Fish and Game). This type of attachment was preferred because it was easy to install onto the sturgeon, the unit was efficient at transmitting a signal because the antenna was exposed to the outside and not contained in the body cavity, this method didn't require surgery, and the transmitter could be easily removed in the event the sturgeon was recaptured. The second type of attachment was internally implanting the entire transmitter capsule into the body cavity. This method was tested for shovelnose during the previous year of this study and results demonstrated there were no complications from surgery and that it appeared to not affect the general movement behavior of the shovelnose (Gardner 1992). This method of attachment has been successfully used by several other researchers including Tyus (1988). Four pallids were equipped with radio transmitters using this type of arrangement. The final type of transmitter placement was also an internal implant with the difference being that the whip antenna protruded through the body wall and was not contained in the transmitter capsule. With the antenna outside the body cavity of the fish the signal strength is much greater (Ross and Kleiner 1982). A radio transmitter has a much greater antenna gain with this type of antenna than an antenna that is encapsulated within the body of the transmitter and within the body of the fish. Only one pallid was equipped with a transmitter using this arrangement. Descriptive features and usage for these three types of transmitters are given in Table 4.

Observations concerning the effects of the transmitters on the pallid sturgeon indicated that the completely internal transmitters probably had the least effect on the fish. All 4 of pallids that were equipped with this type of transmitter were later examined 1-2 months after the implanting surgery. The four pallids all had completely healed incisions and no indications of physical problems were evident. The one pallid that was equipped with an internal transmitter with a protruding antenna was completely healed at the primary incision, however, the secondary incision where the antenna protruded from was inflamed and had not completely healed around the antenna. The antenna could easily slide back-and-forth through the partially healed incision. Because of this condition the antenna was severed and inserted into the body cavity before releasing the fish. Only 5 of the 9 pallids with external dorsal fin transmitters were examined after they were released. All 5 of these pallids had substantial irritation from this type of attachment. The wire holes in the dorsal fin muscle were inflamed and enlarged. Also, the portions of skin which were covered by the transmitter and backing were degenerated in most cases. All 5 transmitters were removed before releasing the fish. Based on these observations it is recommended that the external dorsal fin transmitter method of attachment should not be used for pallids. The shovelnose sturgeon radio telemetry information will not be presented in this years report because of the low number of observations.

Table 5. Physical dimensions and performances of radio transmitters used for pallid sturgeon telemetry studies in the Missouri River, 1992-93.

| | Dorsal fin external | Completely internal | Internal with protruding antenna |
|---|---|---|---|
| Transmitter size | | | |
| Length (in.) | 2-3 | 4 | 3½ |
| diameter (in.) | 0.4 -0.7 | 0.8 | 0.8 |
| weight (gm.) | 10 - 16 | 36 | 44 |
| Number of fish transmittered | | | |
| - pallids | 9 | 4 | 1 |
| - shovelnose | 2 | 2 | 2 |
| Observed average transmitter duration (days) 1/ | | | |
| - pallids | 91 | 112 | 78 2/ |
| - shovelnose | 112 | 75 | 27 |
| Average number of radio contacts | | | |
| - pallids | 14 | 24 | 24 |
| - shovelnose | 18 | 17 | 8 |
| Total number of radio contacts | | | |
| - pallids | 69 | 95 | 24 |
| - shovelnose | 36 | 34 | 8 |

1/ – Applicable for transmittered fish for period April - October.
2/ – After 78 days the antenna was cut due to complications, thereby making the transmitter ineffective.

The radio transmittered pallid sturgeon migrated upriver substantial distances from the lower end of the study area. Appendix Tables B1-5 show the individual movements of 14 pallids. The average migration range for pallids that were monitored for 60 days or more was 39 miles and was as extensive as 61 miles and as limited as 21 miles. Most of the greater distances travelled occurred during June and July. Figure 4 probably describes the typical migration pattern for pallid sturgeon in the study area. This plot depicts the pallid as beginning upriver movement in mid-May, staging in the upper end of the Robinson Bridge section until late June, and then travelling to the furthest upriver point, Stafford Ferry section, by early July. After staging in this upper section for about a month, pallid sturgeon return to the lower reach of the study area for the remainder of the year.

Figure 4. Movement patterns of transmittered pallid sturgeon G-01747 in the Stafford Ferry and Robinson Bridge sections, middle Missouri River, MT, 1993.

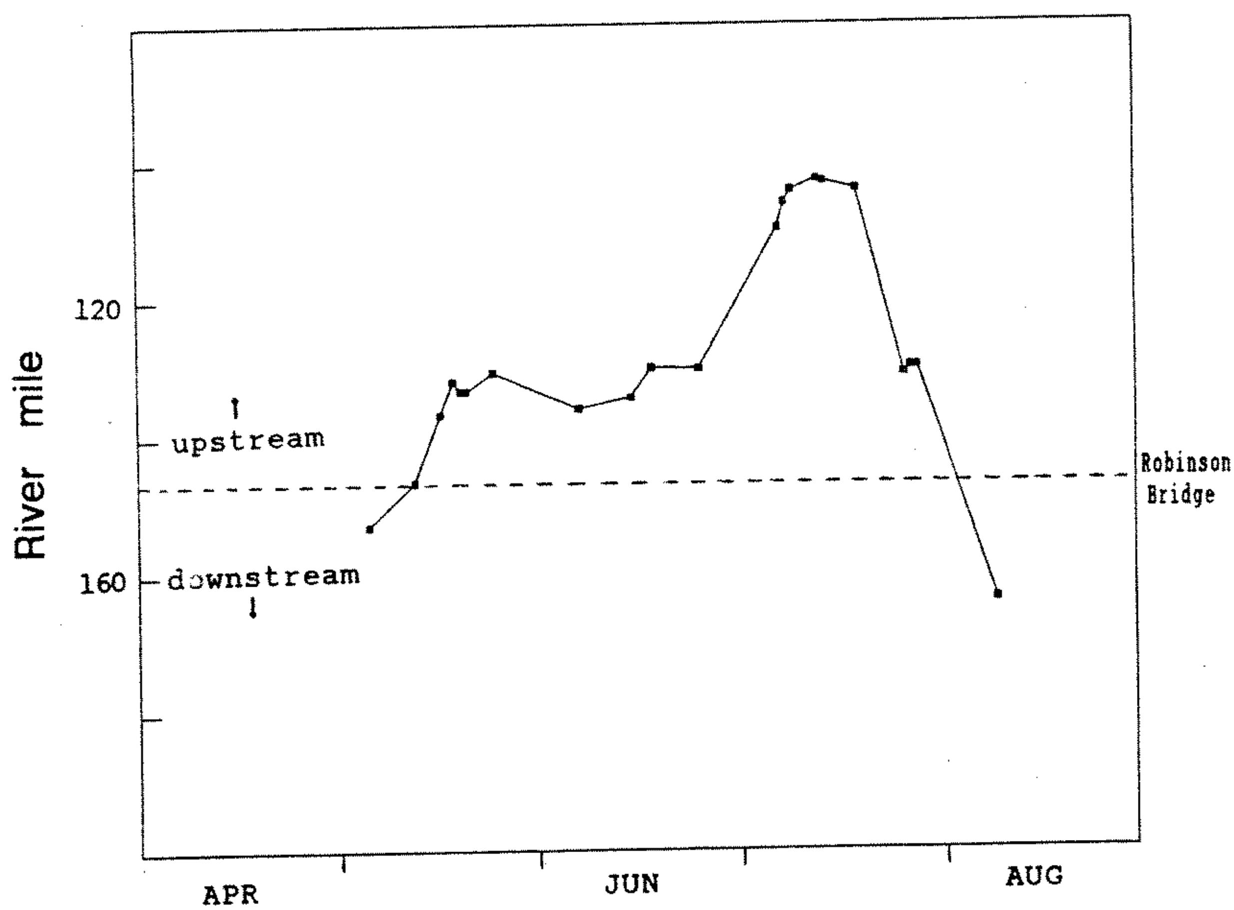
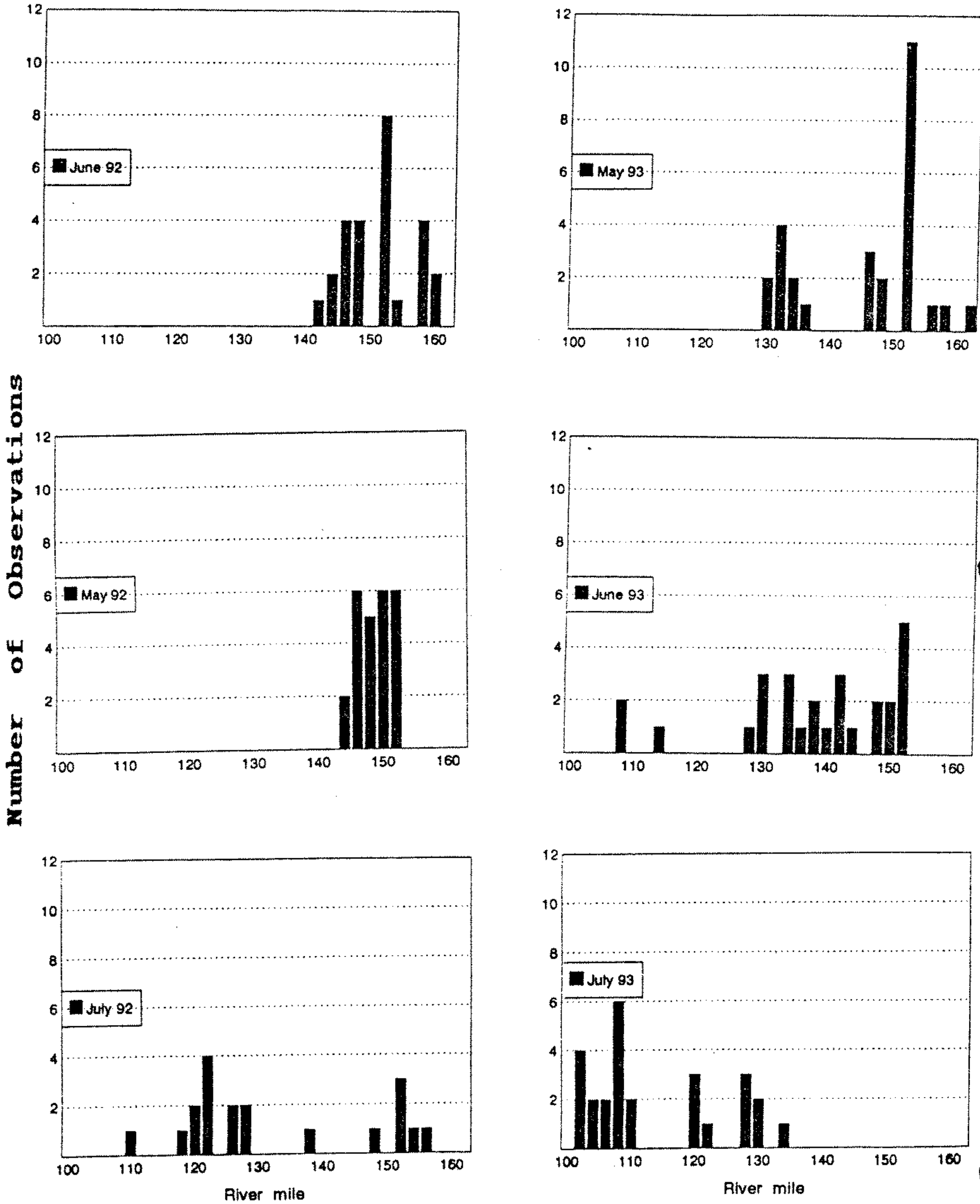


Figure 5. Distribution of monthly river mile locations for transmittered pallid sturgeon in the middle Missouri River, MT, 1992-93.



Movement behavior for radio telemetered pallid sturgeon differed substantially between years. For May and June, 1992 pallid movements were minimal and the average river mile radio locations for these months were 149.7 and 151.9 (Figure 5). In contrast to the 1992 findings, the telemetered pallids gradually moved upstream each month during May and June, 1993, registering average monthly river mile locations of 146.5 and 130.0.

The greatest difference in average monthly river mile location between the two years occurred during July where there was a 18.6 mile difference. The spring river conditions was the most obvious difference in environmental conditions between the two years. River flows for May - July, 1992 were very low ranging from 24 - 48% of average compared to the much greater river flows of 1993 for the same period which ranged between 79 and 171% of average (USGS, 1994). Figure 5 depicts the pallid sturgeon seasonal migration beginning in May. During June pallids continue to move upriver and begin to spread out more. June also is the month that pallids are believed to spawn in. No indication of spawning activity could be determined from these telemetered fish, however, further analysis along with future studies may provide insight regarding spawning activity. It appeared that the monitored pallids reached the furthest upriver destination in early July. This area was in the Stafford Ferry section which is typified as being a canyon reach with a wide and shallow channel, armored with large cobble and boulders. At this time it is unknown why the pallids moved to this area. Radio telemetry observations of pallid sturgeon were reduced after July because transmitter battery life usually expired after 90 days and few pallids were captured and transmittered during the summer. However, one pallid that was monitored during both years through September returned from the Stafford Ferry section to the lower Robinson Bridge section by early-August.

The physical characteristics of the river channel in the study area was inventoried so that micro-habitat use by pallid sturgeon could be compared to availability in a given section. Table 5 shows that the river channel in the upper two study sections are moderately deep with substrates primarily comprised medium to large size gravel. The middle two study sections, White Rocks and Stafford Ferry, are confined in a hard sandstone canyon. A wide shallow channel and swift water currents are characteristic of these sections. The stream channel substrates are comprised of small to large cobble with large boulders also evident. The most downstream section, Robinson Bridge, was considerably different than the rest. Here the channel was typified as being deep with moderate current velocities. The channel substrates were largely comprised of sand and small gravel.

Table 6. River and channel physical conditions for five study sections in the middle Missouri River, MT, 1993. (All values are expressed as averages for the indicated study section).

| | Study Section | | | | |
|---|---|---|---|---|---|
| | Fort Benton | Loma | White Rocks | Stafford Ferry | Robinson Bridge |
| Number of Cross-Secs | 8 | 11 | 14 | 17 | 20 |
| Width (ft) | 432 | 593 | 607 | 668 | 539 |
| Depth (ft) | 6.0 | 6.2 | 5.3 | 5.5 | 7.6 |
| Average Velocity (ft/sec) | 3.0 | 2.9 | 3.8 | 3.7 | 3.0 |
| Average Substrate Type | 3.2 | 3.2 | 4.5 | 4.7 | 1.5 |
| Subst Comp. (avg %) | | | | | |
| 0 - 1 | 16% | 24% | 13% | 6% | 73% |
| 2 - 4 | 58% | 46% | 24% | 32% | 20% |
| 5 - 7 | 26% | 30% | 58% | 53% | 7% |
| 8 - 10 | 0% | 0% | 5% | 9% | 0% |

A total of 104 pallid sturgeon micro-habitat observations were recorded using radio telemetry during 1992-93. Thirteen different pallids were monitored during this two year period. Tables 7 and 8 are a summary of pallid habitat use based on month and study section. Transmittered pallid sturgeon were found in depths ranging from 3 to 15 ft. The average depths varied for each month being the deepest in May and October, and more shallow in July. Point velocities where radio contacts of the pallids were determined were found to be greatest in July and least in October. Pallids were found in wider, more shallow sections of the Missouri River in July then any other time. Correspondingly, they moved furthest from the thalweg (deepest area of the channel) during this month and occupied sites characterized by medium-size cobble. The comparison of pallid micro-habitat use with study section location indicate that pallids preferred the deeper water habitats within the study section. This is demonstrated the best by comparing micro-habitat use in the Stafford Ferry section (Table 8) with the physical conditions of this section (Table 6). Here the average depth in the section was 5.5 ft. while the average point depth that the transmittered pallids were found in for the Stafford Ferry section was 7.1 ft. The pallid migration upstream to the Stafford Ferry section cannot be explained at this time, but, it is fairly evident they reside there and use representative habitats of the area with the exception of the preference for deep pools. Observations of the transmittered pallids in the Lower Robinson Bridge section indicated they did not select for any unique habitat condition in the area, but used the micro-habitat that was representative of the section. There appeared to be differences in micro-habitat use of the transmittered pallids between the upper and lower portions of the Robinson Bridge section. Pallids were found to be closer to the thalweg and in areas with larger substrates in the Upper Robinson Bridge section. More detailed comparisons within the Robinson Bridge section will be made in a later report.

Table 7. Micro-habitat conditions in the middle Missouri River, MT, where radio transmittered pallid sturgeon were located, 1992-93.

| | May | June | July | October |
|---|---|---|---|---|
| # of Contacts | 32 | 32 | 32 | 8 |
| Point Depth (ft) | 8.1<br>(3.0 - 15.0) | 7.5<br>(3.0 - 13.0) | 6.5<br>(3.0 - 10.5) | 8.3<br>(7.0 - 10.0) |
| Point Velocity (ft/sec) | 2.6<br>(1.0 - 5.2) | 2.4<br>(1.2 - 3.2) | 2.7<br>(1.9 - 4.7) | 2.0<br>(1.5 - 2.3) |
| Channel Width (ft) | 541<br>(350 - 725) | 563<br>(425 - 669) | 639<br>(420 - 910) | 420<br>(300 - 573) |
| Thalweg Distance (ft) | 85<br>(0 - 500) | 88<br>(0 - 310) | 126<br>(0 - 600) | 58<br>(0 - 150) |
| Substrate Type | 1.7<br>(0 - 6) | 2.3<br>(0 - 10) | 5.5<br>(0 - 7) | 0.9<br>(0 - 1) |

Table 8. Micro-habitat conditions in the middle Missouri River, MT, where radio transmittered pallid sturgeon were located during May, June, July and October, 1992-93.

| | Stafford Ferry | Upper [1] Robinson Bdg. | Lower [2] Robinson Bdg. |
|---|---|---|---|
| # of Contacts | 18 | 30 | 56 |
| Point Depth (ft) | 7.1<br>(3.6 - 10.5) | 7.6<br>(3.0 - 13.0) | 7.8<br>(3.0 - 15.0) |
| Point Velocity (ft/sec) | 2.9<br>(1.7 - 3.9) | 2.8<br>(1.6 - 4.1) | 2.2<br>(1.0 -3.6) |
| Channel Width (ft) | 668<br>(430 - 910) | 560<br>(350 - 820) | 535<br>(300 - 910) |
| Thalweg Distance (ft) | 113<br>(0 - 600) | 64<br>(0 - 220) | 100<br>(0 - 500) |
| Substrate Type | 5.0<br>(1 - 7) | 3.2<br>(0 - 6) | 1.2<br>(0 - 10) |

1/ - Portion of Robinson section upstream of the Robinson Bdg. (RM 126-148).
2/ - Portion of Robinson section downstream of the Robinson Bdg. (RM 149-176).

## Marias River - Tiber Dam Tailwater

A trout fishery in the 21 mile reach of Marias River immediately below Tiber Dam is maintained by coldwater release. Prior to 1985 the coldwater fishery existed far below its potential because of inadequate instream flows and periodic surface warmwater releases from the dam (Gardner and Berg 1983). The Montana Fish Wildlife and Parks has recommended a minimum instream flow of 500 cfs be maintained in the river below Tiber Dam for the trout fishery.

The trout fishery has improved substantially since 1985, most likely in response to better flow and temperature conditions (Gardner 1988). Field studies in 1987 showed marked improvements in trout numbers, sizes and reproductive success. However, results from the 1988 survey indicated that the trout populations had stabilized and did not continue to improve as anticipated.

A number of mountain whitefish, brown and rainbow trout were sampled while conducting the population estimates (Table 7). Comparisons of these size statistics show that sizes for all three species of salmonids have decreased substantially in 1993. This is attributed to the relatively high numbers of yearling fish that dominated the catch.

Table 9. Comparison of size statistics for mountain whitefish and trout sampled in the Marias River below Tiber Dam during 1987-92.

| Year | Number | Avg. Length (inches) | Avg. Weight (pounds) | Mode (inch) | Median (inch) |
|---|---|---|---|---|---|
| Mountain whitefish | | | | | |
| 1988 | 104 | 12.3 | 0.78 | 9 | 12.6 |
| 1989 | 99 | 13.1 | 0.91 | 15 | 13.2 |
| 1990 | 114 | 13.1 | 0.95 | 12 | 13.3 |
| 1991 | 99 | 13.1 | 0.99 | 9 | 13.3 |
| 1992 | 108 | 15.0 | 1.41 | 16 | 15.0 |
| 1993 | 100 | 13.3 | 1.01 | 14 | 14.5 |
| Brown trout | | | | | |
| 1987 | 102 | 15.7 | 2.00 | 8 | 17.0 |
| 1988 | 111 | 14.0 | 1.24 | 13 | 13.9 |
| 1989 | 27 | 17.0 | 1.89 | 16 | 16.3 |
| 1990 | 118 | 17.0 | 1.92 | 17 | 17.6 |
| 1991 | 118 | 17.7 | 1.79 | 18 | 18.1 |
| 1992 | 84 | 17.4 | 1.47 | 17 | 17.7 |
| 1993 | 68 | 14.6 | 1.32 | 8 | 17.5 |
| Rainbow trout | | | | | |
| 1987 | 108 | 12.2 | 0.87 | 7 | 12.3 |
| 1988 | 124 | 11.5 | 0.63 | 10 | 11.5 |
| 1989 | 5 | 13.8 | 1.00 | 15 | 15.1 |
| 1990 | 65 | 14.9 | 1.19 | 15 | 15.2 |
| 1991 | 79 | 13.8 | 0.88 | 16 | 14.0 |
| 1992 | 76 | 15.2 | 1.27 | 15 | 15.7 |
| 1993 | 103 | 11.1 | 0.61 | 8 | 8.9 |

Trout standing crop estimate statistics for 1993 show that both rainbow and brown trout had relatively high numbers of yearlings (6.0 - 10.9 in.) (Table 8). The 1993 yearling rainbow trout estimate was the greatest ever recorded and 810% greater than the 5-year average. Brown trout yearling numbers were also relatively high and represented 535% that of the 5-year average. The relatively high numbers of both brown and rainbow trout can most likely be attributed to the successful spawning and rearing that occurred in the river the previous year. Stocking of young-of-year and yearling rainbow trout occurred during this period but the lack of marked hatchery trout in the total catch of yearlings indicated that natural reproduction produced the majority of yearlings examined.

Table 10. Standing Crop estimate statistics of trout populations in a 4 mile reach of the Marias River below Tiber Dam during 1987- 1993.

| Size Group | 1993 | 5 Year Average | Maximum | Minimum |
|---|---|---|---|---|
| **Rainbow** | | | | |
| (6.0 - 10.9) | 648 | 80 | 202 | 0 |
| (11.0 - 20.4) | 96 | 152 | 222 | 105 |
| **Brown** | | | | |
| (6.0 - 10.9) | 150 | 28 | 50 | 0 |
| (11.0 - 32.0) | 174 | 158 | 200 | 105 |

Numbers of adult brown trout continue to be stable, while the population of adult rainbow trout has declined to the lowest number recorded. Since 1990 and until 1993, the estimates for yearling rainbows have been far below the 5-year average. Consequently there has been little recruitment to the rainbow population. The year 1993 marks the first time that there has been above average number of yearling rainbows. It is anticipated that numbers of adult rainbow trout in this section of the Marias will increase in future years.

In response to the declining rainbow trout population a plan was developed in 1990 to stock the Marias with wild fingerling rainbows from the Madison River. This action was taken to: 1) increase numbers of rainbow trout to anglers, 2) possibly enhance natural reproduction by introducing rainbow from a population known to reproduce effectively by spawning in a mainstem river, and 3) determine whether or not survival of juvenile fish during the first year is a critical limiting factor.
Table 9 is a summary of the rainbow trout stocking efforts since 1990. A total of 47,785 trout have been stocked but the success of this program has been poor to date. The ratio of stocked (marked) to wild yearling rainbows sampled while conducting the trout estimates gives a good indication of the programs success. The best that was achieved thus far was from the 1992 plant where 21% of the examined yearling rainbows were marked hatchery fish. The 1991 plant had a high ratio where 75% of the examined yearling rainbows were marked hatchery fish. However, the estimate for the yearlings was 24 which is 30% of the 5-year average. The reason for the apparent poor success with the stocking program is unclear. There is a possibility that the stocked rainbows are drifting out of the study section. It is interesting to note that the highest ever yearling rainbow trout estimate occurred on the heels of the year with the greatest stocking effort.

Table 11. Summary of egg collections from wild Madison River rainbow trout and subsequent stocking and survival of hatchery-reared progeny in the Marias River downstream of Tiber Dam, 1990-93.

| Eggs from Madison River rainbows | | Progeny stocked in Marias River | | | | |
|---|---|---|---|---|---|---|
| Date | # eggs collected | Date | #Stocked | Avg Leng. | Mark | Ratio [1/] |
| Spring 1990 | 7,000 | 9/25/90 | 5,085 | 2.8 | Ad | |
| | | | | | | 1:19 |
| Spring 1991 | 6,000 | 10/1/91 | 4,400 | 2.7 | Ad | |
| | | | | | | 6:2 |
| Spring 1992 | 19,500 | 9/30/92 | 4,300 | 2.8 | Ad | |
| | | 4/15/93 | 10,000 | 5.3 | P2 | |
| | | | | | | 13:48 |
| Spring 1993 | 47,000 | 10/4/93 | 11,000 | 2.5 | Ad | |
| | | 5/19/94 | 13,000 | 5.3 | CWT | |

Spawning is an important concern for a river fishery like the Marias. Regulated flows from Tiber Dam can affect the occurrence of flushing flows, important for maintaining stream channel substrates free from the effects of sedimentation. Annual brown trout redd counts have been conducted in the late fall for several years and these surveys have recorded total redd tallies averaging about 100 redds for a 5 mile reach. Rainbow trout redd counts have been conducted only in spring, 1994 recording a total of only 34 redds for this same reach. Rainbow trout spawning habitat could be limiting or the numbers of spawners may be low.

An evaluation of the stream channel substrates was completed to determine if sedimentation was a factor limiting spawning success. Two sites were selected where both rainbow and brown trout redds have been noted. These sites were within 1 mile of the dam and should represent stream channel substrates with the least amount of fine sediments. The results from this evaluation are presented in Table --. Site B, the nearest to the dam, had the least amount of fine sediments averaging 18.3% of fines for the 6 stations sampled. Site A, located about 0.6 miles downstream, averaged 27.8% fines, nearly 10% more than site B. The percentages of fine sediments reported here are within the range of acceptable amounts of sedimentation for rainbow trout as reported by NCASI (1984). Tom Weaver (MTDFWP, personal communication) believes that anything under 20% fines is good and 30% fines would be sub-standard for rainbow trout. R2 Resource Consultants (1993) reported 16% fines for substrate samples collected in the Missouri River near Craig, MT and they considered this value relatively high and that this level of sedimentation may reduce survival to emergence for trout compared to that of the Madison River. They recommended that consideration be given to developing flushing flows for the Missouri River below Canyon Ferry Dam. Based on the information available at this time, I believe that sedimentation of the spawning gravels is affecting spawning success of trout, particularly the rainbows. However, I feel that the poor recruitment of yearlings is a greater limiting factor and has a greater influence on controlling numbers of trout in the Marias River. Improved spawning conditions by providing flushing flows may be of benefit, especially if yearling recruitment is enhanced.

Table 12. Percent composition of the stream channel substrates at two sites on the Marias River downstream from Tiber Dam, 1992.

| Sieve size (mm) | Station # 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site B.** (Immediately down from dam) | | | | | | | | | | | | | |
| 50.8 | 0 | 5.3 | 2.8 | 0 | 12.8 | 0 | | | | | | | |
| 25.4 | 19.9 | 28.7 | 14.7 | 18.6 | 7.1 | 13.0 | | | | | | | |
| 12.4 | 26.1 | 22.7 | 35.1 | 30.1 | 19.1 | 18.5 | | | | | | | |
| 6.3 | 18.9 | 18.7 | 19.0 | 20.4 | 19.6 | 17.4 | | | | | | | |
| 4.76 | 6.4 | 5.4 | 5.2 | 5.8 | 6.5 | 5.7 | | | | | | | |
| 2.36 | 11.9 | 9.7 | 10.1 | 11.4 | 12.5 | 11.3 | | | | | | | |
| 0.85 | 9.2 | 6.2 | 8.2 | 9.0 | 11.8 | 14.6 | | | | | | | |
| 0.074 | 6.8 | 2.7 | 4.6 | 4.4 | 10.2 | 19.3 | | | | | | | |
| <0.074 | 0.9 | 0.6 | 0.2 | 0.3 | 0.3 | 0.4 | | | | | | | |
| % Fines (<0.86 mm) | 16.9 | 9.5 | 13.0 | 13.7 | 22.3 | 34.3 | | | | | | | 18.3 |
| Geometric mean particle size | 8.4 | 12.8 | 10.2 | 9.6 | 7.6 | 4.7 | | | | | | | |
| **Site A.** (0.6 mi. down from dam) | | | | | | | | | | | | | |
| 50.8 | 5.6 | 0 | 3.9 | 8.7 | 3.8 | 3.8 | 2.2 | 8.5 | 4.2 | 9.8 | 0 | 3.6 | |
| 25.4 | 17.4 | 16.9 | 14.6 | 15.4 | 18.7 | 18.3 | 13.6 | 17.4 | 13.0 | 15.2 | 16.8 | 16.9 | |
| 12.4 | 17.0 | 18.7 | 21.7 | 17.8 | 18.1 | 20.2 | 22.1 | 25.4 | 19.0 | 19.3 | 21.9 | 20.9 | |
| 6.3 | 14.0 | 15.0 | 16.7 | 13.8 | 16.3 | 17.1 | 18.4 | 17.4 | 17.2 | 14.3 | 15.2 | 16.5 | |
| 4.76 | 4.5 | 5.7 | 5.4 | 4.5 | 4.7 | 5.4 | 6.1 | 5.6 | 5.4 | 5.2 | 5.8 | 4.9 | |
| 2.36 | 7.9 | 11.9 | 10.2 | 8.8 | 9.1 | 10.4 | 11.8 | 9.7 | 10.0 | 9.9 | 11.9 | 9.0 | |
| 0.85 | 12.8 | 16.0 | 13.0 | 12.6 | 12.1 | 10.3 | 12.9 | 9.2 | 11.7 | 11.8 | 13.6 | 11.4 | |
| 0.074 | 20.0 | 15.3 | 13.3 | 18.1 | 16.4 | 13.7 | 12.3 | 6.6 | 18.5 | 13.7 | 14.3 | 16.2 | |
| <0.074 | 0.9 | 0.6 | 1.2 | 0.4 | 0.8 | 0.7 | 0.6 | 0.3 | 0.9 | 0.8 | 0.5 | 0.7 | |
| % Fines (<0.86 mm) | 33.7 | 31.9 | 27.5 | 31.1 | 29.3 | 24.7 | 25.8 | 16.0 | 31.1 | 26.3 | 28.4 | 28.3 | 27.8 |
| Geometric mean particle size | 5.7 | 5.4 | 6.3 | 6.4 | 6.2 | 7.0 | 6.3 | 10.2 | 5.4 | 7.3 | 5.9 | 6.4 | |

## RECOMMENDATIONS

1. Continue with the pallid sturgeon study. Sampling efforts were very successful again this year. Sampling should be expanded to include the delta area at the head end of Fort Peck Reservoir. The early life stages of pallid sturgeon should be investigated by sampling for larvae and juveniles with a trawl. Continue testing radio telemetry gear so that improvements can be made with the present system.

2. Initiate sampling for special status fish such as the sicklefin chub and sturgeon chub. Determine their present status.

3. Monitor trout population trends, success of wild rainbow trout fingerling plants, and extent of natural reproduction in the Tiber Dam tailwater section by obtaining biannual standing crop estimates at least through 1997. Develop management recommendations (such as changes in Tiber Dam operations or habitat improvements) to address limiting factors and enhance rainbow populations.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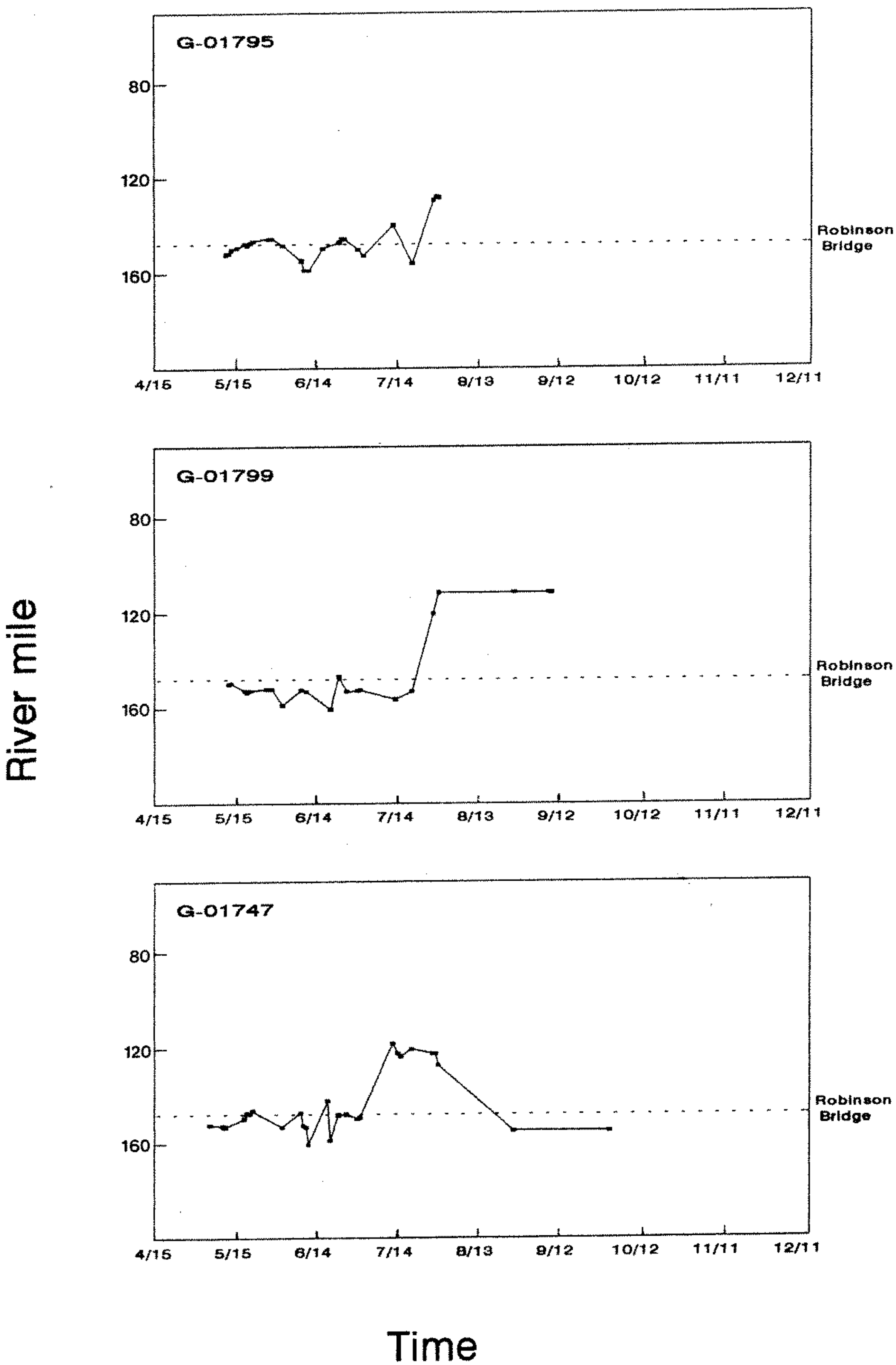
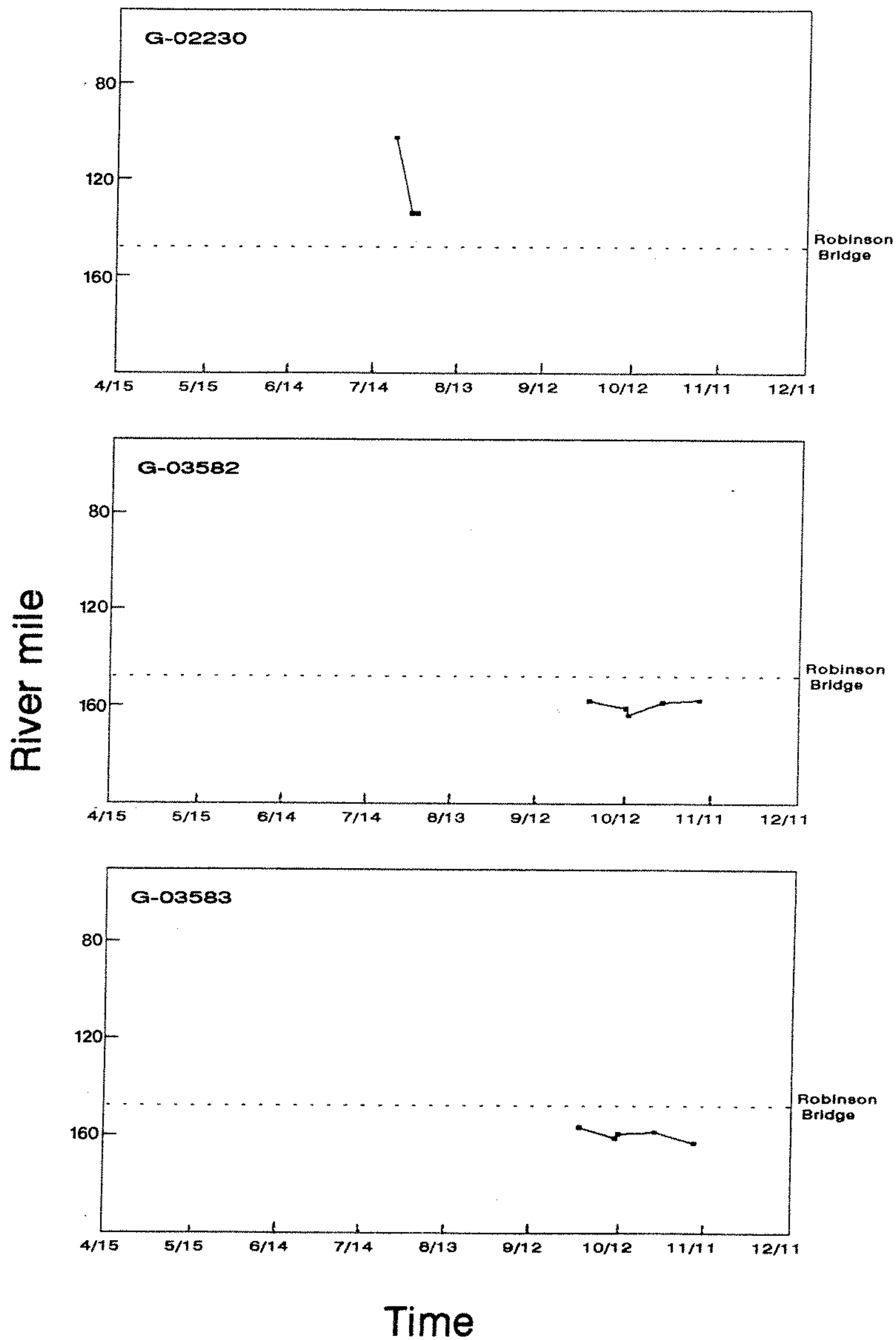
Appendix A1. Size data (in. and lbs.) and capture information for pallid sturgeon sampled in the middle Missouri River, MT, 1990-94.

| Tag number | FL | WT | Capture date | River mile | Recapture record |
|---|---|---|---|---|---|
| S-07479 | 50.0 | 30.0 | 5/16/90 | 160.7 | RM 153 5/12/93; |
| S-07398 | 52.0 | 30.0 | 6/15/90 | 140.2 | |
| S-00084 | 54.0 | 37.0 | 10/3/90 | 128.2 | RM 158 11/3/93; RM 153 4/11/94 |
| S-00154 | 60.0 | 50.0 | 11/1/90 | 160.7 | RM 158 11/10/92; |
| S-00162 | 53.8 | 37.0 | 11/1/90 | 160.7 | |
| G-01352 | 55.0 | 38.0 | 7/10/91 | 133.2 | |
| G-01433 | 50.3 | 28.5 | 8/13/91 | 99.5 | RM 153 5/20/92; |
| G-01747 | 55.5 | 37.5 | 5/6/92 | 152.0 | RM 148 5/21/92; RM 153 5/6/93 |
| G-01795 | 50.5 | 28.5 | 5/12/92 | 152.0 | |
| G-01799 | 51.3 | 29.5 | 5/13/92 | 149.8 | |
| G-01640 | 52.0 | 29.5 | 5/28/92 | 152.2 | |
| G-01838 | 42.7 | 17.5 | 6/23/92 | 133.0 | |
| G-02230 | 54.9 | 40.0 | 7/22/92 | 102.8 | |
| G-03582 | 54.3 | 32.0 | 10/1/92 | 154.8 | |
| G-03583 | 51.3 | 31.5 | 10/2/92 | 156.7 | |
| G-03584 | 56.5 | 40.0 | 10/13/92 | 158.5 | |
| G-03127 | 56.3 | 37.0 | 10/28/92 | 158.7 | RM 153 4/26/93; |
| G-03144 | 54.0 | 41.0 | 10/30/92 | 162.0 | |
| G-03154 | 43.0 | 13.2 | 4/21/93 | 149.8 | |
| G-03159 | 56.0 | 41.0 | 4/27/93 | 148.5 | |
| R6-10001 | 43.0 | 19.5 | 5/19/93 | 133.8 | |
| R6-10002 | 44.7 | 22.0 | 6/17/93 | 141.4 | |
| R6-10003 | 60.0 | 47.0 | 9/22/93 | 149.8 | |
| R6-10004 | 59.5 | 45.0 | 10/26/93 | 149.8 | |

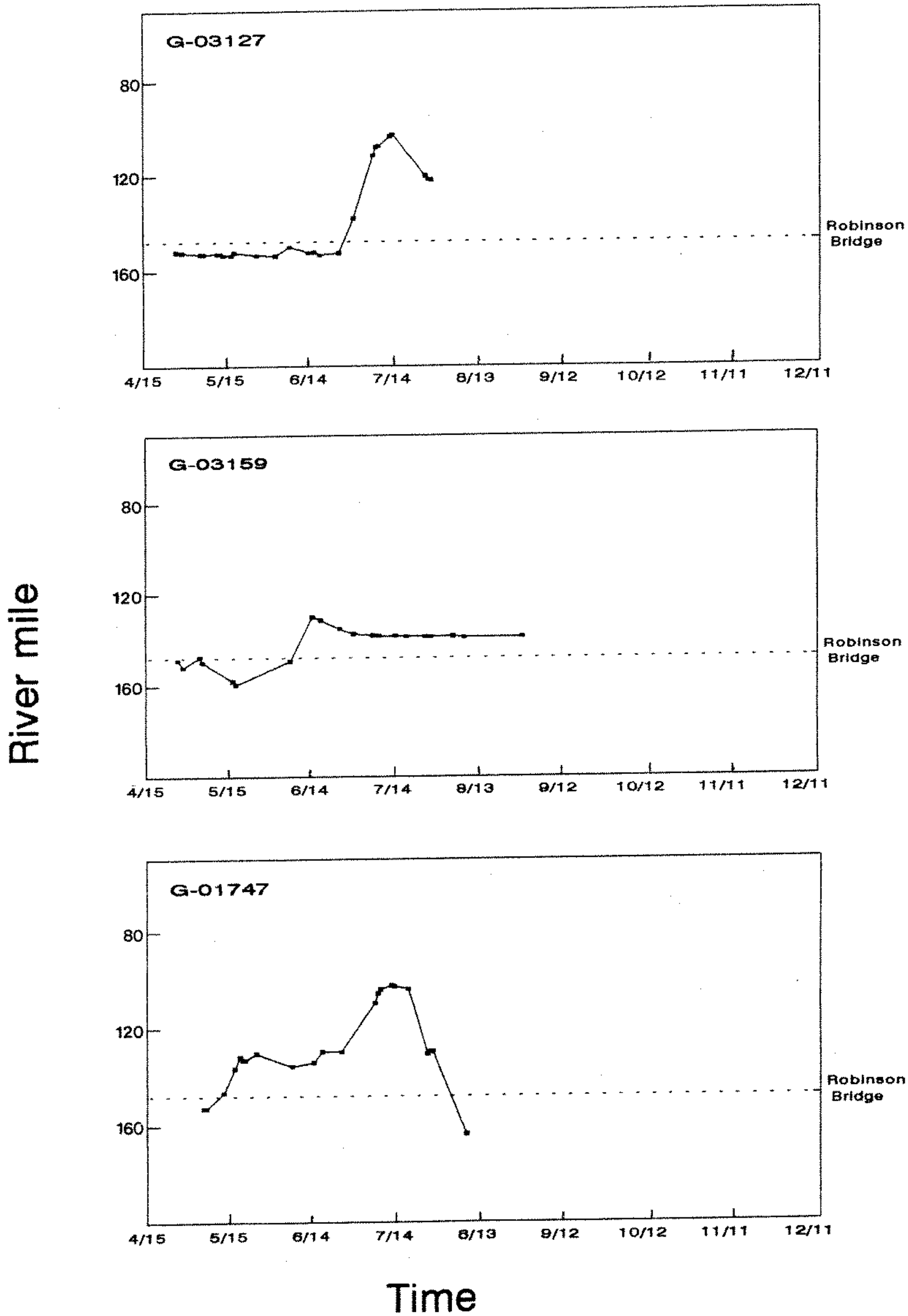
Appendix Figure B-1. Movement patterns of individual radio-tagged pallid sturgeon in the Stafford Ferry and Robinson Bridge sections, Missouri River, 1992.



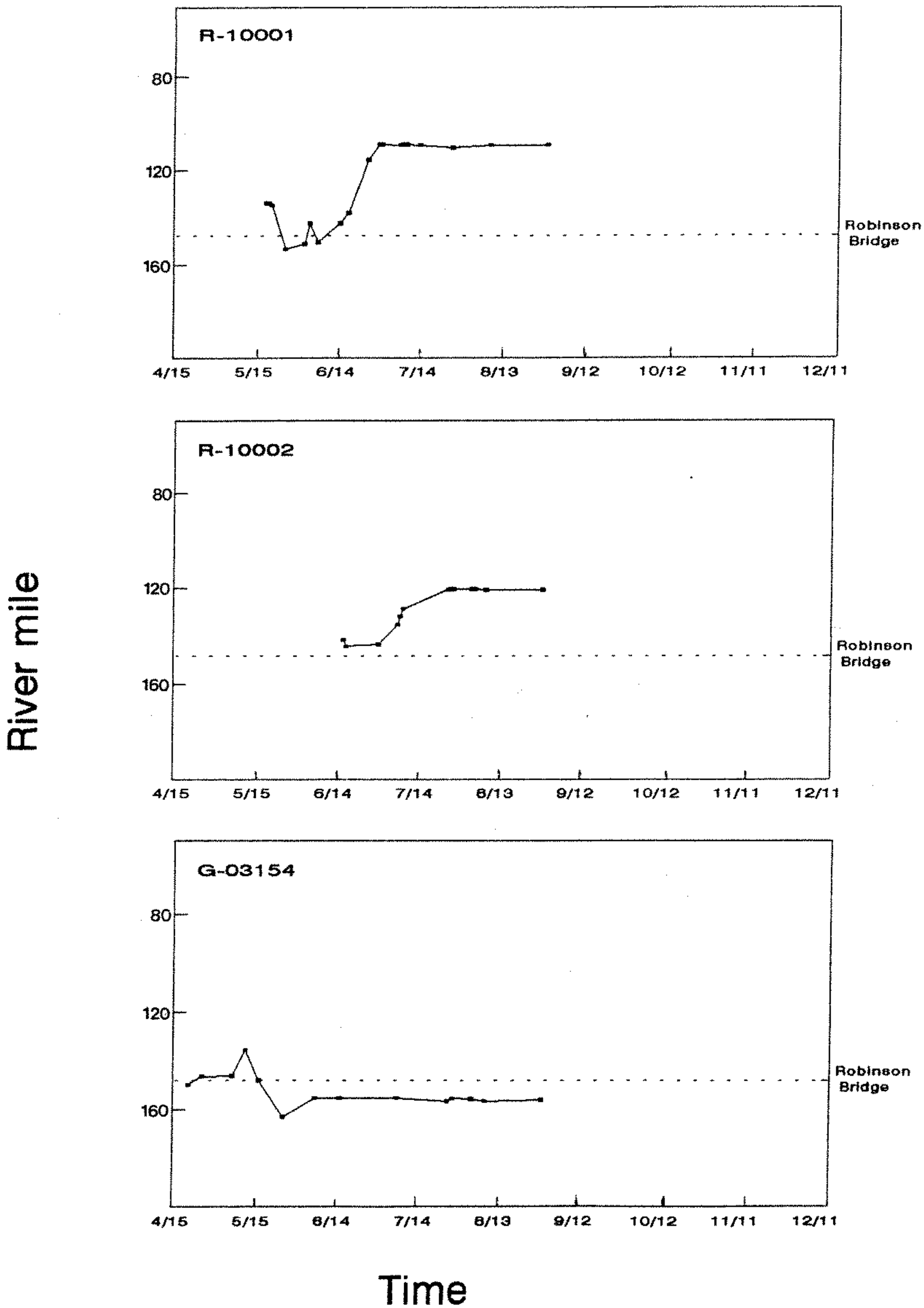
Appendix Figure B-2. Movement patterns of individual radio-tagged pallid sturgeon in the Stafford Ferry and Robinson Bridge sections, Missouri River, 1992.



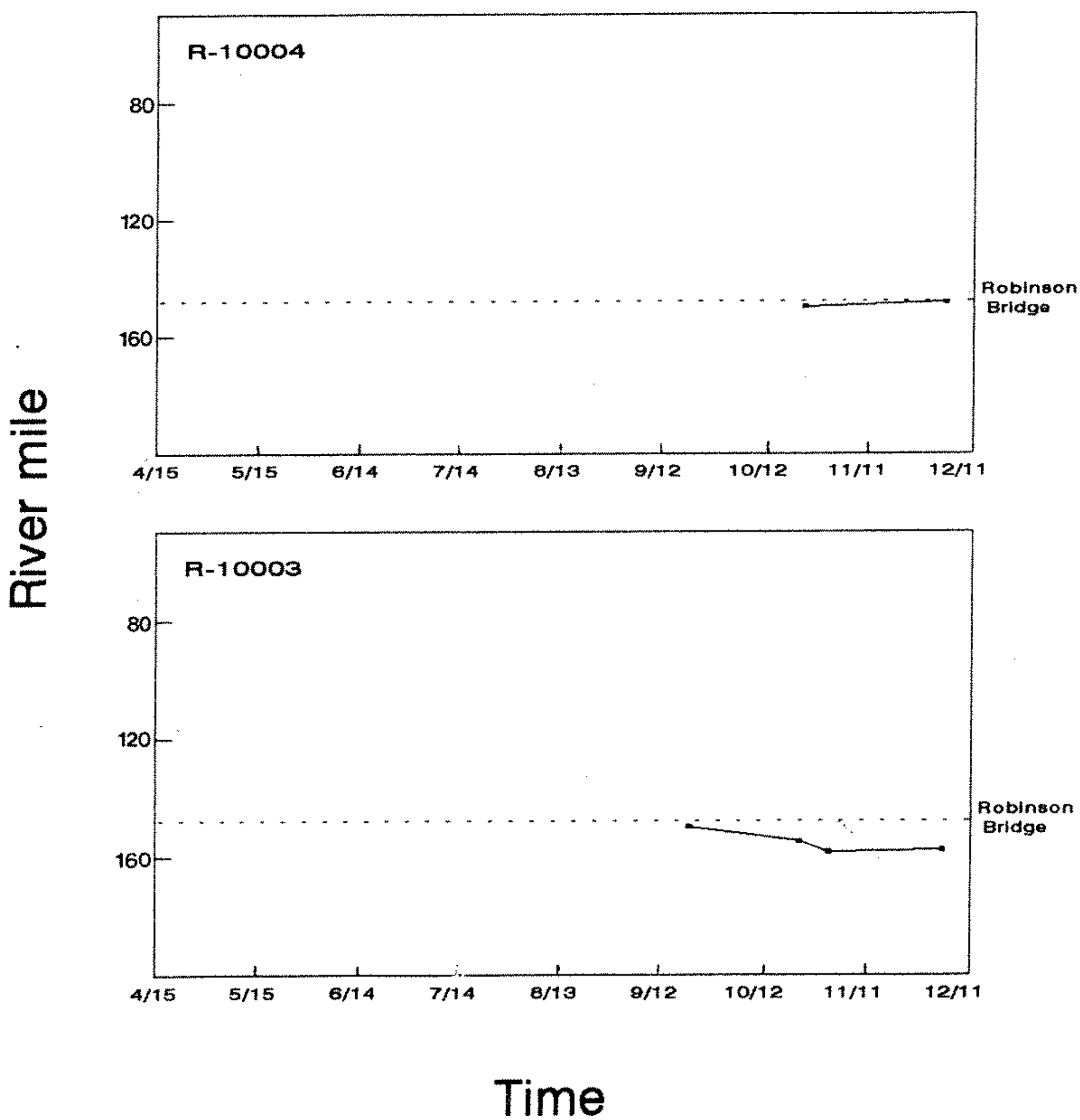
Appendix Figure B-3. Movement patterns of individual radio-tagged pallid sturgeon in the Stafford Ferry and Robinson Bridge sections, Missouri River, 1993.



Appendix Figure B-4. Movement patterns of individual radio-tagged pallid sturgeon in the Stafford Ferry and Robinson Bridge sections, Missouri River, 1993.



Appendix Figure B-5. Movement patterns of individual radio-tagged pallid sturgeon in the Robinson Bridge section, Missouri River, 1993.



Prepared by: William M. Gardner

Date: September, 1994

Code numbers of waters referred to in this report are:

| | | | |
|---|---|---|---|
| 16-2520 | Missouri | River | Section 06 |
| 16-2522 | Missouri | River | Section 06B |
| 17-4864 | Missouri | River | Section 07 |
| 14-3240 | Marias | River | Section 01 |