LIFE HISTORY, HABITAT AND DISTRIBUTION OF THE LAKE STURGEON *Acipenser fulvescens* IN THE SOUTH SASKATCHEWAN RIVER, ALBERTA

by

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VITA

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ABSTRACT

The life history, habitat, and distribution of the lake sturgeon in the South Saskatchewan River, Alberta were investigated during 1968 from April to November and in 1969 from June to September. A total of 223 specimens was used for an age and growth study. Sixty seven percent of the fish were in age groups III through IX and the rest were in age groups X to LI. Females were larger than males in the older age groups. The sex ratio (males to females) for all age groups was 1:1.1. Males were sexually mature in age group XIX and females in age group XXV. The number of eggs per female ranged from 117,450 to 607,400. Aquatic invertebrates were the most numerous food items found in the lake sturgeon diet. Fish were present in 25 percent of the stomachs. Fishing success was related to habitat. All lake sturgeon taken during the habitat study were in depths greater than two meters and at velocities less than 80 cm per sec. Of 56 sturgeon tagged and released only two were recaptured. The greatest distance traveled was 60 km.

INTRODUCTION

The life history, habitat and distribution of the lake sturgeon, *Acipenser fulvenscens* (Rafinesque), were studied in the Alberta portion of the South Saskatchewan River during 1968 from April to November and in 1969 from June to September.

The lake sturgeon is indigenous to the Hudson Bay, St. Lawrence (including the Great Lakes), and Mississippi River drainages. The species has been depleted throughout most of its range by over-exploitation and/or by man-made environmental changes (Harkness and Dymond, 1961). In Alberta the species is known to occur in the South Saskatchewan River from the confluences of the Bow and Oldman Rivers to the Saskatchewan border. Reports of the species in the drainages above the confluences have not been confirmed. Prior to 1940 it was legal to take lake sturgeon, but after this date fishing was prohibited until 1968 when a limited fishery was permitted. The only available published work on lake sturgeon from the Saskatchewan River drainage is that of Royer (1968), who reported on age and growth of specimens taken in the Saskatchewan River Delta about 700 km downstream from the present study area. Other age and growth studies are reported for: Lake Nipigon, Ontario (Harkness, 1923); Lake St. Francis and the St. Lawrence River (Cuerrier and Roussow, 1951); Lake Winnebago Region, Wisconsin (Probst and Cooper, 1955); Nelson River, Manitoba (Sunde, 1959). The latter two studies included data on reproduction and harvest. Spawning periodicity was reported on by Roussow (1957), while the lake sturgeon, its history and problems of conservation were reviewed by Harkness and Dymond (1961).

DESCRIPTION OF AREA

The present study was confined to the South Saskatchewan River in Alberta. The drainage exclusive of the Red Deer River lies in southern Alberta and northwestern Montana and has an area of approximately 67,340 square kilometers. Its tributaries drain the east slopes of the Rocky Mountains from Glacier National Park, Montana northerly to and including Banff National Park, Alberta. The Oldman and Bow Rivers which are its two major tributaries join to form the South Saskatchewan River 14 km north of Grassy Lake, Alberta (Figure 1).

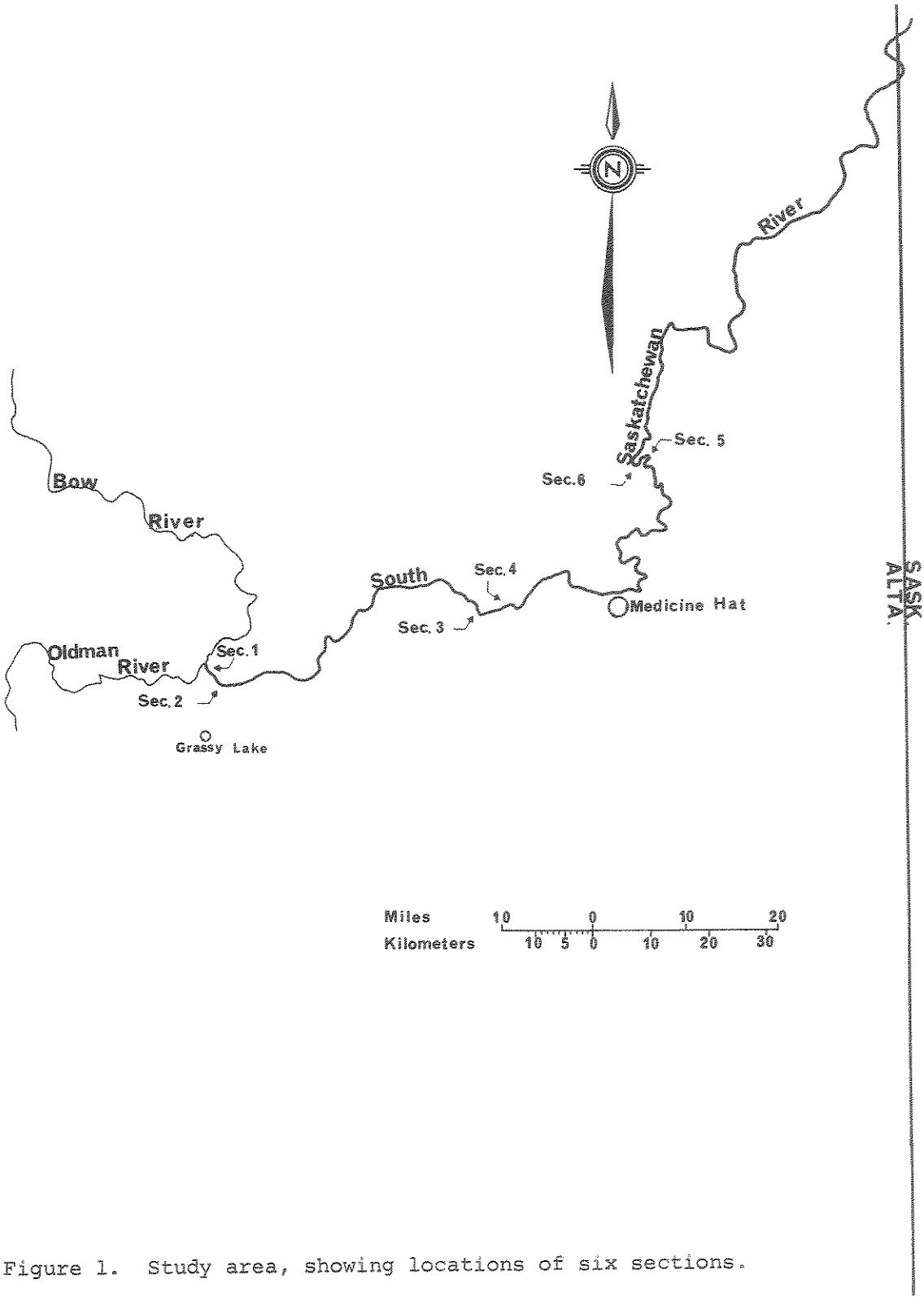

Figure 1. Study area, showing locations of six sections.

METHODS

Attempts were made to catch lake sturgeon using set lines, gill nets, seines, and poison, but the set line was the only effective method. Each consisted of a nylon line (25-100 meters in length) rigged with 3 to 50 hooks (size 6/0 and 8/0), baited with minnows. Set lines were fished in back waters during peak river discharge and in the main channel after high water subsided.

Total and fork lengths of sturgeon were secured to the nearest millimeter and weights to the nearest 0.10 kilogram for those less than 5 kilograms in weight and to the nearest 0.25 kilogram for larger fish.

Age determinations followed the method of Cuerrier (1951) with minor modifications. Pectoral fins were removed at their articulation with the body and dried. The first pectoral ray of each fin was sectioned (0.2 to 0.5 mm) at right angles to the long axis with a single carborundum blade. Sections were then emersed in 70 percent alcohol prior to annulus determination. Annuli were considered to be the narrow dark concentric rings (Figure 2). These were more easily distinguished at their greatest curvature on the ventral-radial axis of the arrow-shaped sections. Growth rates were determined from empirical total lengths and not by back calculation because of the extreme variation in the shape of pectoral rays.

Sex determinations were made by examination of the gonads. Gonads were then weighed to the nearest gram. Sexual maturity stages followed the criteria described by Roussow (1957).

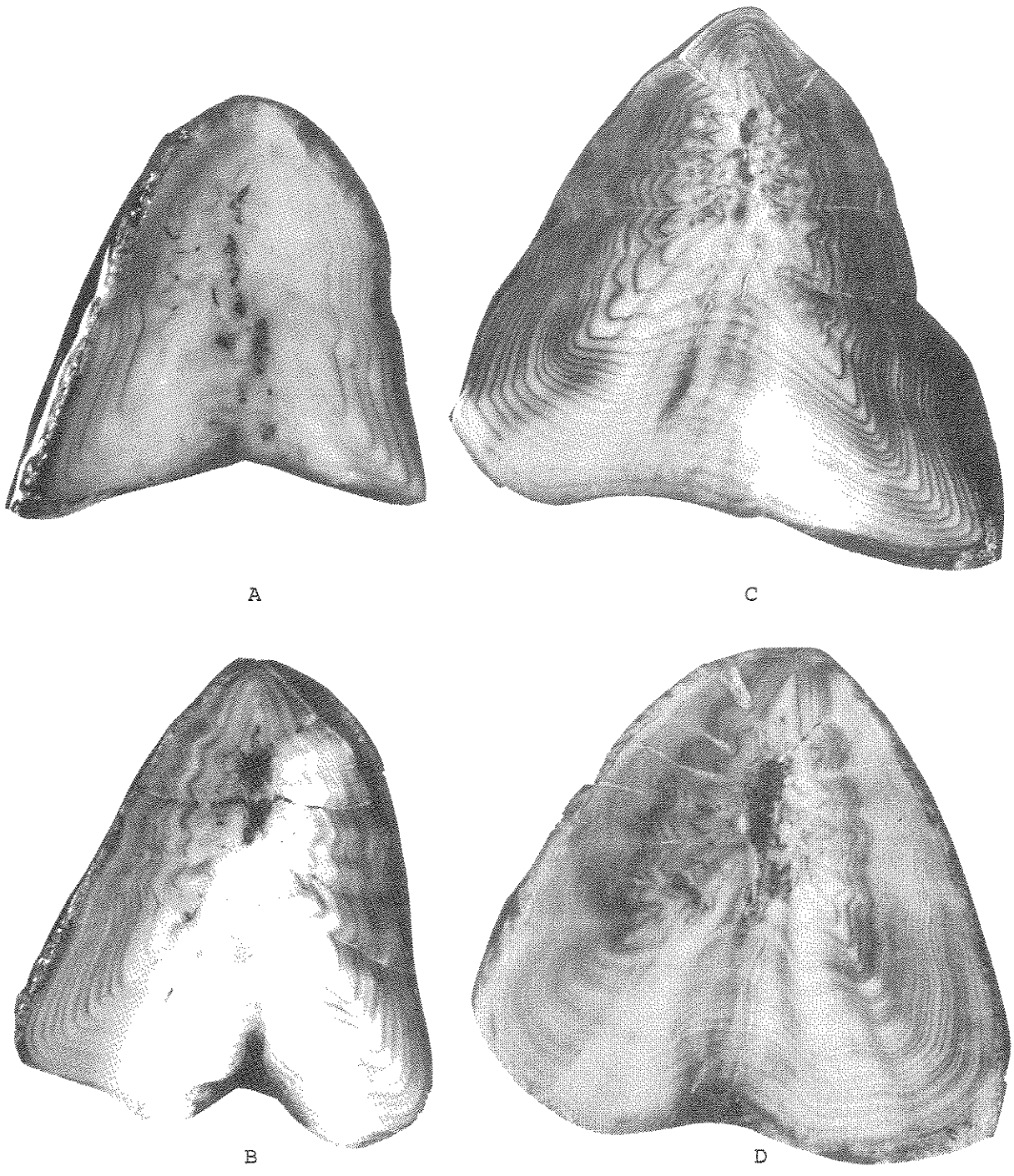

Figure 2. Cross sections of pectoral rays from lake sturgeon. A.- 785 mm 7-years-old. B.- 992 mm 13-years-old. C.- 1190 mm 19-years old. D.- 1480 mm 36-years-old. Photos by Don Fritts.

The food of the lake sturgeon was determined by examination of the stomach contents. The organisms found were classified to order and enumerated. The occurrance and numerical value of food items from aggregate stomach samples were expressed as percentages.

Morphometric data and study section locations were secured from aerial photos (1:2640) taken in 1962. Sections varied in length from 670 to 975 meters and transects perpendicular to the river channel were located at 62 meter intervals. Channel widths were measured by trangulation and areas with a planimeter. Depths were measured to the nearest 0.5 meters by a Furuno FG-200 depth recorder. Velocities were estimated by timing floats between transects and bottom types were classified according to Welch (1952).

River discharge and water chemistry information were obtained from records of the Canada Department of Energy, Mines, and Resources. Water temperatures were recorded with a 30-day Rayan Thermograph.

An attempt to determine lake sturgeon habitat was made by relating fishing success to the physical parameters of two areas (each comprised of three sections).

A few observations were made on the movement of lake sturgeon by tag and recovery.

RESULTS

Age and Growth

Age was determined for 221 lake sturgeon taken in 1968 and for two collected near Medicine Hat in 1964. These latter were in age group II. Sixty-seven percent of the fish collected were in age groups III through IX. Twenty-nine age groups between X and LI years were represented but no more than seven fish were in any single age group (Table I).

Length ranged from 208 mm in age group II to 1705 mm in age group LI. Size for given age groups varied between fish from the different localities, however not all sturgeon were taken on the same date and the number in each age group was small. Female sturgeon were slightly larger than males in older age groups (Figure 3). This may not be representative since samples were small. Royer (1968) observed a similar difference between males and females while Probst and Cooper (1957) reported no difference in size between male and female sturgeon.

A growth curve was derived from combined data of all specimens taken in 1968 from my study sections (Figure 4). The growth rate was similar to that reported for sturgeon from the Saskatchewan River Delta and for Lake Winnebago. Mean growth increments varied from 263 mm (age groups II and III) to 54 mm (age groups VIII and IX), while the mean for age groups II through IX was 72 mm. In age groups older than IX sample sizes were variable. The mean increment was 24 mm for age group X through XXI and 13 mm for age group XXI through LI.

TABLE I. Age, Number and Total Lengths (mm) of Lake Sturgeon from the South Saskatchewan River (April - November, 1968).

Age group	No. fish	Length mean	Length range	Age group	No. fish	Length mean	Length range
I	-			XXVII	3	1388	1130-1450
II	2*	212	208- 217	XXVIII	2	1305	1130-1480
III	7	475	465- 485	XXIX	2	1450	
IV	21	586	553- 670	XXX	1	1467	
V	17	640	550- 682	XXXI	-		
VI	33	739	575- 823	XXXII	-		
VII	35	803	690- 907	XXXIII	1	1580	
VIII	15	853	700- 955	XXXIV	1	1350	
IX	22	907	770- 960	XXXV	3	1452	1430-1480
X	5	976	800-1100	XXXVI	-		
XI	5	1037	936-1070	XXXVII	2	1489	1428-1500
XII	2	1003	1000-1006	XXXVIII	1	1600	
XIII	4	1025	1005-1035	XXXIX	0		
XIV	7	1176	1095-1125	XL	0		
XV	5	1137	980-1110	XLI	2	1476	1460-1505
XVI	3	1115	1050-1180	XLII	1	1350	
XVII	1	1122		XLIII	-		
XVIII	2	1167	1114-1167	XLIV	-		
XIX	6	1265	1150-1390	XLV	-		
XX	3	1291	1140-1375	XLVI	-		
XXI	1	1306		XLVII	-		
XXII	-			XLVIII	2	1548	1511-1585
XXIII	-			LIX	1	1500	
XXIV	-			L	1	1650	
XXV	2	1356	1135-1430	LI	1	1705	
XXVI	1	1350		LII			

* Taken in 1964 near Medicine Hat

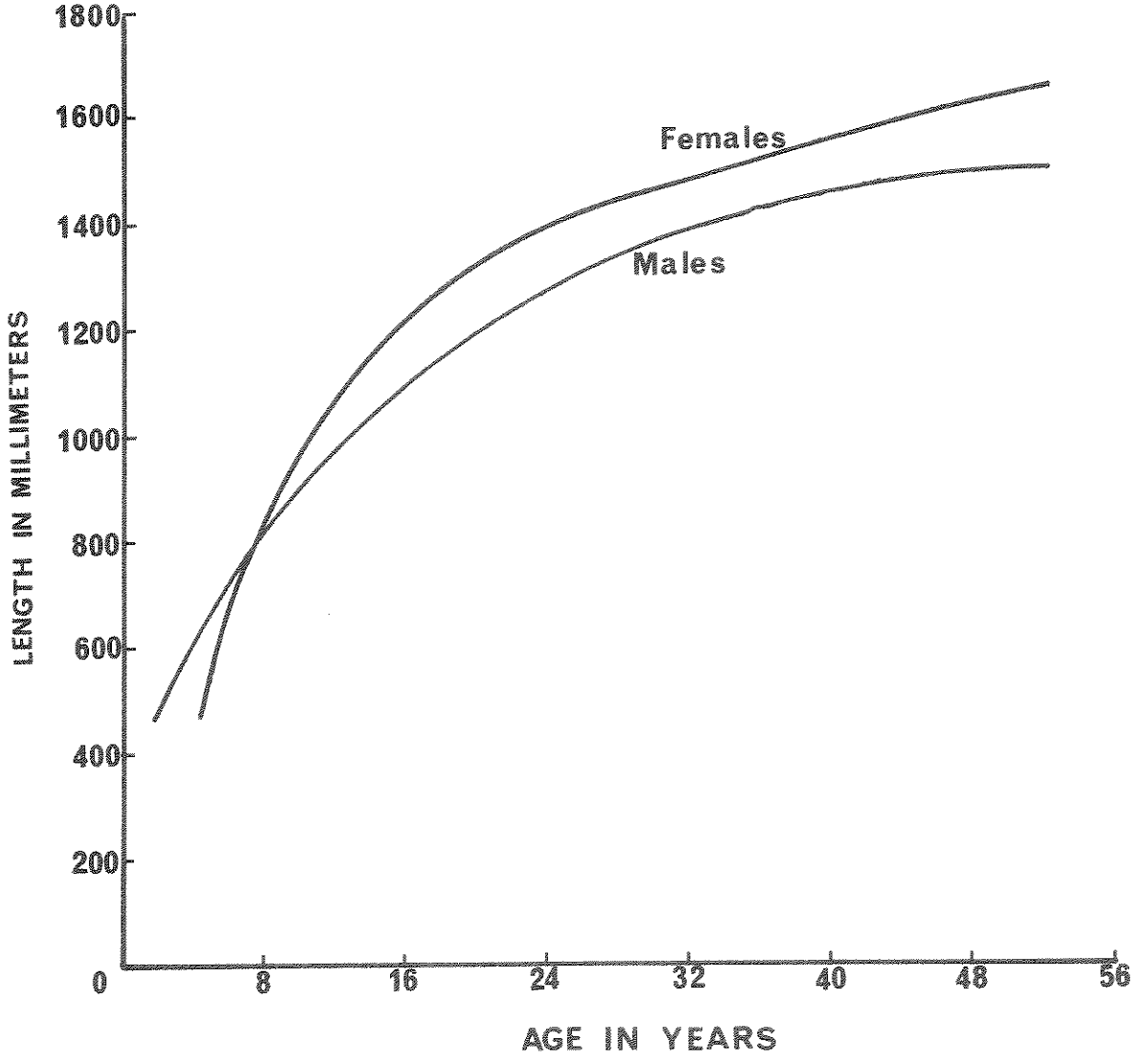

Figure 3. Length of male and female lake sturgeon from the South Saskatchewan River, Alberta.

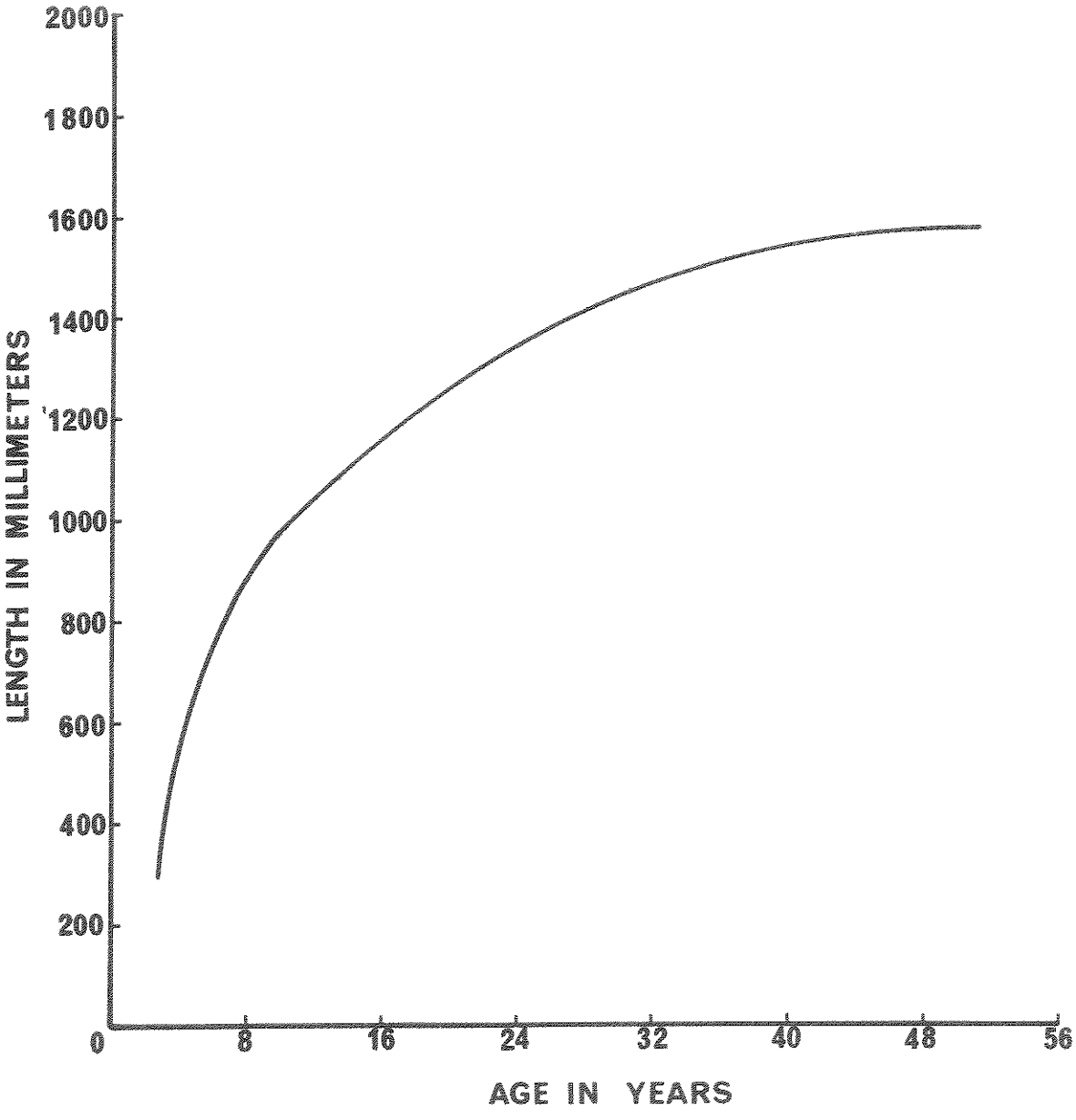

Figure 4. Growth curve of lake sturgeon from the South Saskatchewan River, Alberta.

These results were similar to those of Royer (1968) who reported an average annual increment of 58 mm for age groups 0 through XX and 15 mm for age groups XX through XL for sturgeon from the Saskatchewan River Delta.

The length-weight relationship of lake sturgeon was computed to be Log W = 9,067 + 3.28 log L, where W is weight in kilograms and L is total length in millimeters (Figure 5). This relationship is similar to that reported for lake sturgeon from other areas.

Fecundity

Only 3 of the 97 females had mature eggs in their ovaries. The number of eggs was calculated for each of these by weighing the ovaries and counting five sub-samples consisting of approximately five percent of the total ovary weight. The smallest female (1,350 mm) contained 117,450 eggs while the largest (1,705 mm) had 607,400 eggs. The average number of eggs per kilogram of fish weight was 1,188 while average per kilogram of ovary was 84,988. Cuerrier (1949) and Dubreuil and Cuerrier (1950) reported on the fecundity of lake sturgeon for the Ottawa River and Lake St. Peters. Fish from Lake St. Peters averaged 36 pounds (16.34 kg) and contained 184,914 eggs and one weighing 79 pounds (35.86 kg) had 370,910 eggs. Harkness and Dymond (1961) suggested that 5,000 eggs per pound of fish is a reasonable number to expect in most lake sturgeon of 20 pounds or more in weight.

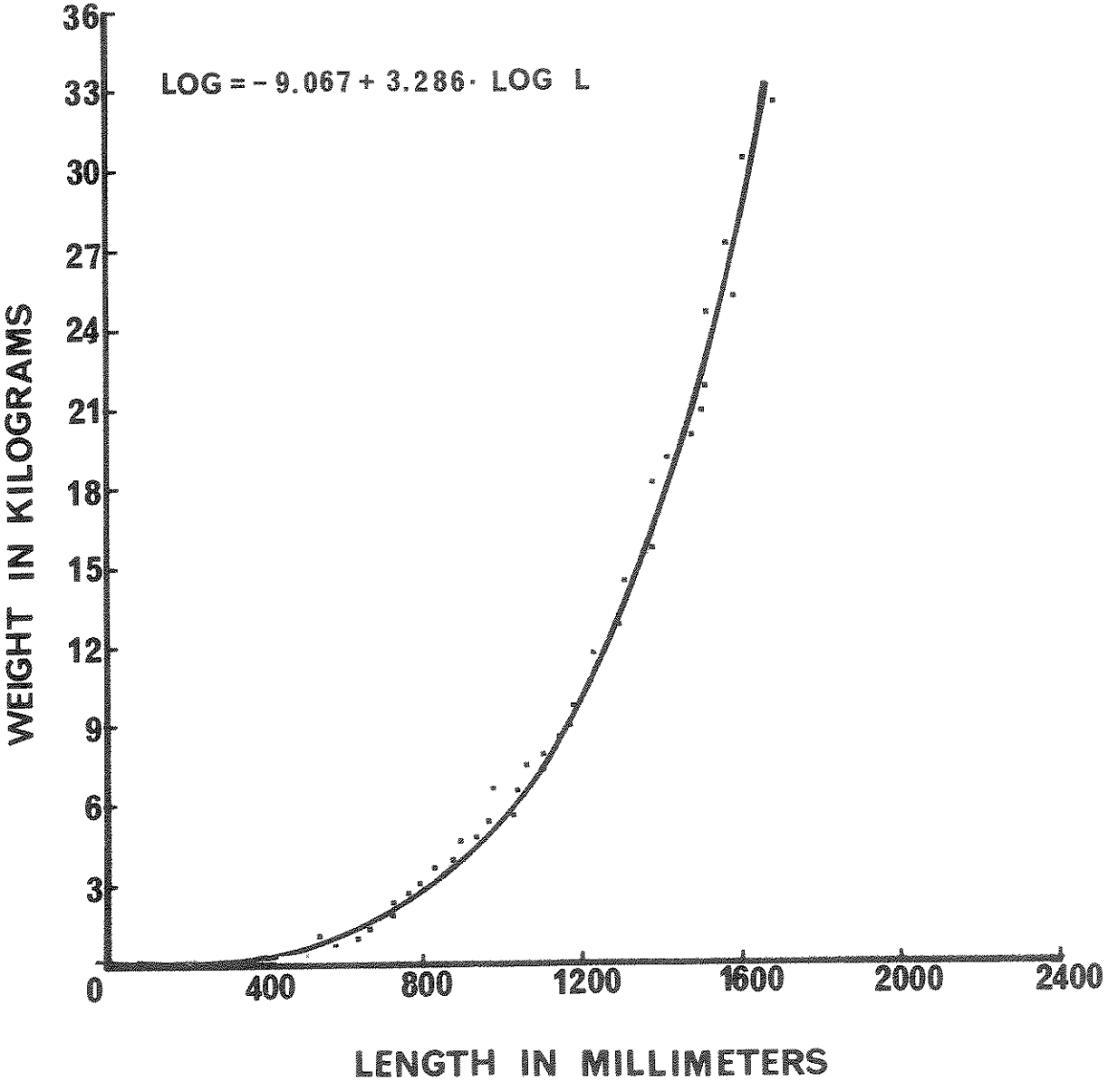

Figure 5. Length-weight relationship of the lake sturgeon from the South Saskatchewan River, Alberta. The curve is the solution of the equation; the dots show the actual weights at various lengths.

Sex Ratio

The sex ratio of 224 lake sturgeon taken in 1968 was 1.1 males to 1 female. Males and females were about equally represented in year classes III through XX, but females outnumbered the males 19 to 12 in the age groups greater than XX. Probst and Cooper (1955), Cuerrier (1949), and Sunde (1959) reported that younger lake sturgeon had approximately equal sex ratios while older fish were predominantly females.

Maturity

The gonads of 198 lake sturgeon were examined. The weights of paired testes ranges from 12 grams in year class III to 5 kilograms in year class XXXIV. Paired ovary weights ranged from 13.5 grams in age group IV to 7.5 kilograms in age group LI. Two males were spent while five males and three females were ripe. All ripe fish were taken after mid-July and they presumably had spawned in the spring of 1969. The youngest male was XIX years and the youngest female XXV years (Table II). The remaining fish in age groups greater than XIX were in varying stages of gonad development. Roussow (1957) reports that maturity for both sexes is reached at VIII to XIII years and spawning usually occurs first at XII to XIX years for the males and XIV to XXIII for the females. Spawning periodicity varied between four and seven years for females. Cuerrier (1949) reported that maturity is reached at XIV years for males and XXIII years for females.

TABLE II. Age, Length (mm), Weight (kg), Sex and Gonad Weight of Ripe and Spent Lake Sturgeon.

Age, Years	Length (mm)	Weight (kg)	Sex	Weight of Gonads (gm)
25	1350	15.50	F-R	2,800
50	1650	32.00	F-R	4,062
28	1450	17.50	M-S	885
27	1387	19.75	M-S	763
48	1510	24.75	M-R	4,750
41	1505	25.00	M-R	5,000
19	1388	21.25	M-R	2,750
37	1428	23.00	M-R	3,250
35	1480	23.50	M-R	4,250
51	1705	45.50	F-R	7,500

M = Male
F = Female
S = Spent
R = Ripe

Food

Stomachs from 136 lake sturgeon taken from April through September 1968 were examined for food content. A total of 116 (86.7 percent) contained definable food organisms. Fragments of mollusks were present in all stomachs. The percentage occurrence of aquatic invertebrates in stomachs were: Diptera larvae (Chironomidae and Tipulidae) 85.5 percent; Ephemeroptera nymphs 75.4 percent; Plecoptera nymphs 42.3 percent; Odonata nymphs 33.0 percent; and Trichoptera larvae 73.2 percent. Fish occurred in 25

percent of the stomachs. Some sand and fine gravel were preent in all stomachs. Harkness (1923) reported that lake sturgeon from Lake Nipigon fed on ephemerid nymphs, chironmid larvae and mollusks and suggested that it feeds on the most abundant bottom organisms available and without preference.

The stomach contents of large lake sturgeon show little selection in feeding, however in fish, 600 mm or less in length, 62 percent of the diet was diptera, thus indicating a preference (Table III). Fish were present in 25 percent of the lake sturgeon greater than 600 mm in length. Probst and Cooper (1955) reported that fish were found only occasionally in lake sturgeon stomachs from the Lake Winnebago Region, Wisconsin and these were probably discarded bait, while Semakula and Larkin (1969) reported that fish occurred in about half of the stomachs of white sturgeon *Acipenser transmontanus* taken in the Fraser River, British Columbia.

Lake Sturgeon Habitat

General observations were made on the physical, chemical and biological features of the South Saskatchewan River in an effort to define the habitat of the lake sturgeon. This included about 300 km of river which is presumably occupied by this species. Most of the data were secured in the vicinity of Medicine Hat and may not be representative of the entire river in Alberta. In addition, detailed physical information was secured for six sections (approximately six km) of river in relation to fishing success.

TABLE III. Percentage Frequency of Occurrence (in parentheses) and Percent Composition by Number of Aggregate Lake Sturgeon Stomach Samples.

	Length Classes						
	400-599	600-799	800-999	1000-1199	1200-1399	1400-1599	Total
Stomachs							
Number	12	48	43	14	10	9	136
% empty	0	4.4	6.5	1.5	.7	0	13.3
Food Items							
Insecta							
Diptera	62.0(100)	28.3(88.8)	35.9(85.3)	29.1(81.8)	27.1(77.7)	30.2(77.7)	37.5(85.5)
Ephemeroptera	8.8(25)	37.1(78.5)	25.0(83.3)	31.1(83.1)	28.6(66.6)	24.7(66.6)	33.7(75.4)
Trichoptera	28.9(83.3)	30.2(69.0)	28.6(82.4)	24.2(81.8)	27.1(77.7)	28.2(77.7)	21.4(73.2)
Plecoptera	.5(16.6)	1.5(23.8)	4.8(32.4)	10.3(100)	10.5(66.6)	9.4(88.8)	3.7(42.3)
Odonata	1.0(8.3)	1.8(16.6)	1.9(29.4)	1.7(63.6)	3.0(44.4)	1.6(44.4)	1.8(33.0)
Fish	-	1.0(4.7)	3.6(14.7)	3.4(54.5)	3.7(77.7)	5.9(88.8)	2.9(25.0)
Mollusca	*	*	*	*	*	*	

* Not measured

General Parameters

Peak discharge occurs in June and coincides with runoff from snow melt in the headwaters. Low flows come in late summer and again during mid-winter. An increase appears after low summer flows, resulting from reduced irrigational use. The mean monthly discharge during 1968 and 1969 ranged from 70 cms to 521 cms. Maximum discharge was 836 cms and minimum 35 cms. Maximum instantaneous discharge of 4,323 cms occurred on June 11, 1953 and a minimum of 10 cms on November 22, 1929. Annual monthly mean river temperatures recorded at Medicine Hat ranged from 2 C in December to 22 C in August. Daily temperatures were taken in section three from June through August of 1968 and 1969. They ranged from 13 C to 24.5 C. The highest temperature occurred on July 25, 1969 during a period when air temperatures exceeded 36 C.

Chemical analyses were made on monthly samples taken in 1968 near Medicine Hat, Alberta (Table IV). The pH, total alkalinity, total hardness and conductance decreased during high water (June) and were at their maximum values during low flow (December and January). Turbidity on the other hand was highest in June during runoff.

Algae blooms appeared in the upper reaches of the South Saskatchewan River during periods of low flow and probably resulted in part from domestic and industrial effluents entering the Oldman River at Lethbridge and Taber.

Rooted aquatic plants were common along the entire river. Other fish caught on set lines along with lake sturgeon, in the order of decreasing

TABLE IV. Chemical Analyses of the South Saskatchewan River near Medicine Hat, January 1968 - December 1968.

Date (1968)	PH	Turbidity (Jackson Units)	Total Alkalinity (ppm)	Total Hardness ($CaCO_3$) (ppm)	Conductance @ 25°C (Microhoms)
January	8.2	1.0	169	220	412
February	8.2	2.1	147	192	382
March	8.0	2.6	120	158	349
April	8.4	1.2	117	158	364
May	8.1	2.1	114	153	385
June	8.0	75.0	109	130	281
July	8.3	6.7	113	134	291
August	8.7	6.4	125	134	322
Sept-ember	8.7	6.9	118	140	328
October	8.4	1.9	140	169	371
November	8.2	1.9	131	157	326
December	8.2	3.4	178	210	426
MEAN	8.2	9.3	131	162	353

abundance, were: sauger *(Stizostedion canadense)*, northern pike *(Esox lucis)*, walleye *(Stizostedion vitreum)*, burbot *(Lota lota)*, and rainbow trout *(Salmo gairdneri)*. Mountain whitefish *(Prosopium williamsoni)*, goldeye *(Hiodon alosoides)*, flathead chub *(Hybopsis gracilis)*, lake chub *(Hybopsis plumbea)*, emerald shiner *(Notropis atherinoides)*, spottail shiner *(Notropis hudsonius)*, longnose dace *(Rhinichthys cataractae)*, quillback

carpsucker *(Carpiodes cyprinus)*, northern sucker *(Catostomus catostomus)*, white sucker *(Catostomus commersoni)*, mountain sucker *(Pantosteus platyrhnchus)*, northern redhorse *(Moxostoma macrolepidotum)*, trout-perch *(Percopsis omiscomaycus)*, and yellow perch *(Perca flavescens)* were also present.

Habitat in Relation to Fishing Success

Two areas each composed of three sections were established for more intensive study. Area 1 (sections 1, 3, and 5) was known to produce good fishing (Figure 6.), while Area 2 (sections 2, 4, and 6) was not used by fishermen and presumably supported few sturgeon (Figure 7). Parameters measured were area, width, gradient, velocity depth and bottom type (Table V). Area 1 was approximately 48 hectares, while Area 2 included 60 hectares. Average depth and average thalweg depth were greater and velocities less in Area 1 than in Area 2. Sand-silt bottom made up 20 to 40 percent of the river bed in Area 1 and only 10 percent in Area 2. Other bottom materials were little different in the two areas.

A total of 252 hours were spent fishing in each area using five set lines each equipped with 20 hooks (Table VI). Each set line was approximately 33 m long. These were distributed randomly through the areas. Eighty two percent of the 45 fish captured were taken from Area 1 and 18 percent from Area 2. This represents a catch of 0.76 per hectare (0.18 per hour) from Area 1 and 0.13 per hectare (0.03 per hour) in Area 2. The mean weight of the fish taken in Area 1 was 4.6 kg (range 2.5 to 16.5 kg) and 2.6 kg (range 2.6 to 10.5 kg) in area 2. Kilograms of fish per hectare

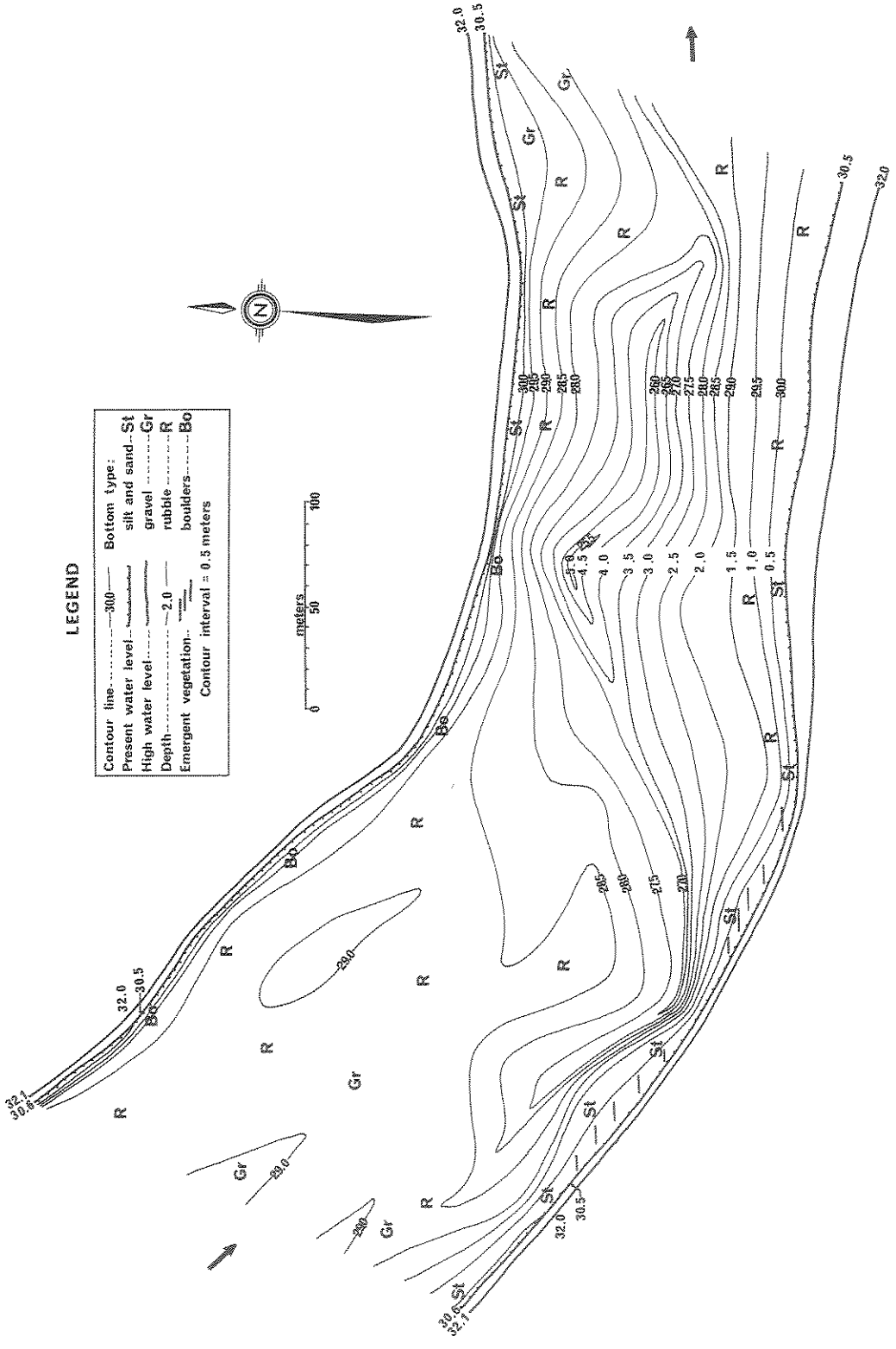

Figure 6. Section three representing Area 1.

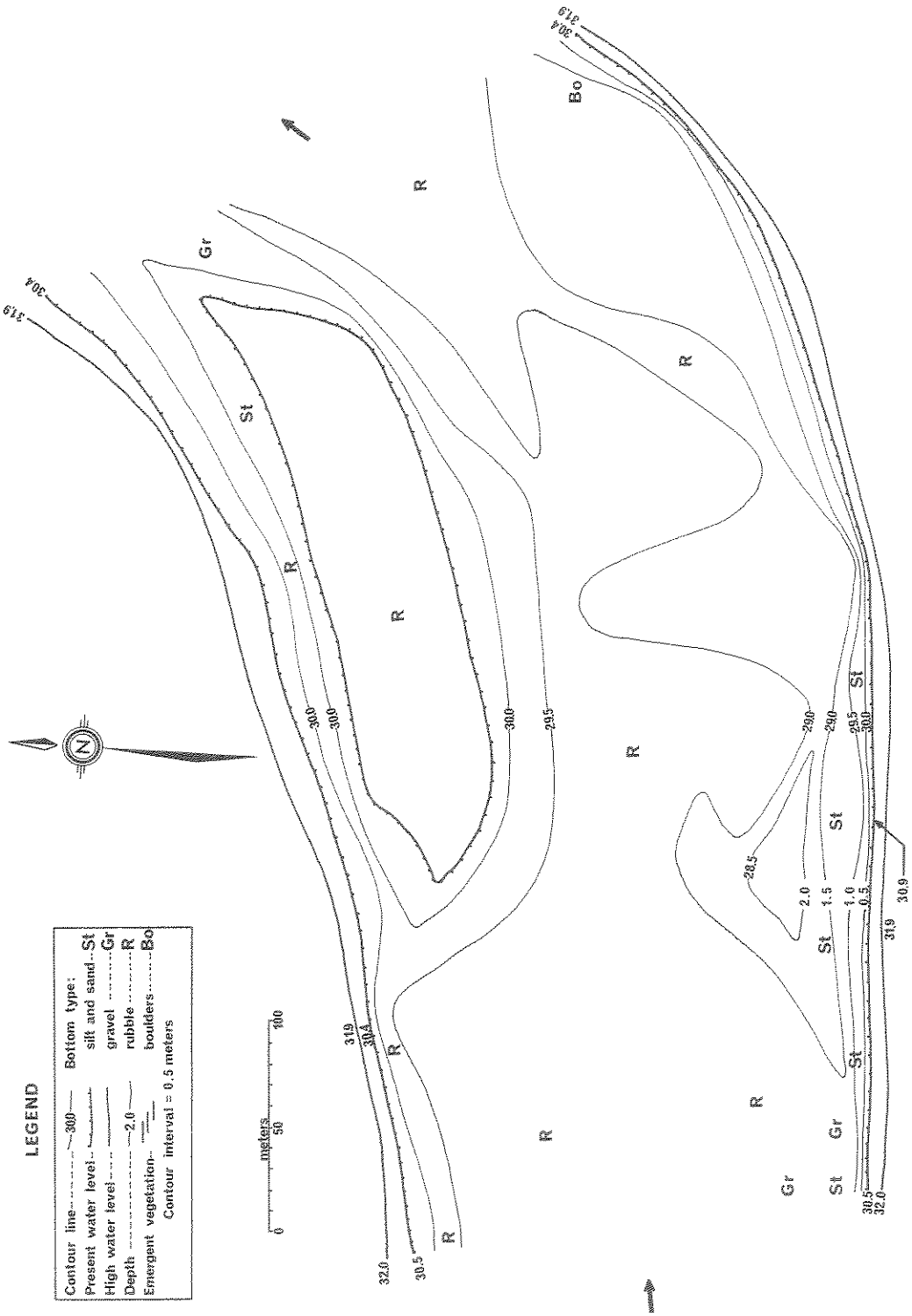

Figure 7. Section four representing Area 2.

TABLE V. Physical Parameters in Areas 1 and 2, South Saskatchewan River.

Parameters	Area 1			Area 2		
	1	3	5	2	4	6
Area (hectares)	18.8	11.8	17.2	23.7	17.3	18.1
Average width (meters)	193	194	189	260	285	198
Average depth (meters)	2.0	2.5	4.0	1.0	1.0	1.3
Gradient (meters/kilometers)	.54	.16	.21	.65	.20	.32
Average thalweg depth (meters)	2.0	3.7	3.7	1.8	1.4	1.3
Mean velocity (meters/second)	.9	.3	.4	1.0	1.6	1.4
Bottom type (%)						
Sand-silt	25	20	40	10	10	10
Gravel	20	10	10	30	0	30
Rubble	55	40	40	50	70	50
Boulders	0	30	10	10	20	10

were 3.5 in Area 1 and 0.25 in Area 2.

An attempt was made to relate fishing success to physical parameters. Depth, velocity, and bottom were the only parameters which could be related to fishing success. The first two were the most important. All lake sturgeon were captured where thalweg depths exceeded two meters (Figure 8) and where velocities were less than 80 cm per sec. The bottom material where 82 percent of the sturgeon were taken had a high percentage of sand-silt. The distribution of lake sturgeon is probably determined to a large extent by the interaction of these parameters.

TABLE VI. Hours Fished, Hook Hours, and Number of Lake Sturgeon Taken in Areas 1 and 2. July 28, 1969 - August 8, 1969, South Saskatchewan River.

Sections		Hours Fished	Hook Hours	No. Fish
	1	84	8,400	10
Area 1	3	120	12,000	13
	5	48	4,800	14
		252	25,200	37
	2	84	8,400	3
Area 2	4	120	12,000	3
	6	48	4,800	2
		252	25,200	8

Movement

Magnin and Beaulieu (1960) reported that 40 percent of recaptured lake sturgeon tagged in the St. Lawrence River moved less than 16 km and 70 percent less than 54 km. Beaulieu and Corbeil (1964) related the movement of lake sturgeon in Quebec to seasonal temperature changes. In an attempt to determine the movement of lake sturgeon 21 were tagged and released (August, 1968) in the same section where captured in the South Saskatchewan River. Three were from section one and 18 from section three. They ranged from 510 to 998 mm in length. One of these was recaptured in the same section where released (November, 1968) and another in section one approximately 60 km upstream from the point of release (August, 1969).

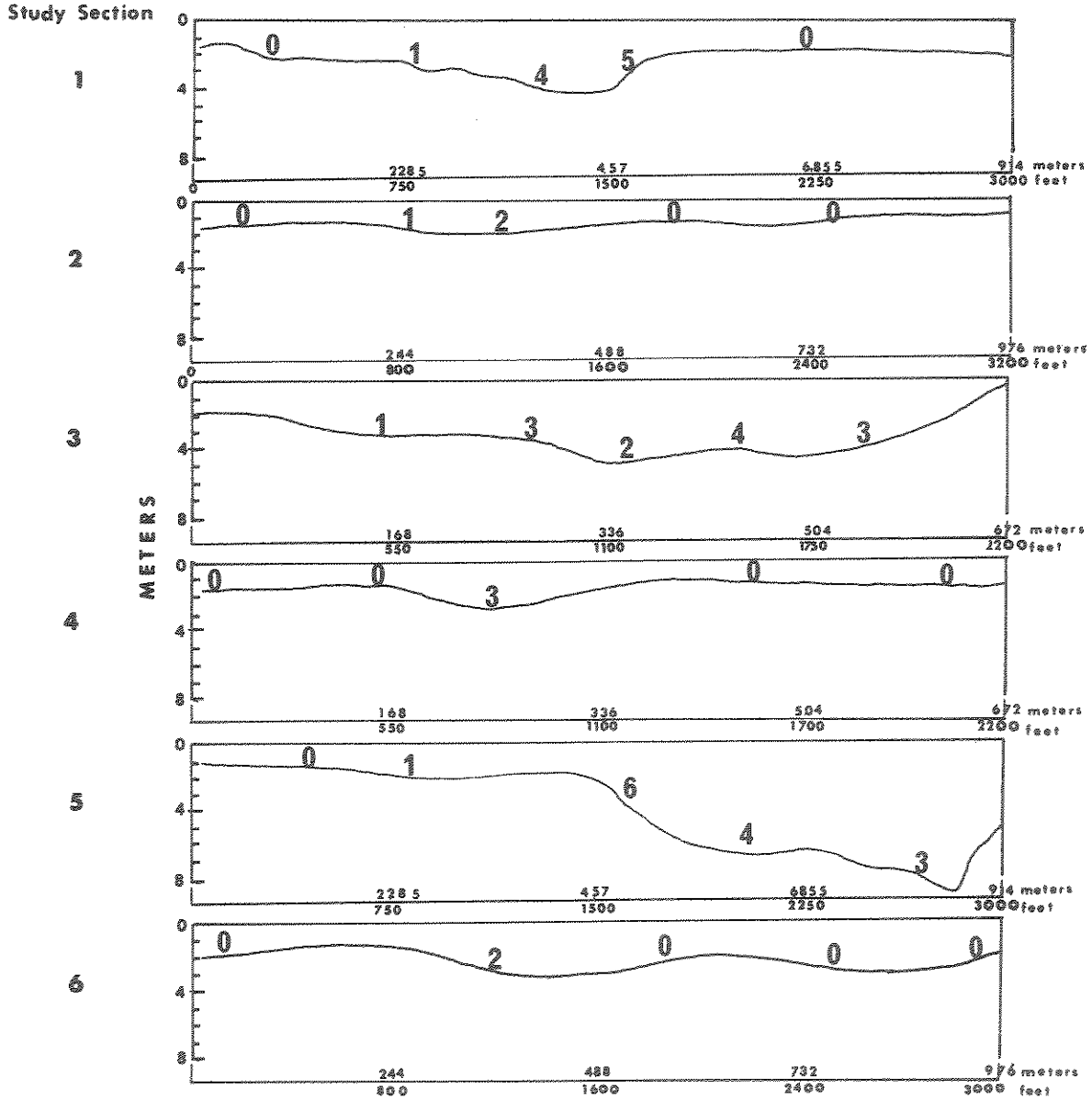

Figure 8. Bottom profiles along the thalwegs of the six sections showing approximate location of catch and number of lake sturgeon captured.

This latter fish had grown from 775 to 780 mm in length during the interim. None of the 35 lake sturgeon tagged in 1969 were recaptured.

Lake sturgeon were more numerous in back-waters and along banks in the spring (May and June). They moved into portions of the main channel where depths were greater than two meters in July and remained throughout the fall and winter. These observations are similar to those reported for lake sturgeon in other areas.

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