OBSERVATIONS ON THE LIFE HISTORY, MOVEMENT, AND HARVEST OF THE PADDLEFISH, POLYODON SPATHULA, IN MONTANA

by

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ABSTRACT

The life history, movements and harvest of the paddlefish in Montana was studied from 1963 to 1965. Specimens were secured from the Yellowstone and Missouri Rivers by snagging, seining, poisoning, and gill netting. A total of 486 specimens collected for age and growth were in the age classes 4 to 28. About 88 percent of the paddlefish collected at Intake were in age classes 7 - 12 and these had an average total length of 50.4 inches and weighed 23.28 pounds. About 61 percent of those from the dredge cuts were in age classes 17 - 24 and averaged 50.7 inches and 20.83 pounds while 65 percent of the paddlefish from the Missouri River were in age classes 19 - 25 and averaged 59.5 inches and 54.27 pounds. The same age classes were represented each year in each area. Females were generally older and larger than males. The ratio of males to females was as follows: Intake (1,403 specimens) - 35.9:1; Dredge cuts (75 specimens) - 2.5:1; Missouri River (37 specimens) - 1.8:1. The estimated number of eggs for 4 females ranged from 82,397 to 269,043. Egg diameters ranged from 2.35 to 2.43 millimeters. Of 1,146 paddlefish tagged at Intake, 164 were recaptured one or more times. Four of these moved about 200 river miles downstream from the tagging site, one moved about 100 miles upstream, and one moved about 70 miles down the Yellowstone River and 190 miles up the Missouri River. The harvest for the Intake area was estimated at 2,562 paddlefish or 28 tons in 1964 and 1,143 paddlefish or 12 tons in 1965.

INTRODUCTION

The paddlefish is native to the Missouri and Yellowstone Rivers of Montana. The first authentic record of paddlefish for Montana was in 1946 (Brown, 1951). Since that time it has been reported on several occasions in the upper end of Fort Peck Reservoir on the Missouri River and in the dredge cuts below the dam. While unconformed reports of paddlefish catches exist for the Yellowstone River prior to 1961, the first large run was observed in 1962. This occurred below the Intake diversion dam. Since the paddlefish has become better known, fishing pressure has increased in several areas. In view of the increased respect given the paddlefish as a food and game fish, the Montana Legislature changed its status to a game fish effective July 1, 1965. The importance of this fish stimulated the Montana Fish and Game Department to finance the present study which concerns the life history, movement, and harvest of the paddlefish. This study extended from May 1963 to December 1965. Field collections were made during May and June of 1964 and May through August of 1965 at two locations on the Missouri River and one on the Yellowstone River (Figure 1).

Most data were collected from the area below the Intake diversion dam, which is located on the Yellowstone River 20.1 river miles downstream from Glendive, Montana. Paddlefish were concentrated there probably because of difficulty in passing over the dam. The river at this place has a mean width of about 800 feet and is very swift and turbulent (Figure 2). The bottom is composed of large boulders, rubble, and gravel

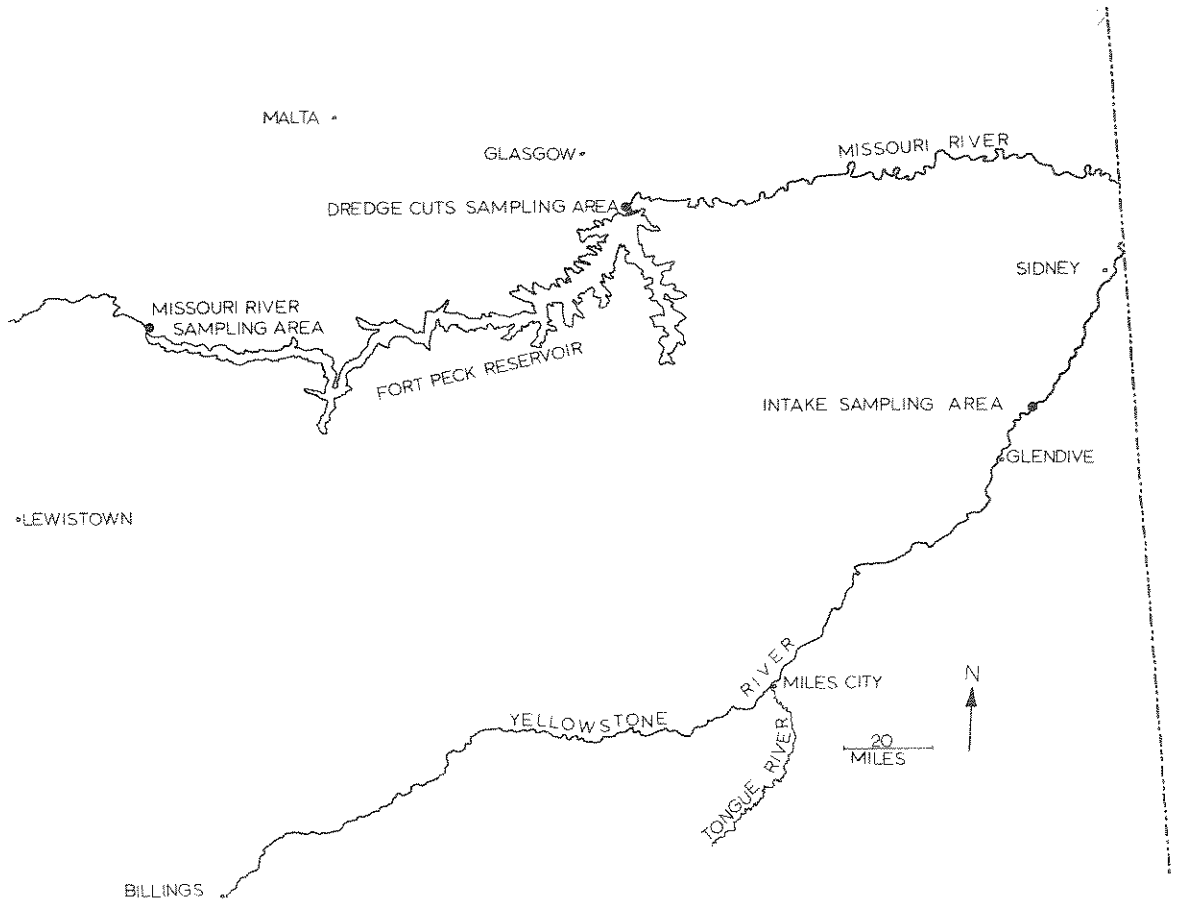

Figure 1. Map showing the study areas.

interspersed with sandy areas. Fishing is almost entirely confined to the northwest bank, since the southeast bank is inaccessible except by boat, during periods of high water.

Collections were also made from two areas of the Missouri River. One is located about 10 miles upstream from Fort Peck Reservoir and extends for about 5 miles along the northeast shore of the river. The river here has a low velocity without turbulence and has a mean width of

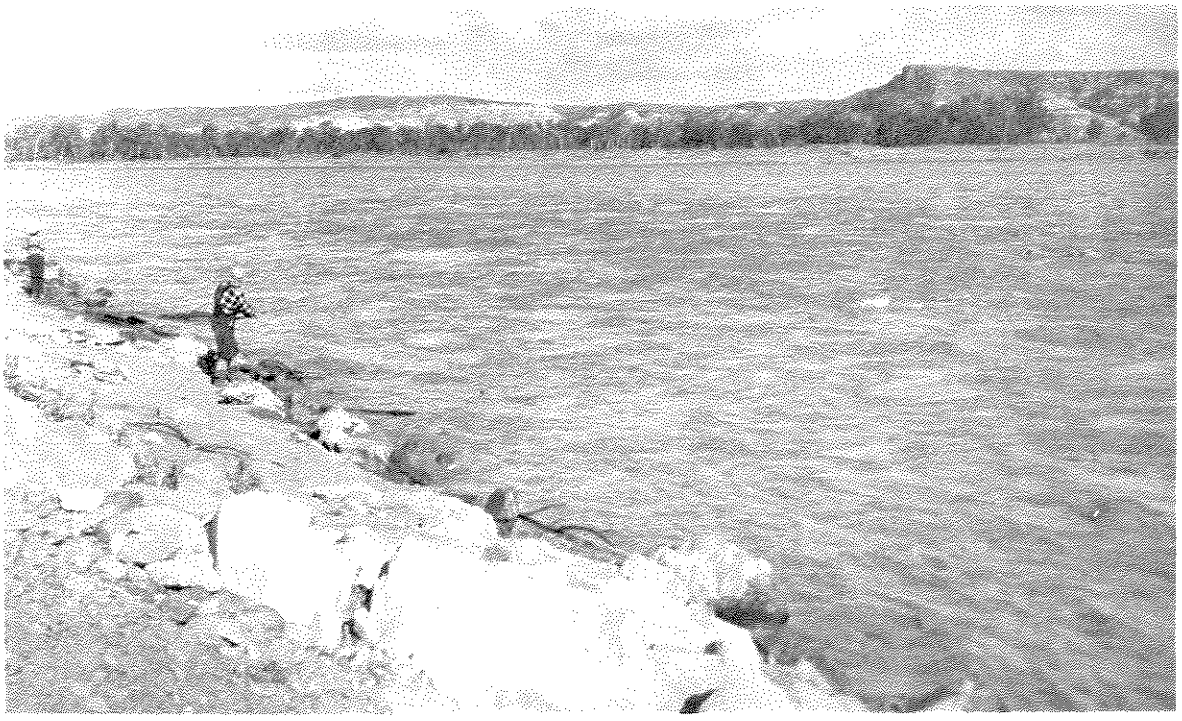

Figure 2. The Intake study area on the Yellowstone River. Photo by Hector LaCasse.

about 350 feet. The bottom is composed mostly of mud and silt. The other area is a dredge cut, where earth was borrowed for the construction of the dam (Figure 3). This is located about 1 mile below Fort Peck Reservoir and is more or less isolated from the Missouri River. It has an area of about 300 surface acres and a maximum depth of 22 feet. The bottom is mainly clay with some gravel areas.

Figure 3. The dredge cut study area below Fort Peck Reservoir. Photo by Eugene Kuszmaul.

Methods

Four methods of collecting paddlefish were used in each collection area; snagging, seining, poisoning, and gill netting. Snagging was effective in the rivers where the fish were concentrated but of little value in standing water where no such concentrations existed. Seining (250 foot 3/4 inch bar mesh beach seine) was most effective in standing water. Poisoning (Pro-Nox Fish) was quite successful where an entire unit of water could be treated but entirely ineffective for spot treatments.

Very few fish were taken with gill nets. Regardless of where the nets were set, large mesh (3 and 4 inch bar measure) nets were the most effective.

A total of 3,173 paddlefish was weighed to the nearest 0.25 pound using a Chattilon spring balance calibrated to the nearest 0.5 pound. Length measurements (to the nearest 0.1 inch) were recorded for 1,979 of these and sex for 1,515. Dentary bones were secured for age and growth determinations. Cross sections (200 to 500 micra in thickness) were cut from either side of the dentary bone near the symphysis, at a place where the bone bends caudo-mesiad. These cross sections were studied under magnification (30x) and annuli determined and counted. Jaw sections from old fish whose bones are mature and heavily calcified were cleared in xylene.

An estimate of the harvest of paddlefish was secured from creel census data. Almost all the fishermen were given creel census cards when they began fishing. The cards called for information on the number of paddlefish caught, the number kept, and the place of residence of the fisherman. A total of 66.2 percent of the cards handed out in 1964 and 47.7 percent in 1965 were returned. The number of paddlefish caught and the number kept per fisherman trip as well as the total harvest (weight, numbers) were calculated from these returns. The catch per trip was based on the number of fishermen contacted in a given day. A few fishermen may have been counted twice in one day if they left the Intake area and returned later to fish again.

LIFE HISTORY

Age and Growth

The dentary bones from 486 paddlefish were sectioned and studied. The dark discrete bands which appeared in cross section of these bones were interpreted as annuli (Figure 4). The halo-like and short bands

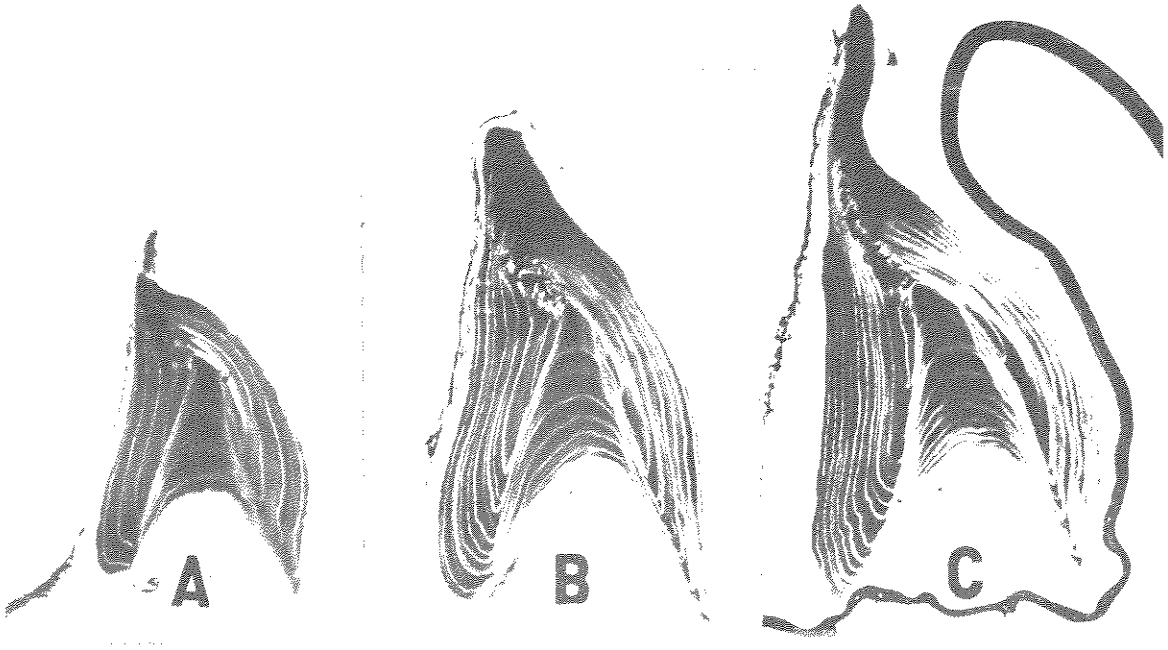

Figure 4. Cross sections of dentary bones from paddlefish. A- 40.8 inch, 5-year-old fish. B- 48.2 inch, 9-year-old fish. C- 52.9 inch, 12-year-old fish. Photos by Donald Fritts.

which ended abruptly or coalesced with others were not considered annuli. Annuli were more easily distinguished in the mesial arm since they are more widely separated and all counts were restricted to this area.

Intake

Age and actual total lengths were determined for 343 paddlefish collected from this area and calculated total lengths at each annulus were determined for 258 of these. Ages of these fish ranged from 4 to 25 years (Table 1). The youngest fish had an actual total length of 37.8 inches

Table 1. The age, average total length, and number of paddlefish collected in Montana.

	Intake			Dredge cuts		Missouri River	
Age class	No. fish	Avg. actual length	No. fish	Avg. calculated length	No. fish	Avg. actual length	No. fish	Avg. actual length
1			258	8.2				
2			258	16.0				
3			258	22.7				
4	1	37.8	258	28.7				
5	2	38.2	257	33.7				
6	4	45.2	255	37.8				
7	13	43.6	253	41.3				
8	47	48.0	245	44.1	1	39.0		
9	73	48.9	195	46.4	3	39.1		
10	79	50.4	164	47.8	1	44.5		
11	64	52.2	96	48.9	4	47.5		
12	25	54.3	49	48.6	4	46.2	1	49.0
13	5	55.2	24	46.3	4	44.7	2	54.1
14	1	48.0	18	45.7	7	47.0	-	———
15	2	51.9	17	47.5	5	49.9	4	51.3
16	5	53.6	16	49.2	4	48.4	1	53.1
17	5	54.1	15	50.5	11	50.5	2	55.4
18	6	55.6	12	51.5	6	48.4	-	———
19	4	54.5	10	52.2	11	51.1	6	58.5
20	4	58.1	7	53.2	11	53.8	3	59.6
21	-	———	3	52.5	8	52.5	3	60.3
22	-	———	3	52.3	6	55.1	2	62.9
23	1	57.5	3	54.1	8	54.5	4	63.1
24	-	———	2	55.9	6	53.1	3	67.7
25	2	57.4	2	56.5	2	51.4	3	67.9
26					2	56.0		
27					4	56.4		
28					1	50.6		

while the oldest was 56.2 inches. The average actual growth increment for

paddlefish, ages 4 to 13, was 1.9 inches per year, while those from age 14 to 25 had an increment of 0.2 inches. The average actual growth increment for all fish was 1.1 inches (Figure 5). The average annual calculated growth increment of paddlefish was 7.2 inches per year for ages 1 to 4, 2.9 inches for ages 5 to 11, and 0.5 inches for ages 12 to 25 (Table 1). The average calculated growth increment for all fish was 2.2 inches per year. The average calculated growth increment for all fish is greater than the actual growth increment. This may be accounted for by the absence of the young faster growing fish. I have no explanation for the calculated total lengths always being less than the actual lengths. Males ranged in age from 4 to 16 years with 90 percent of them younger than 13 years. Females ranged in age from 7 to 25 years with 71 percent older than 16 years.

Dredge cuts

Dentary bones from 109 paddlefish were collected in this area. Specimens ranged in age from 8 to 28 years. The youngest had a total length of 39.0 inches while the oldest was 50.6 inches. No calculated total lengths were determined for these fish because they were mostly older and were extremely difficult to age. The average actual growth increment of paddlefish was 2.7 inches per year for ages 8 to 11, 0.4 inches for fish older than 11, and 0.7 inches for all the fish. Males ranged in age from 8 to 28 and represented all age classes. Females ranged from 11 to 27 years with 81 percent older than 15.

Missouri River

Thirty-four paddlefish from this area ranged in age from 12 to 25

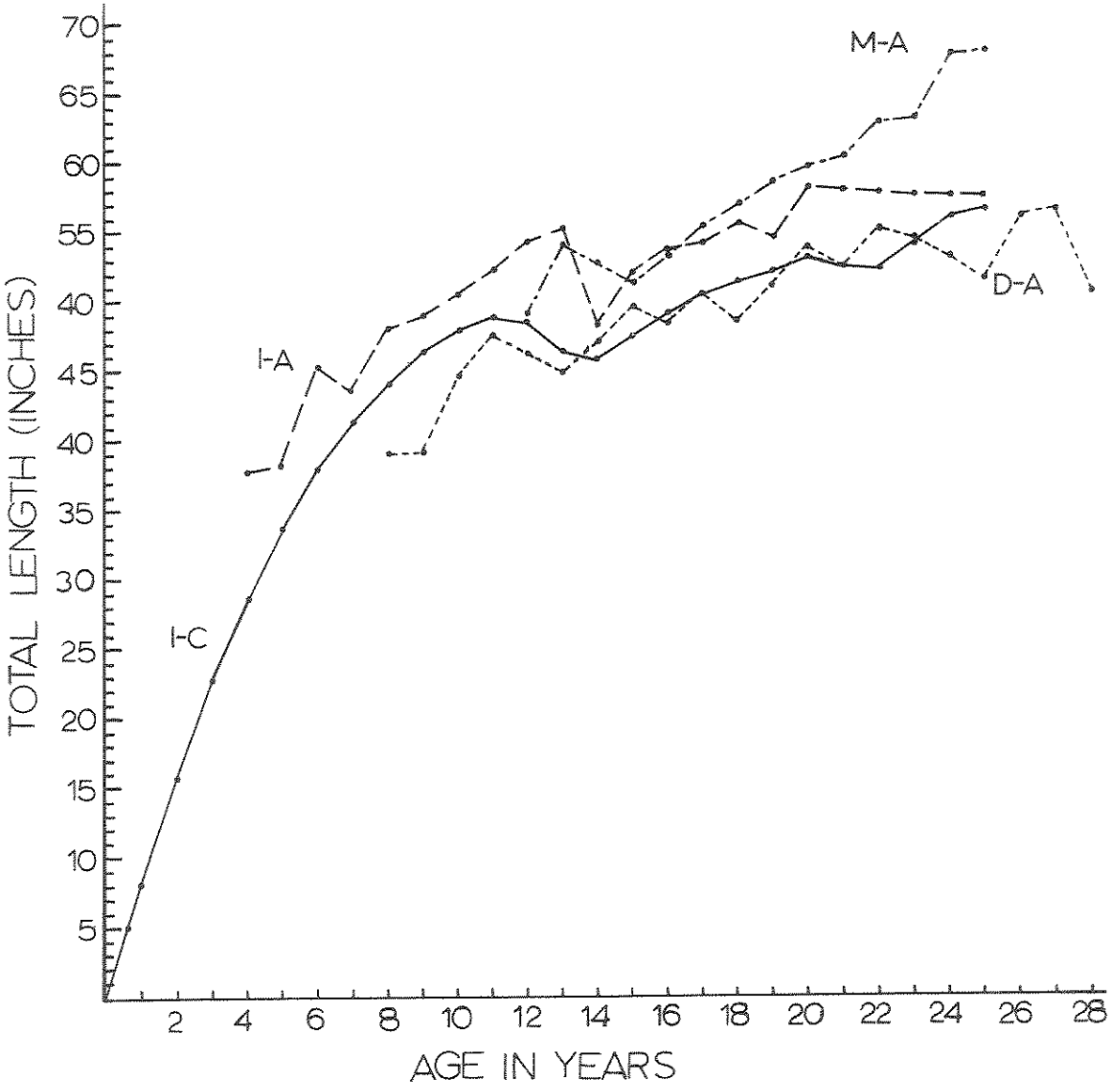

Figure 5. The relation between total length and age of Montana paddlefish. I-A Intake actual lengths. I-C Intake calculated lengths. D-A Dredge cuts actual lengths. M-A Missouri River actual length.

years. The youngest had a total length of 49.0 inches while the oldest was 72.8 inches. The calculated total lengths of these fish were not determined. The average actual growth increment was 2.1 inches per year for all the fish. Males ranged in age from 12 to 25 years and represented all age classes. Females ranged from 19 to 25 years and were all older than 18.

There were no great differences in age class distribution in the years for which collections were made at any one area. However there were differences between the areas. The majority of the fish taken at Intake were in age classes 7 - 12 whereas those from the dredge cuts were 17 - 24 and those from the Missouri River 19 - 25 (Table 1).

The average actual total lengths and growth increments and the average calculated total lengths and growth increments for Montana paddlefish are less than those reported by D. H. Thompson (1933) and L. A. Adams (1942) in Illinois and A. Houser (1965) in Oklahoma. Adams (1942) reported that the most rapid period of growth for paddlefish occurred during the first 3 years. This was also true for the Montana paddlefish but the growth was less in the Montana specimens.

Sex Ratios

Sex was determined by examination of the gonads since no sexual dimorphism was found in the paddlefish. A total of 75 fish taken from the dredge cuts had a ratio of 2.5 males to 1 female. Thirty of these were collected in July of 1963 when one branch of the "cuts". containing 65 acres, was isolated and poisoned (Table 2). The rest were obtained by

Table 2. Sex ratios of paddlefish from Montana.

Location	Year	Number of fish	Males (%)	Females (%)	Sex ratio
Dredge cuts	1963	30	76.7	23.3	3.3:1
	1965	45	68.9	31.1	2.2:1
Missouri River	1965	37	64.9	35.1	1.8:1
Intake Dam	1963	14	100.0	0.0	14.0:0
	1964	832	97.3	2.7	36.8:1
	1965	557	97.1	2.9	33.8:1

netting and snagging in the other areas of the dredge cuts, during July and August of 1965. The 37 paddlefish collected by netting and snagging in the Missouri River during May and June of 1965 showed a ratio of 1.8 males to 1 female. The sex ratio of 1,403 paddlefish taken by snagging at Intake during May of 1963 and May and June of 1964 and 1965, was 35.9:1. The greater preponderance of males at this place may have resulted from males migrating further upstream than females during the spawning season or it may be due to a difference in time of migration between the sexes.

Fecundity

The ovaries of 15 paddlefish were collected for making egg counts. Only three taken at Intake in June and one from the dredge cuts in August, 1965, had mature eggs. The other 11 were taken in the dredge cuts in July and August of 1965 and had minute eggs. The number of eggs was estimated for each fish by weighing the ovaries and then counting the eggs in 8 subsamples (4 from each ovary) constituting approximately 5 percent of the total weight.

The estimated number of eggs for the 4 paddlefish ranged from 82,397 to 269,043 (Table 3). The smallest female had a total length of 47.7

Table 3. The age, total length, and weight of paddlefish, weight of ovaries, estimated number and average diameter of eggs.

Coll. No.	Age	Total length	Weight of fish (lb.)	Weight of ovary (gm.)	Estimated No. eggs	Avg. diameter eggs (mm.)
I-99*	16	51.9	21.25	1,332	171,387	2.35
I-112	15	47.7	16.50	576	82,397	2.43
I-115	18	51.9	22.00	692	99,541	2.40
DC-41	24	53.8	46.75	1,826	269,043	2.38

* I - fish from Intake; DC - fish from the dredge cuts.

inches and weighed 16.50 pounds while the largest was 53.8 inches long and weighed 46.75 pounds. Needham (1965) reported that a 40.00 pound paddlefish had 371,480 eggs and a 68 pound female 608,650. The weights of ovaries from the 4 Montana paddlefish are less than those for most ripe females taken in Missouri (Purkett, 1961). The mature eggs of Montana paddlefish ranged from 2.35 to 2.43 millimeters in polar diameter. These were preserved while within the ovary in 10 percent formalin for 5 to 6 months. Larimore (1950) showed a diameter of 2.0 millimeters and Stockard (1907) a polar diameter of 2.7 and an equatorial diameter of 2.2 millimeters. There was no correlation between the age and size of the fish and the size of the eggs for the Montana specimens.

MOVEMENT

An attempt was made to study the movement of paddlefish captured at Intake. Fish from this area were collected by snagging and only those in good physical condition were tagged. A total of 778 paddlefish was tagged

with numbered plastic bands (poultry—size 11) placed around the dentary bone. Since the tag numbers were repeated, a different color was used each year (blue in 1964 and white in 1965). A numbered yellow dart tag inserted below the anterior portion of the dorsal fin was used on an additional 368 fish in 1964. A total of 1,146 fish was tagged and 1,120 of these were released below the dam and 26 above. The average weight of 1,134 fish was 20.80 pounds and the average total length of 344 fish was 49.5 inches.

A total of 866 fish was tagged in 1964 and the number of fish recaptured is as follows (Table 4): 101 fish (11.6%) were recaptured once and 9 fish (1.0%) were recaptured twice in 1964; 17 fish (1.9%) were recaptured once and 1 fish (0.1%) was recaptured twice in 1965; 3 fish (0.3%) were recaptured once in 1964 and once in 1965; 1 fish (0.1%) was recaptured once in 1964 and twice in 1965. Of 280 fish tagged in 1965, 17 (6.1%) were recaptured once and none have been recaptured twice. A total of 13.8 percent of the returns came from Intake where they were released. Subtracting the fish removed (83) and mortalities of unknown causes (3) from the total number tagged leaves a possible 1,060 fish unaccounted for.

Six fish tagged in 1964 were caught in areas other than Intake. Four of these were taken in the Shell Creek area of Garrison Reservoir—three on June 29, 1964 and one on July 1, 1965. The 3 fish recaptured in 1964 had moved downstream about 200 river miles from the tagging site. Recapture dates were 32, 41, and 45 days after release. The specimen recovered in Garrison Reservoir in 1965 was taken 406 days after release.

Table 4. Number of paddlefish tagged and recaptured.

	May 8-June 20, 1964	May 12-June 14, 1965	Totals
Total number tagged and released	866	280	1,146
Total number recaptured in 1964	123	---	123
Number recaptured and released in 1964	64	--	64
Number of recaptured fish caught and released again in 1964	9	--	9
Total number recaptured in 1965	24	18	42
Number recaptured and released in 1965	4	2	6
Number of recaptured fish caught and released again in 1965	2*	0	2

* These fish came from the 64 fish recaptured and released in 1964.

One tagged paddlefish was recovered at the mouth of the Tongue River on June 30, 1964, 42 days after release. This is about 100 river miles upstream from Intake. One paddlefish was recaptured in the dredge cuts below Fort Peck Reservoir on August 16, 1965. This is a movement of at least 70 river miles down the Yellowstone River and 190 river miles up the Missouri River, from the release site.

Recaptures of tagged fish in Garrison Reservoir suggest that this may be the source of many of the paddlefish caught at Intake. Returns also show that paddlefish may disperse themselves widely both up and downstream. Twenty-four paddlefish tagged in 1964 at Intake were recaptured at this same site in 1965. This may indicate that paddlefish migrate annually. Purkett (1963) stated that "the appearance of paddlefish in the

spawning run both in the year of tagging and the following year indicates that this migration may be made annually".

HARVEST

In 1964 the catch of paddlefish at Intake was estimated to be 5,924 fish, weighing 65 tons. Of these 2,562 or 28 tons were kept (Table 5) and

Table 5. Paddlefish harvest from Intake.

	1964	1965
Number of fishermen	1,338	607
Number of fish caught	3,922	1,075
Number of fish kept	1,696	545
Number of fish caught per fisherman trip	2.93	1.77
Number of fish kept per fisherman trip	1.27	0.90
Average weight of fish caught	21.97	21.86
Total number of fish removed (estimate)	2,562	1,143
Total weight of fish removed (estimate)	56,287.14	24,985.98

the rest were returned to the river. In 1965, the total catch was 2,254 paddlefish weighing 25 tons. Of these 1,143 fish weighing 12 tons were kept. Based on fish kept, the harvest was 55 percent less in 1965 than in 1964. The weight of individual paddlefish (1,818 specimens) caught in 1964, varied from 5.50 pounds to 42.00 pounds with an average of 21.97 pounds. In 1965, the weight of individual fish (1,229 specimens) ranged from 5.00 pounds to 46.00 pounds with an average of 21.86 pounds.

There were about 55 percent less fishermen and 73 percent fewer fish caught in 1965 than in 1964. During both years about 60 percent fewer

fish were caught in June than in May. About 20 percent of the fishermen in 1964 and 42 percent in 1965 caught no fish. The catch rate per fisherman trip was about 3 fish in 1964 and 2 fish in 1965. The average number of fish kept per fisherman trip was only slightly higher in 1964 than in 1965. Most of the fishermen who took several paddlefish per trip kept only two even though there was no legal limit.

Since there were differences in water level, flow, temperature, and turbidity in the 2 years of the census, an attempt was made to correlate these conditions with the catch rate. The water level, temperature, and turbidity information was obtained at Glendive, Montana, about 20 river miles upstream from Intake. Flow data were obtained at Sidney, Montana, about 40 miles downstream. The catch was highest (2.93 fish per fisherman trip) in 1964 when the average water level was 2,045.37 feet above sea level, the average flow was 24,769 c.f.s., the average temperature was 58.3°F., and the average turbidity was 1,570.8 p.p.m. The catch rate was the lowest (1.77 fish per fisherman trip) in 1965 when the average water level was 2,046.18 feet above sea level, the average flow was 32,118 c.f.s., the average temperature was 50.2°F., and the average turbidity was 1,066.4 p.p.m. Purkett (1963) stated that catch rates may be high even in low populations because paddlefish congregate below riffles when water levels are low. The average catch rates of paddlefish from the Intake area were higher than those from the Osage River, Missouri (Purkett, 1963).

The residence of fishermen was secured from creel census cards. Slightly more than 95 percent of the fishermen in both years, came from

Montana. The percentage of fishermen and the distances traveled are as follows: 62 percent within 50 miles; 21 percent from 50 - 100 miles; 17 percent from distances greater than 100 miles. Five percent of the fishermen were from out of state with the largest number from North Dakota.

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