STATE OF ALASKA

William A. Egan, Governor

Annual Progress Report for

A LIFE HISTORY STUDY OF SHEEFISH AND WHITEFISH IN ALASKA

by

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ANNUAL REPORT OF PROGRESS

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The jobs included under Study R-II are as follows:

RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-4 *Name:* Sport Fish Investigations of Alaska.

Study No.: R-11 *Study Title:* A Life History Study of Sheefish and Whitefish in Alaska.

Period Covered: July 1, 1971 to June 30, 1972.

ABSTRACT

In late September and early October, 1971, 998,000 sheefish, Stenodus leucichthys, eggs were taken from the Koyukuk, Kobuk, and Kuskokwim rivers. Hatching success and survival were poor.

Preliminary limnological investigations of Imuruk Basin were completed.

Spawning grounds of Kuskokwim River sheefish were located 1,350 km up the Kuskokwim at Highpower Creek. Spawning began on September 29 and reached a peak on October 2 and 3. All spawning occurred in the lower 200 m of Highpower Creek at water depths of 1.3-2.7 m.

A survey of middle Yukon River tributary streams between Fort Yukon and Rampart in early June indicated presence of sheefish at the mouths of all these streams. Heaviest concentrations were found at Ray River and Hess Creek.

A summer food habits study of Holitna River sheefish showed that chum salmon, Oncorhynchus keta; silver salmon, O. kisutch; and king salmon, O. tshawytscha, fingerlings were the most important food items, comprising over 95% by weight of all food eaten.

A statistically based creel census on the Holitna River indicated a total fishing effort of 962 angler hours. Most of the fishing effort and success were in July and 304 sheefish were retained by anglers.

The 1971 winter subsistence catch at Selawik Lake was 3,416 sheefish. The Kobuk River subsistence catch was 9,485 and the Kotzebue catch was 682. The Kotzebue Sound commercial catch was 456 fish.

An age and growth study conducted on Delta Clearwater River round whitefish, Prosopium cylindraceum, revealed a maximum age of 10 years and maximum length of 42 cm.

A comparative age and growth study was conducted on broad whitefish, Coregonus nasus, from the following drainages: Porcupine River, Minto Flats, Holitna River, Imuruk Basin, and Sagavanirktok River. Porcupine River and Minto Flats fish grow most rapidly.

RECOMMENDATIONS

1. Continue the egg takes utilizing stocks from two or three populations. Continue experimenting with methods of rearing sheefish to fingerling size.

2. Begin the search for spawning grounds of middle Yukon River sheefish.

3. Initiate a tag and recovery program in the middle Yukon River system to determine sheefish movements and population status.

4. Continue research on whitefish taxonomy and distribution. Initiate age and growth studies on middle Yukon River Bering cisco and follow their spawning migrations.

TECHNIQUES USED

Sheefish for egg takes were captured by hook and line, beach seine, and 5-inch stretch mesh gill nets. Kuskokwim River fish were placed in a holding pen until they were ready to spawn. Eggs were hatched in the Fire Lake Hatchery. Some fry were placed in the Clear Rearing Pond while the remainder were experimentally fed in the hatchery. Water samples were analyzed with a Hach field kit and salinity samples were analyzed by the Institute of Marine Science.

The search for Kuskokwim River sheefish spawning grounds covered the entire drainage utilizing boat and aerial surveys. The upstream spawning migration was followed by a netting program. Spawning grounds were delineated by visual observations of spawning activity.

Holitna River sheefish were collected for stomach samples throughout the summer by hook and line and gill net. Stomachs were placed in 10% formalin. Only stomachs containing food were used in computing percentage occurrence of food items.

Holitna River angler use was estimated by randomized angler counts. Only returns from completed angler trips were used in computing catch statistics.

Gill raker and lateral line scale counts were made in the field. The first left arch was excised and all gill rakers, including rudimentary ones, were counted.

Data on subsistence sheefish utilization in the Selawik Lake ice fishery were collected by a Selawik resident. Data on subsistence and commercial utilization of Kotzebue and Kobuk River sheefish were provided by the Division of Commercial Fisheries.

Whitefish were often collected in conjunction with other sheefish job objectives and also by North Slope project personnel. Delta-Clearwater River round whitefish were collected by a shocker boat. Large mesh gill nets used for capturing sheefish took only larger whitefish; thus, few young whitefish appeared in the sample. Lengths at the end of each year of life for five Alaskan broad whitefish populations were back calculated from scale samples.

FINDINGS

Job R-II-A Sheefish Lake and River Adaptability Study.

Objectives

1. To locate suitable potential sheefish egg-take sites.
2. To find a method of rearing sheefish to fingerling size.
3. To determine suitability of new lakes and streams for sheefish.

Egg Take

Sheefish, Stenodus leucichthys, egg-take sites in 1971 were the Kobuk River approximately 47 km upstream from Kobuk Village, the Koyukuk River above Hughes, and the upper Kuskokwim River at Highpower Creek. Spawning areas on the Kobuk River were marked in late August so the egg-take crew could locate spawning fish. On September 27, 358,000 eggs were taken from Kobuk River fish. These eggs reached the Fire Lake Hatchery on September 29.

Seines and hook and line were used to capture nine male and four female Koyukuk River sheefish used for the egg take on September 30 and October 1. Approximately 240,000 eggs were taken but these eggs did not reach the hatchery until October 2 because of poor flying weather.

The two-year search for the spawning grounds of Kuskokwim River sheefish proved fruitful on September 19, as the fish were found at the mouth of Highpower Creek 18 km upstream from Telida. A holding pen was constructed and fish were placed in the pen beginning September 22. By October 1, all males were ripe.

Eight males and six females were used in the egg take on October 3. Some were partially spent and two females contained only a few hundred eggs each. Water temperature was 2°C. Approximately 400,000 eggs were taken. Due to the bad weather conditions, the eggs did not reach the Fire Lake Hatchery until October 5.

The 998,000 eggs suffered a 50% mortality soon after reaching the hatchery, probably due to the delay in reaching the hatchery. The mortality

was greatest in the Kobuk and Kuskokwim lots, probably also due to a shortage of males for fertilizing the last egg lots.

The eggs began hatching in late January and hatching was nearly completed by March 15, 1972. The 1972 hatching success of 15% compares with 35% in 1968, 49% in 1969, and 25% in 1970.

Feeding Experiments

On February 23, 83,000 sheefish fry were placed in the Clear Rearing Pond. All fry were lost as a result of an oil spill on March 9.

Two lots of 4,000 fry each were kept in the Fire Lake Hatchery aquaria and fed experimental diets consisting of Oregon mash and frozen brine shrimp. As of March 15, the fish were actively feeding and mortality was minimal. By March 27, fish of both lots began to die and the experiment was terminated. The remaining fish were fed live brine shrimp and were in good condition until late April when they all died unexpectedly.

Four-Mile Lake

Only two sheefish were taken in two net nights at Four-Mile Lake during July, 1971. These fish were 415 and 425 mm in length, an average increase in growth of approximately 20 mm since September, 1970.

In April, 1971, two man-days of angling through the ice in 20 locations plus eight over-night set lines were unproductive.

The first sport-caught sheefish from Four-Mile Lake was recorded in mid-August, 1971. The sheefish population in Four-Mile Lake is probably small and, with the abundant invertebrate food, are reluctant to bite.

Engineer Hill Lake

Forty-four yearling sheefish averaging 140 mm fork length were stocked in Engineer Hill Lake in July, 1970.

In July, 1971, one net night of fishing took 1 grayling, Thymallus arcticus; 11 lake chubs, Couesius plumbeus; and 3 sheefish (290 - 320 mm). The sheefish were in good condition and feeding on snails and insects. This indicates good survival and growth.

Imuruk Basin Survey

Imuruk Basin salinity data for 1970 and 1971 are presented in Table 1. The higher values in 1970 are due to continued winds from the west allowing higher salinity water to enter the Basin.

\BLE 1 Comparative Salinity Values (ppt) for Imuruk Basin, 1970 and 1971.

Location	1970	1971
Upper Imuruk	3.8	1.0
Lower Imuruk (Ptarmigan Point)	5.4	2.0

Water chemistry data are presented in Table 2.

.BLE 2 Water Chemistry Data from Various Areas of Imuruk Basin, 1971.

Location	Total Alkalinity (ppm)	Total Hardness (ppm)	pH
ıuruk Basin at Agiapuk Mouth	81	256	7.8
1/2 Miles up Agiapuk River	154	246	8.0
·wer Kuzitrin River	100	103	7.8
per Imuruk Basin	81	103	7.8
uruk Basin at Ptarmigan Point	91	178	8.1
ksuk Channel	91	391	9.0

Gill nets were set in various areas of the Agiapuk River delta, mainly collect broad whitefish, Coregonus nasus, for an age and growth study. e following results of six net nights of fishing with a 125-foot graduated sh gill net indicate the large amount of forage food that would be availle for sheefish in this area: 4 herring, Clupea harengus; 2 pink salmon, corhynchus gorbuscha, 1 chum salmon, O. keta; 3 round whitefish, Prosopium lindraceum; 513 least cisco, C. sardinella; 53 humpback whitefish, C. pidhian; 26 broad whitefish; 3 burbot, Lota lota; and 15 northern pike, Esox cius.

Job R-II-B Spawning Habits of Sheefish in Alaska.

Objectives

1. Location of Kuskokwim River spawning areas and observations of spawning.

2. Enumeration of spawning populations of the Chatanika, Kuskokwim, Holitna, and Koyukuk rivers.

1971 Kuskokwim River Spawning

Research in 1970 indicated that sheefish do not spawn in the Holitna River (Alt, 1971). Examination of ovaries of fish taken 36 km up the Holitna River in early June, 1971, revealed the presence of mature females with eggs over 75% developed (2 mm diameter). There were also many non-spawning mature females with tiny eggs (less than 0.5 mm) and some residual eggs from the previous year's spawning. The percentage of females that would spawn the current fall decreased throughout the summer, and by early August, all potential spawners had left the Holitna River.

Examination of gonads of 15 sheefish taken at McGrath between June and late August indicated that these fish would spawn during the current fall. In late July, the upper Kuskokwim in the vicinity of Medfra was surveyed (Figure 1). Gill nets were set in the South Fork, East Fork, and Big River, which are glacial tributaries of the Kuskokwim River. Three potential spawners were taken 5 km up Big River. The Middle Fork enters Big River above this netting site, so these fish could spawn in the Middle Fork as claimed by local residents. No sheefish were taken in the South or East forks and, according to local residents, none spawn in these streams. Five sheefish were captured in the main Kuskokwim River near Medfra at this time. From September 7-9, nine net nights of fishing in lower Big River and the mouth of the Middle Fork took no sheefish. If some of the Kuskokwim fish spawn in the Middle Fork, they may have been upstream at this time.

In mid-September, six sheefish in spawning condition were taken at the junction of the North Fork of the Kuskokwim and McKinley Fork (also called Swift Fork). No sheefish were taken in four net nights of fishing in the North Fork, 12 km upstream from the McKinley Fork confluence. At this point, the North Fork is non-glacial, dark-colored, slow-moving, and has a mud bottom. Because these conditions exist more or less to the headwaters of the North Fork, it can be ruled out as a spawning stream.

The search for the spawning grounds then led up McKinley Fork to its junction with Highpower Creek (Slow Fork), 17 km upstream from Telida (Figure 1) and 1,350 km upstream from the mouth of the Kuskokwim River. At this point, the braided, glacial McKinley Fork is unnavigable and probably a barrier to further upstream sheefish migration.

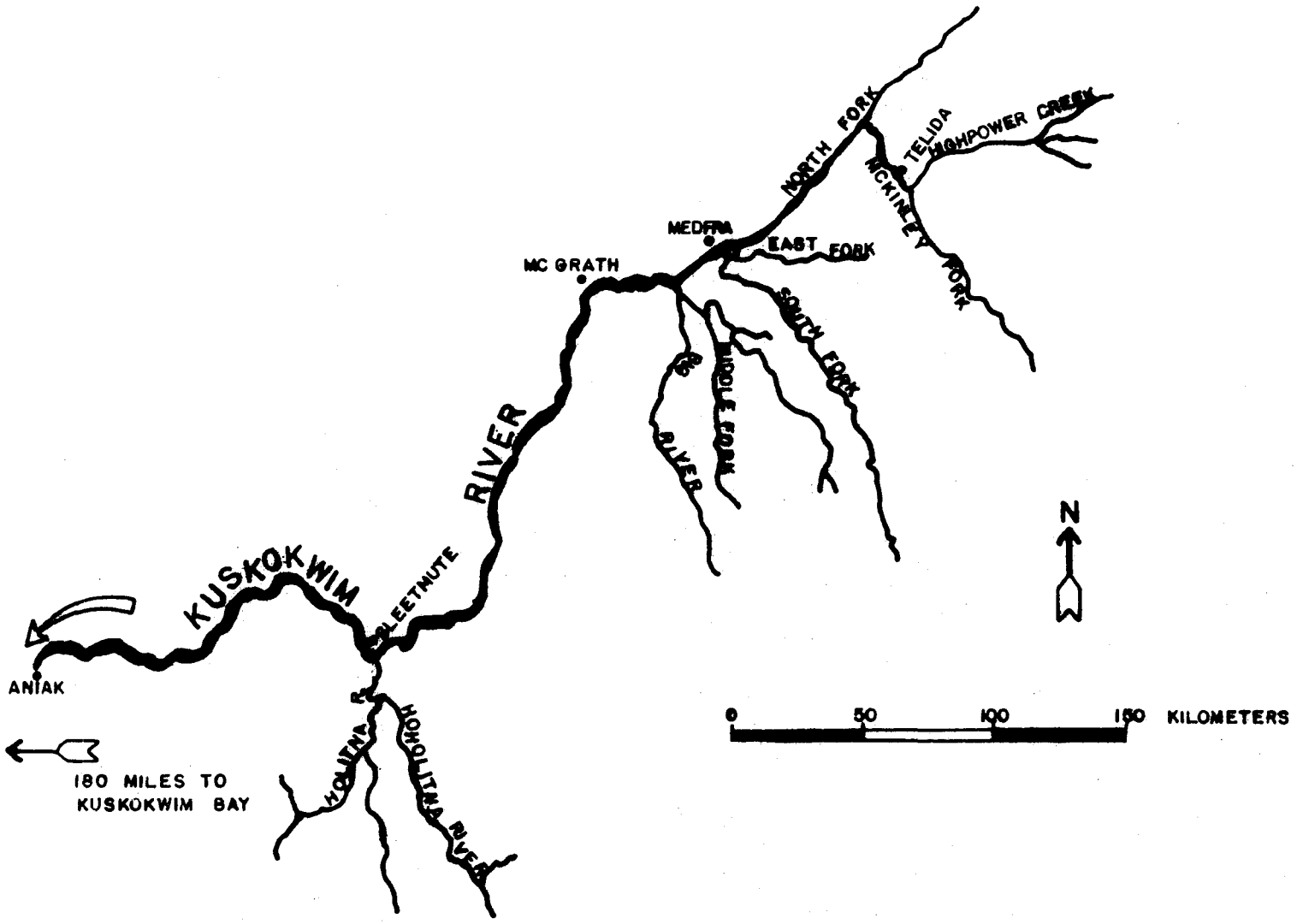

FIGURE 1 MIDDLE AND UPPER KUSKOKWIM RIVER DRAINAGES.

Sheefish were abundant in the lower 200 m of Highpower Creek on September 19. Fifty-one fish were tagged between September 20 and 28. Mean fork length of 35 males was 73 cm and 16 females was 81 cm.

Gill net sets 3.5 km upstream (4 net nights), 7 km upstream (6 net nights), and 42 km upstream (2 net nights) took 1 sheefish; 32 silver salmon, O. kisutch; 4 chum salmon; 5 round whitefish; 3 broad whitefish; 10 humpback whitefish; 2 least cisco; 3 grayling; 2 northern pike; and 1 sucker, Catostomus catostomus. The sheefish was taken 7 km upstream. Gill net sets in the lower 1,000 m of Highpower Creek from September 25 to October 3 (5 net nights) took 44 sheefish, 1 silver salmon, 1 chum salmon, 29 broad whitefish, 6 humpback whitefish, and 1 least cisco.

The lower 42 km of Highpower Creek were surveyed by boat to determine if suitable spawning conditions were available. An area approximately 24 km upstream had the right combination of gravel size, water depth, and current for sheefish spawning. In view of the low sheefish catch in the test nets upstream, it is probable that all sheefish spawning occurs in the lower 200 m of Highpower Creek.

Aerial surveys were conducted on September 29 but no fish could be observed because of the deep, turbid, and somewhat glacial water. All other upper Kuskokwim tributaries between the North Fork and Big River were aerial surveyed and the only other possible spawning ground would be located in the Middle Fork of the Kuskokwim about 85 km upstream of its confluence with Big River at 155°22'N Lat. 63°37'W Long., and 155°24'N Lat. 63°43'W Long. This water is somewhat glacial.

Observations to determine exact spawning locations began the evening of September 25 at the mouth of Highpower Creek and off gravel bars 1.4 km down McKinley Fork from Highpower Creek. No spawning occurred in McKinley Fork. Spawning in the lower 200 m of Highpower Creek began September 30. Water temperature was 3.0°C, depth was 1.3 - 2.7 m, and velocity was less than 5 km per hour. Highpower Creek is 50 m wide at this point (Figure 2). The bottom is composed of differentially sized gravel. Spawning never began before 5:15 PM, and the peak of activity occurred between 7:30 and 8:30 PM. By 10:45 PM, most spawning activity had ceased. Spawning reached a peak on the evening of October 3 when the water temperature was 1°C. Although the lower 1,200 m of Highpower Creek was monitored, no spawning was noted above the first 200 m.

Heavy slush ice in McKinley Fork and Highpower Creek terminated the study on October 4.

A large number of sheefish had probably not yet spawned and spawning would continue for two to three additional nights. Post-spawning downstream migrations are under the ice most of the way to the Lower Kuskokwim River. The fish are in the vicinity of Bethel by early November (Rae Baxter, personal communication).

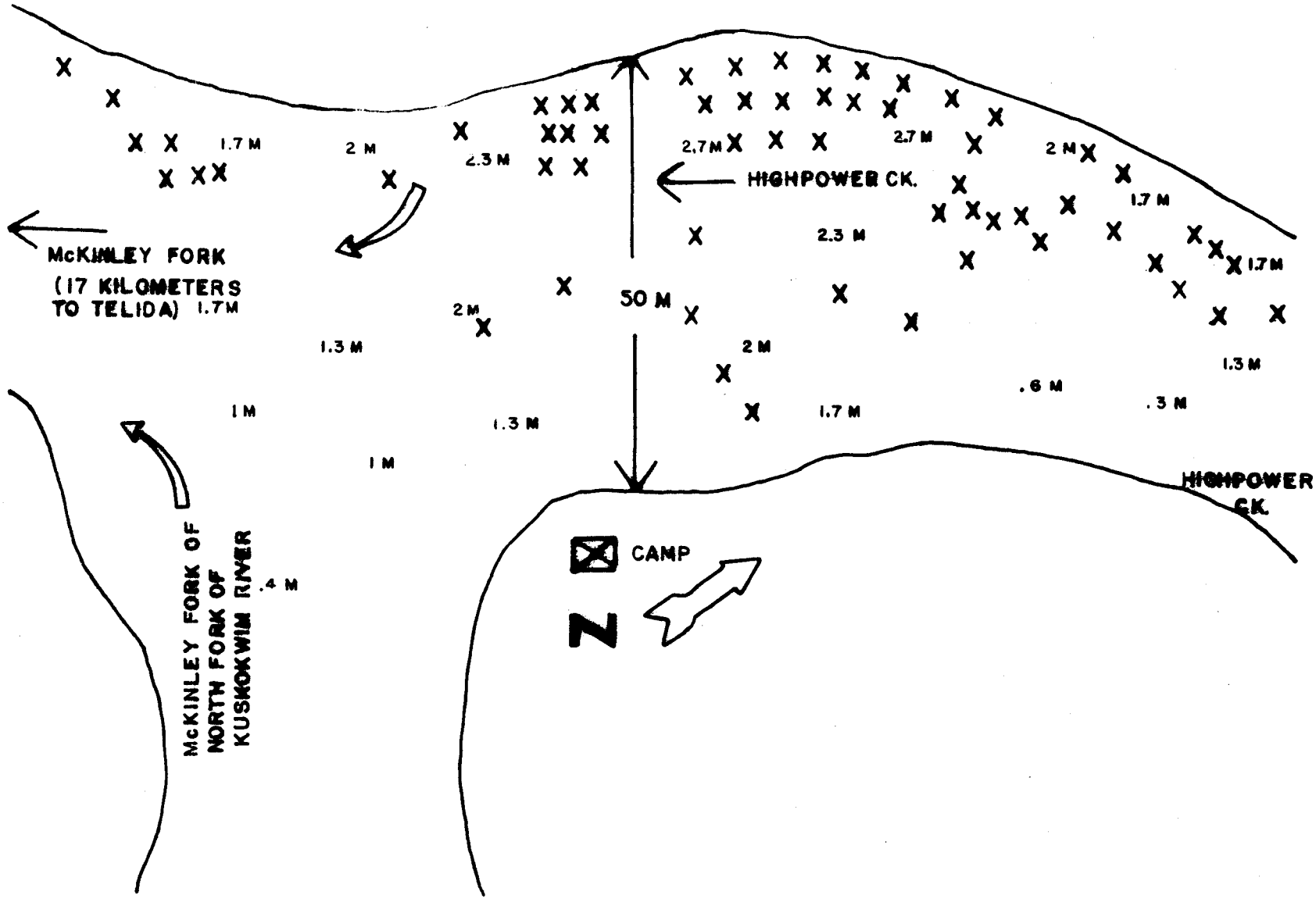

FIGURE 2 LOCATION OF SHEEFISH SPAWNING AREAS, MOUTH OF HIGHPOWER CREEK, 1971. Areas where fish spawned are indicated by an "X". Observations were not made during the entire spawning period. Water depths are given in meters

It appears that almost the entire Kuskokwim River sheefish population spawns in the lower 200 m of Highpower Creek. Highpower Creek spawning habitat is poor in comparison to that of the Kobuk and Koyukuk rivers. The water is turbid and slow moving. Moreover, all spawning probably occurs on one bar. Thus, any natural or man-made change in this small area could have serious effects on the Kuskokwim River sheefish population. Since the spawning population is apparently quite small, no commercial fishery should be allowed.

Aerial Surveys of Other Rivers

An aerial survey of the upper Kobuk River was flown on August 30 under ideal conditions. A total of 8,166 spawning sheefish were enumerated, 6,650 of these between Selby and Beaver River. This is the highest count since aerial survey began in 1967.

An aerial survey of the Selawik River between Ekiek Creek and Ingruksukuik Creek was also made on August 30. The river was very low and the number of possible spawning areas was small. A total of 1,105 sheefish were enumerated. Additional spawners were probably still coming upstream.

An aerial survey of the Alatna River was attempted but was unsuccessful because of high water.

Job R-II-C Movements, Age and Growth, and Population Dynamics of Sheefish in Upper Yukon River and Seward Peninsula-Norton Sound Streams.

Objectives

1. Determination of location, abundance, and run timing of sheefish in the Porcupine, Chandalar, and Ray rivers.

2. Determination of age and growth, food habits, and migratory patterns of sheefish in these rivers.

Yukon River Surveys

Yukon River tributaries between Rampart and Fort Yukon were surveyed June 10-23, 1971. Sheefish were taken in all streams surveyed except Minook Creek (Table 3). Water levels in all streams had dropped considerably since breakup, but were still higher than normal.

Porcupine River

Some sheefish caught would spawn in the current year. In August, 1970, most spawning sheefish were upstream, as none were taken at test net sites in the lower river. A yearling sheefish, 160 mm fork length, was received from a gill net at Old Crow, Yukon Territory. This reinforces the theory that Porcupine River sheefish spawn in the upper Porcupine River. In 1971, Canadian fisheries researchers found young sheefish upstream from Old Crow and took sheefish in spawning condition in August in the main Porcupine River near the mouth of Bell River (M. Elson personal communication). This is approximately 700 km upstream from Fort Yukon.

Young sheefish are year-round residents of the Porcupine River. Larger sheefish probably overwinter either in the Porcupine or in the main Yukon near the Porcupine.

Other Tributaries

One sheefish, a non-spawner, was taken at the mouth of Birch Creek. Sheefish have been taken in upper Birch Creek near the Steese Highway in the fall and probably spawn in this stream.

Age and Growth and Food Habits

Scales of 37 sheefish were collected from the Porcupine River in 1971. Age and growth data from these fish and the 33 collected in 1970 will be presented in a comprehensive age and growth study in 1973. Age and growth data from sheefish of other middle Yukon River tributaries will be reported later.

Date and Location	Net Nights*	Number Captured**											
		SF	RWF	BWF	HWF	LCi	BCi	GR	NP	S	Ch	BB	TR
June 10 and 16 Porcupine R. mouth	7	7	--	8	3	3	2	1	15	4	--	--	1
June 11 Black R. mouth (25-Mile Porcupine R.)	4	5	--	1	5	5	--	1	8	--	--	--	--
June 12-15 Ward Camp (90-Mile Porcupine R.)	19	25	--	10	28	5	--	--	--	32	--	--	1
June 17 Birch Creek	3	1	--	--	--	1	--	--	1	--	--	--	--
June 18 Hodzana River	5	1	--	1	4	40	--	--	7	--	--	--	--
June 19 Dall River	3	6	--	3	5	14	1	--	6	2	--	--	--
June 20 and 23 Ray River	7	21	--	1	28	35	16	--	7	9	2	2	--
June 21 Hess Creek	5	31	4	4	20	13	65	--	14	4	--	--	--
June 22 Minook Creek	2	--	--	--	--	--	10	--	--	--	--	--	--

*Nets used included two 125' experimental gill nets; one 80', 3"-; one 100', 2 1/2"-; and one 80', 2"-bar measure gill nets.

**SF - Sheefish
RWF - Round whitefish
BWF - Broad whitefish
HWF - Humpback whitefish
LCi - Least cisco
BCi - Bering cisco
GR - Grayling
NP - Northern pike
S - Sucker
Ch - Lake chub
BB - Burbot
TR - Trout perch (Percopsis omiscomycus)

Food habits data are also fragmentary at present and will be reported later.

Migrations

The presence of sheefish in the Porcupine River in early June indicates that these fish have not migrated up from the Yukon River mouth (as the Koyukuk River fish do) but rather are local year-round residents. A spawning migration probably occurs up the Porcupine River during the summer since no fish in spawning condition were found in the lower Porcupine in late August, 1970. Fourteen sheefish were tagged with spaghetti tags 160 km up the Porcupine in June, 1971.

Job R-II-D Sheefish/Salmon - Predator/Prey Relationship on the Kuskokwim River.

Objectives

1. Assess importance of salmon as a summer food item of sheefish in the Holitna River, Kuskokwim River drainage.

2. Determine food habits of Kuskokwim River sheefish over the period of an entire year, if feasible.

Summer Food Habits

Stomach contents of 129 Holitna River sheefish were examined (Table 4). Sheefish were taken at the mouth of the Holitna and 34 and 68 km upstream by gill net and hook and line. Chum, silver, and king salmon fingerling were the most important food items.

Salmon, 60-90 mm in length, in the sample consisted of both silver and king salmon. These species could be separated only by counting pyloric caeca and were combined in the analysis. The majority were probably age 1.0 king salmon.

The larger silver and king salmon fingerling were most prevelant in the sheefish diet in early summer while incidence of chum salmon fingerling was higher in late summer. This is because of differences in the timing of their seaward migrations.

Pacific lampreys, Lampetra japonica, were most important in the early summer diet and occurred more frequently in stomachs of sheefish caught at the mouth of the Holitna River. Results of the 1971 food habits study agree closely with limited data collected on the Holitna River during the summers of 1967, 1968, and 1969, in that salmon fingerling make up the major volume of the sheefish summer diet.

Young of northern pike, suckers, and coregonids (especially humpback whitefish) were very common in the Holitna during the summer, yet were little utilized by sheefish. This indicates a preference for salmon fingerling, as also indicated for upper Yukon River sheefish (Alt, 1965).

Fall and Winter Food Habits

Non-spawning and immature sheefish spending the summer and fall in the lakes and streams of the lower Kuskokwim drainage feed very little on salmon fingerling (Baxter, personal communication) but rather utilize ninespine stickleback, Pungitius pungitius, pike, and whitefish. Stomachs of four lower Kuskokwim sheefish, 61-78 cm in length, captured on October 20, 1971, contained 6 pike, 1 whitefish, and 338 stickleback.

TABLE 4 Stomach Contents of 129 Sheefish, Holitna River, June-August, 1971.

Food Organism	Stomachs in Which Organisms Occurred*								
	June			July - August			Combined		
	No. Organisms	No.	% Occurrence in Feeding Fish	No. Organisms	No.	% Occurrence in Feeding Fish	No. Organisms	No.	% Occurrence in Feeding Fish
Lamprey	54	14	48.0	6	3	5.6	60	17	20.7
Salmon:									
silver (95 - 115 mm)	215	19	65.0	4	3	5.6	219	22	26.8
silver & king (60 - 90 mm)	316	18	62.0	25	12	22.6	341	30	36.5
chum (35 - 50 mm)	48	3	10.0	257	33	62.2	305	36	43.9
unidentifiable remains	1	1	Trace	28	11	20.7	29	12	14.6
Coregonids	0	0	0.0	2	2	3.8	2	2	2.4
Northern pike	0	0	0.0	1	1	Trace	1	1	Trace
Suckers	0	0	0.0	2	1	Trace	2	1	Trace
Insects	1	1	Trace	2	2	3.8	3	3	3.6

*Three of 32 stomachs (9.4%) in June, and 44 of 97 (45.4%) in July-August were empty.

No winter sheefish stomach samples were collected on the lower Kuskokwim River in 1971 and 1972, but catches during past seasons indicated that the least cisco was the main food item (Baxter, personal communication).

Job R-II-F Sheefish and Whitefish Utilization.

Objectives

1. To determine angler use and harvest of Minto Flats and Holitna River sheefish.

2. To determine trends in the subsistence and commercial fisheries in the study areas.

Holitna River Creel Census

A creel census was conducted on the Holitna River during June, July, and August, 1971. A stratified, random sample of fisherman counts of the type used by Roguski and Winslow (1969) was used in estimating total angler hours (Table 5). Only completed trip interviews were used to estimate number of angler trips and catch figures. The main angling effort was expended at the mouth of the Holitna River, with lesser effort near the Fish and Game camp 34 km upstream. These two areas were checked during each census period. Some anglers in float planes may have fished 70 km up the Holitna River and left without being counted, but this number is believed to be small. Nearly all fishing is done in July. Few fishermen were noted on the Holitna River after the first week of August.

Sheefish began moving into the Holitna River in late May and were taken by gill net 34 km upstream and at the mouth by June 2. However, sheefish did not begin to take lures until the water level receded by mid-June. By early August, most sheefish had left the Holitna. Thus, the Holitna River is mainly an area where sheefish (mainly immatures and non-spawning adults) feed on salmon smolts.

The majority of sport fishermen were brought in by fishing guides from the Bristol Bay area. In most cases, they rented a boat at Sleetmute but some fished from the airplane floats. The remainder of the anglers flew their own small planes or were local residents. Most of the sheefish caught were returned to the water. In July, during the period of high success, approximately four fish were released for every one retained.

Sport-caught sheefish averaged 4 kg, but most fishermen retained only the larger fish or those injured. Only one trophy-size sheefish (over 30 pounds) was noted.

Selawik Subsistence Catch

The 1971 sheefish subsistence catch at Selawik Lake in April and May was 3,416. There were 27 families from Selawik fishing and 4 families from Noorvik and Kiana. Additional families from the lower Kobuk River villages may have fished but were not contacted.

ABLE 5 Results of Holitna River Creel Census, June to August, 1971.

Angler Hours

une	July	August	Total Estimated Hrs.
)	910	52	962

ishery Statistics

ɔ. angler trips	244
ean hours per angler trip	3.9
otal sheefish catch (retained by angler)	304
heefish retained per angler	1.2
heefish retained per hour	0.3
ize range of catch	2 - 37.5 lbs.

The 1971 sheefish subsistence catch from the Kobuk River was 9,485, ncluding the following: Noorvik, 5,975; Kiana, 1,060; Ambler, 711; hungnak, 671; Kobuk, 1,068.

The Kotzebue subsistence catch from Hotham Inlet in 1971 was 682 with) fishermen participating. This compares with a catch of 3,250 in 1970 rom 33 fishermen.

The commercial catch from Hotham Inlet was 456 fish (3,978 pounds).

Job R-II-G Distribution, Movements, Age and Growth, and Taxonomic Status of Whitefish (Coregonus sp.) in the Arctic-Yukon-Kuskokwim Area.

Objectives

1. To determine whitefish distribution in the Arctic-Yukon-Kuskokwim area.

2. To determine growth and age at sexual maturity.

3. To determine the taxonomic status of whitefish in the Arctic-Yukon-Kuskokwim drainage and the North Slope.

Tanana Drainage

A broad whitefish was captured in the Tanana River 14 km upstream from the mouth of the Chena River in September, 1971. This represents the farthest upstream penetration of this species documented in the Tanana drainage.

Only least cisco and humpback whitefish were taken by gill net in Nelson Clearwater Creek.

Round whitefish were the only species of whitefish captured with a shocker boat in the Delta Clearwater River in May and early October.

Middle Yukon River

In June, 1971, round, broad, and humpback whitefish, least cisco, and Bering cisco, C. laurettae, were taken in the majority of middle Yukon tributaries sampled (Table 3).

A large number of mature Bering cisco were migrating upstream into Hess Creek and Ray River on June 22 and 23. Whitefish distribution will be discussed in greater detail after all tributaries of the middle Yukon have been test netted in 1972.

Kuskokwim River

Round, humpback, and broad whitefish and least cisco were taken in the Holitna River during June and July, 1971. The greatest upstream movement was during early June.

The upstream spawning migration of Bering cisco in the South Fork of the Kuskokwim River had begun by July 22. None were taken in any other tributary sampled. Humpback and broad whitefish and least cisco were taken in Big River and the South and East forks of the Kuskokwim at this time.

Three net nights of fishing in the North Fork of the Kuskokwim 12 km
ıstream from its junction with McKinley Fork in early September resulted
ı the capture of humpback, broad, and round whitefish.

Test netting in Highpower Creek at the extreme limit of navigation in
e Kuskokwim River revealed the presence of spawning round, broad, and
mpback whitefish and least cisco.

Four whitefish species appear to be distributed throughout the Kusko-
im drainage. Bering cisco have a more limited distribution.

gavanirktok River - North Slope

Extensive test netting during the Arctic char, Salvelinus alpinus,
gging program indicates that round, broad, and humpback whitefish and
ast and Arctic cisco, C. autumnalis, are present in the Sagavanirktok
ver drainage. Round whitefish are abundant in the upstream areas.

e and Growth Studies

und Whitefish:

A sample of 210 round whitefish, 200 - 420 mm fork length, was
llected by shocker boat on May 17, 1971, in the lower Delta Clearwater
ver. The majority were 280 - 350 mm in length and ages V - VIII (Table 6).
fish of age classes I and II or over age X were captured. Both males and
males become sexually mature at ages VI and VII.

The data indicate Delta Clearwater round whitefish grow faster than
lville River specimens (Kogl, 1970).

BLE 6 Age-Length Relationship of 58 Round Whitefish, Delta Clearwater River, May, 1971.*

Age Class	n	Length (mm) Range	Mean
I	0	--	--
II	0	--	--
III	2	200 - 225	212
IV	5	225 - 260	242
V	12	260 - 305	283
VI	9	275 - 335	307
VII	8	320 - 355	339
VIII	8	330 - 370	354
IX	7	360 - 405	384
X	7	375 - 420	396

ample selected to represent each 10 mm length group nearly equally.

TABLE 7 Mean Back-Calculated Length of Minto Flats Broad Whitefish (Sexes Combined).

Age at Capture	n	Mean Fork Length (mm) at End of Each Year of Life										
		L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}
V	7	163	286	367	438	503						
VI	26	145	263	350	435	497	543					
VII	21	130	230	318	398	464	524	569				
VIII	18	134	224	293	351	418	474	525	577			
IX	4	115	201	268	327	381	429	484	531	584		
X	3	127	203	278	315	365	408	450	495	537	589	
XI	1	125	200	245	295	345	430	485	515	555	610	630
		Mean Length for All Age-Groups										
	80	138	242	323	396	460	508	530	560	564	594	630

road Whitefish:

A comparative age and growth study was carried out on five populations f broad whitefish including 80 fish from the Minto Flats, 53 from Imuruk asin on the Seward Peninsula, 32 from the Porcupine River, 73 from the uskokwim River, and 104 from the Sagavanirktok River. Fish were collected n 1970 and 1971.

Lengths of fish in all populations were back calculated from scale amples because few young fish were captured.

Minto Flats broad whitefish ranged in length from 40 - 64 cm and 0.9 - .1 kg in weight. Most were captured in the Tolovana River in the vicinity f New Minto village. No small broad whitefish were taken in the large esh gill nets used.

Fish ranged from age V - XI with 81% between ages VI and VIII Table 7). Minto Flats broad whitefish grow rapidly, often reaching 60 cm nd 3.6 kg by age VIII. The growing season begins in May soon after ice es out, and scale annuli are usually present by late May. Lee's phenomenon s apparent in Minto Flats broad whitefish. The reason is that apparently ower-growing fish live longer than the faster-growing fish.

Nearly all broad whitefish sampled in the Minto Flats were mature. males are apparently non-consecutive spawners as many large fish were und during the summer that contained tiny eggs (less than 0.5 mm) and sidual eggs of the previous year's spawning.

Imuruk Basin broad whitefish were 23.5 - 45.0 cm in length. They were ken in Imuruk Basin proper as well as the lower reaches of the three major vers flowing into the Basin: the Agiapuk, Kuzitrin, and Pilgrim rivers. st Imuruk Basin fish were ages V - VIII (Table 8).

Males generally matured between 32 and 38 cm and VI - VII years of age; males matured at 38 - 40 cm and at VII - VIII years of age.

The Sagavanirktok River broad whitefish were collected in the lower ver and the adjacent estuarine areas in the Beaufort Sea. They were ptured with large mesh gill nets used in the Arctic char study, so fish young age groups are poorly represented. Fish of age classes VII through made up 77% of the catch (Table 9). No broad whitefish over 50 cm were ken.

Data on sexual maturity are sparse but, in general, males mature at e VII - IX and females at age VIII - X.

Fish of age classes V - VII were most frequently captured in the rcupine River (Table 10).

In this limited sample, age at sexual maturity was males, age V (47 cm) d females, age V and VI (48 cm).

TABLE 8 Mean Back-Calculated Length of Imuruk Basin Broad Whitefish (Sexes Combined).

Age at Capture	n	Mean Fork Length (mm) at End of Each Year of Life							
		L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
III	1	130	190	230					
IV	1	114	195	251	286				
V	10	100	162	220	269	304			
VI	19	109	173	230	273	308	344		
VII	15	101	173	224	272	311	347	380	
VIII	7	107	186	234	281	319	356	395	428
		Mean Length for All Age-Groups							
	53	105	173	227	273	310	347	385	428

Age at Capture	n	Mean Fork Length (mm) at End of Each Year of Life												
		L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}	L_{12}	L_{13}
II	3	105	156											
III	3	109	152	199										
IV	--	--	--	--	--									
V	5	110	163	206	246	286								
VI	8	99	162	214	260	295	327							
VII	23	102	159	214	258	299	332	355						
VIII	20	106	157	216	259	301	335	361	391					
IX	21	115	168	223	276	331	352	378	399	423				
X	16	110	158	209	247	301	337	365	393	417	439			
XI	3	114	166	216	274	313	345	377	408	438	460	477		
XII	1	118	160	200	240	280	316	350	370	415	445	472	498	
XIII	1	128	160	190	218	248	295	335	358	395	417	440	460	480
		Mean Length for All Age-Groups												
	104	108	161	215	260	306	338	365	395	420	442	468	479	480

TABLE 10 Mean Back-Calculated Length of Porcupine River Broad Whitefish (Sexes Combined).

Age at Capture	n	Mean Fork Length (mm) at End of Each Year of Life							
		L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
IV	1	168	290	400	475				
V	10	134	282	372	429	476			
VI	10	139	250	349	420	469	512		
VII	10	130	237	320	383	431	476	520	
VIII	1	154	260	320	365	420	460	488	528
		Mean Length for All Age-Groups							
	32	136	258	349	411	457	492	517	528

These fish were taken in the Kuskokwim River near the mouth of the olitna River and in the lower 54 km of the Holitna. No broad whitefish ider 40 cm were taken even though a graduated mesh gill net was fished ntermittently throughout the summer. Age classes V - VII were the most ommonly represented (Table II). These fish ranged between 40 and 56 cm n length.

Examination of gonads indicated that males were mature at ages V and at lengths from 40 - 46 cm and females were mature at ages VI and VII at - 46 cm.

Broad whitefish taken on the spawning grounds in Highpower Creek 350 km up the Kuskokwim) in early October included a 36 cm age IV male nd a 44 cm age V female. Their growth rates are similar to that of Holitna ver fish, and tag recovery data indicate this is a migratory population th wintering grounds in the lower Kuskokwim River.

mparative Results:

Figure 3 compares growth of broad whitefish from five Alaskan populaons. Porcupine River fish are the fastest growing followed closely by olitna River and Minto Flats fish. Although the Porcupine River is above e Arctic Circle, growth of these fish indicates a growing season similar Interior Alaskan streams.

Growth of broad whitefish from lower Mackenzie River, Northwest rritory (Hatfield, et al., 1972) and Kolyma River, Siberia (Berg, 1948) is ntermediate between growth of Sagavanirktok and Porcupine River fish. The gavanirktok fish have growth rates similar to those of Coppermine River, rthwest Territory (Muth, 1969).

itefish Taxonomy

In 1971, taxonomic data were collected on Bering cisco from the Kuskoim and middle Yukon rivers; humpback whitefish from Highpower Creek, a skokwim tributary; the middle Yukon River and the Kobuk River.

ring Cisco:

Ciscoes collected in 1970 with a terminal mouth and immaculate ventral ns were designated as C. autumnalis, the Arctic cisco (Alt, 1970). Those llected at the Colville and Sagavanirktok rivers had total gill raker unts of 41 - 44. Those from the Seward Peninsula had total counts of 31 - while Porcupine River ciscoes had total counts of 33 - 37 (Alt, 1970). ll raker counts of Bering Sea drainage ciscoes collected in 1971 were milar to counts of the 1970 sample (Table 12).

Those ciscoes with a terminal mouth and immaculate ventral fins with - 25 gill rakers on the upper arch or total gill raker counts of 30 - 38

TABLE 11 Mean Back-Calculated Length of Holitna River Broad Whitefish (Sexes Combined).

Age at Capture	n	Mean Fork Length (mm) at End of Each Year of Life							
		L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
IV	5	114	225	314	396				
V	20	124	231	327	396	451			
VI	34	124	224	316	389	437	483		
VII	13	112	198	278	348	422	451	491	
VIII	1	128	198	270	344	428	484	545	570
		Mean Length for All Age-Groups							
	73	121	221	312	384	438	474	495	570

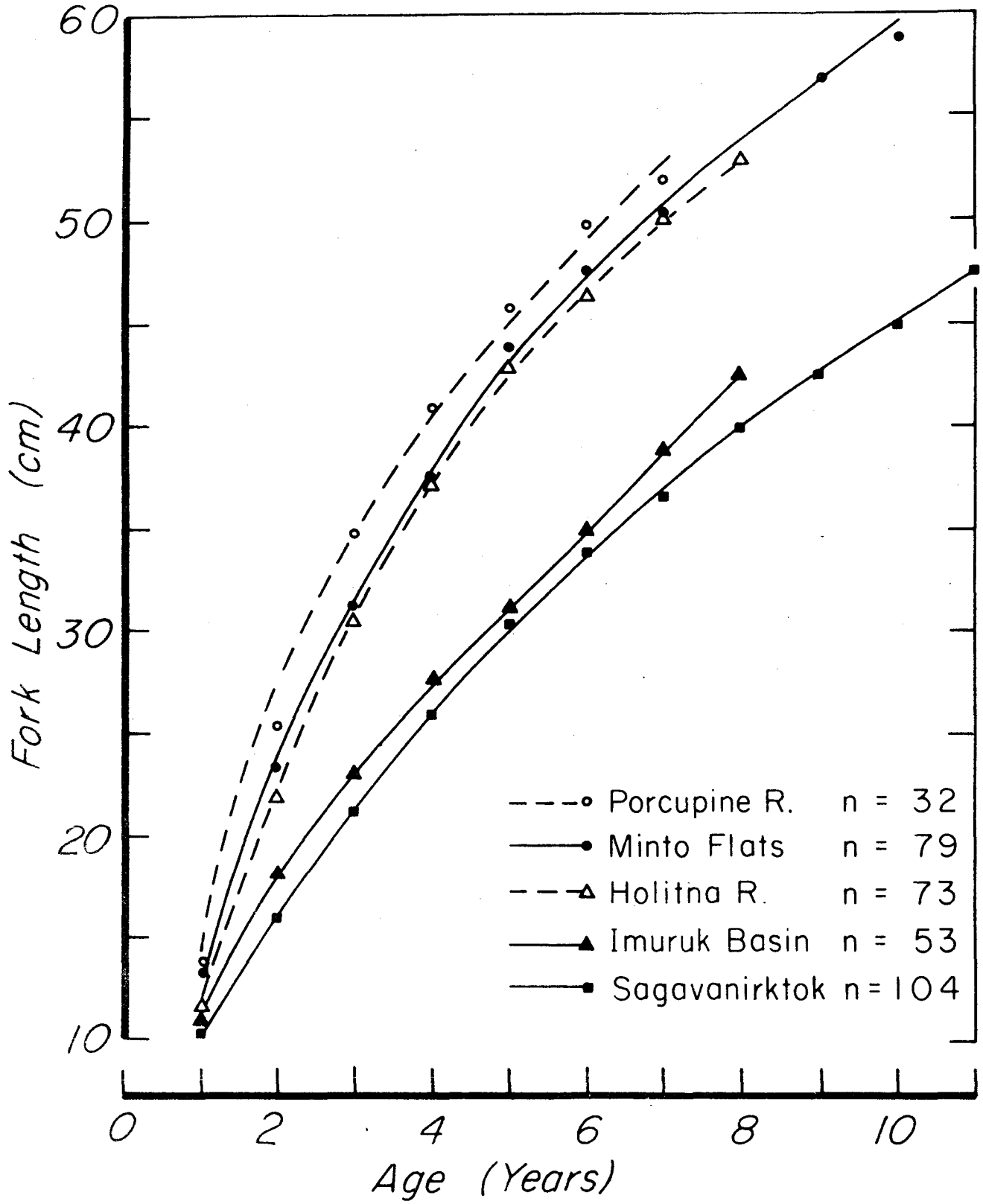

FIGURE 3 GROWTH OF ALASKAN BROAD WHITEFISH

should be designated as the Bering cisco, C. laurettae, as advocated by McPhail (1966) and McPhail and Lindsey (1970). The Bering cisco is distributed throughout the Bering and Chukchi Sea drainages and the Prince William Sound area.

TABLE 12 Gill Raker Counts of Bering Cisco From Two Alaskan Drainages, 1971.

		Gill Raker Counts			
		Upper Arch		Total Count	
Area	n	Range	Mean	Range	Mean
Middle Yukon River	24	20 - 24	21.2	33 - 37	34.2
South Fork of Kuskokwim River	9	20 - 22	21.4	33 - 37	34.7

Humpback Whitefish:

Gill raker counts of humpback whitefish collected during 1971 are presented in Table 13.

TABLE 13 Gill Raker Counts of Humpback Whitefish Collected in Various Alaskan Drainages, 1971.

Area	n	Range	$\bar{x}$	Modal Count
Highpower Creek (Upper Kuskokwim)	15	20 - 24	21.9	22
Dall River mouth (Middle Yukon)	5	23 - 25	24.2	24 and 25
Kobuk River	14	19 - 24	21.9	23

Generally speaking, humpback whitefish populations in more interior waters have higher modal and mean gill raker counts (Alt, 1970). The low count for Highpower Creek is an exception to this, or it is an anadromous population. The high counts for middle Yukon fish are similar to counts for humpback whitefish from the Chatanika River. The larger sample of fish from the Kobuk River in 1971 gives a lower mean gill raker count than the 1970 sample, although the modal counts would only be slightly higher.

Modal counts of humpback whitefish taken near the coast usually are 23 or fewer; e.g., Colville River - 22 (n = 15), Imuruk Basin - 23 (n = 11).

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