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FISHERY RESOURCES OF THE ATHABASCA RIVER
DOWNSTREAM OF FORT McMURRAY, ALBERTA

VOLUME III

by

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ABSTRACT

During 1977, the second year of a two-year study, the fish populations of the Athabasca River were investigated in two general areas downstream of Fort McMurray. Field work was carried out from mid-April to early November in the Mildred Lake study area and from mid-May to mid-October in the Delta study area. Fish were collected with gillnets, seines, and angling gear in order to identify the species present and their distribution and relative abundance during the open-water period, and to obtain samples for life history analysis. A conventional tagging program was undertaken to delineate migration patterns for the major fish species.

The 1977 study identified 24 fish species from the lower Athabasca River, 11 of which were common. All 24 species were present in samples from the Mildred Lake study area, while only 18 were captured in the Delta study area. A total of 27 species were identified from the Athabasca River during the two years of the study. Major upstream movements of walleye, goldeye, longnose sucker, and white sucker occurred in the Athabasca River during early spring. These runs were apparently initiated under ice-cover and reached the Mildred Lake study area before the ice had left the Athabasca River. The walleye and sucker runs were spawning migrations and the early spring upstream movements of these species were followed by a more gradual downstream dispersal that continued throughout the summer. The entire lower Athabasca River is important as a summer feeding area for immature goldeye which enter the study area prior to break-up and departed in late autumn. These goldeye are thought to belong to the population that spawns in the Peace-Athabasca Delta. Thus, the lower Athabasca River may play a major role in the maintenance of that population. A large upstream spawning migration of lake whitefish occurred during September and October. Some whitefish returned to Lake Athabasca shortly after spawning but others may have overwintered in the Athabasca River. Trout-perch, flathead chub, emerald shiner, and lake chub were the major forage fishes observed.

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Floy tags were applied to 6783 fish in 1977, bringing to 9311 the total number of fish tagged during the two years of the study. The overall recapture rate to date is 4.2%. Tag return evidence suggests that the walleye, goldeye, lake whitefish, longnose sucker, and white sucker observed in the lower Athabasca River came from Lake Athabasca and the Peace-Athabasca Delta.

The fry of many fish species appeared in the Athabasca River during June and July. Most of these fry did not remain in the study area but were carried downstream to nursery areas in the lower Athabasca River or Lake Athabasca.

1. INTRODUCTION

The present and proposed development of the Athabasca Oil Sands may introduce disturbance to some lake and river systems of the lower Athabasca River drainage. Local disruption in the form of land clearing, muskeg drainage and removal, stream diversions, and the construction of access routes may affect the water quality and quantity of streams in addition to the physical alterations produced. Other activities that could affect water quality include tailings pond seepages and saline minewater discharges. The diversion or blockage of streams may affect fish spawning runs. Critical fish rearing, feeding, and overwintering areas may be disturbed or lost altogether. In the case of migrant fish populations, e.g., from Lake Athabasca, such local disruptions could have far-reaching effects.

To provide information that could be used to minimize the adverse effects of development on the fish populations of the Athabasca River and its tributaries, the Alberta Oil Sands Environmental Research Program (AOSERP), through its Aquatic Fauna Technical Research Committee, initiated an integrated series of projects to assess the baseline state of the fish resources of the area. The work, which began in 1976, involved a broadly-based fisheries investigation of the Athabasca River as well as a site-intensive study of selected tributaries. Tributaries chosen for intensive study were those considered to be most immediately imperilled by future surface mining operations or by increased pressure from a growing human population. The study of the Athabasca River was to concentrate on the section of stream between Fort McMurray and Lake Athabasca.

This report presents the results of work done in 1977, the second year of a two-year study intended to evaluate and describe the baseline state of the fish resources of the Athabasca River downstream of Fort McMurray. Results of the 1976 study have been presented by Bond and Berry (in prep.).

Specific objectives of the study were as follows:

1. To ascertain the seasonal distribution and relative abundance of the major fish species of the Athabasca River downstream from Fort McMurray;

2. To identify the migration patterns throughout the open-water period for these major fish species through a conventional tagging program;
3. To document the timing of the downstream movements of fry in the Athabasca River;
4. To identify possible spawning areas in the Athabasca River and in tributary streams through the presence of ripe and/or spawned-out fish, as well as the presence of eggs and fry; and
5. To establish a data base with respect to the general biology of the major fish species that frequent the Athabasca River (i.e., age, growth, sex ratio, maturity, fecundity, food habits, etc.).

2. DESCRIPTION OF THE STUDY AREA

The Athabasca River arises in the Rocky Mountains and flows approximately 1440 km before entering the western end of Lake Athabasca where it contributes to one of North America's major wetlands, the Peace-Athabasca Delta. Approximately 450 km of the river's course lie within the AOSERP study area (Figure 1), 300 km being downstream of Fort McMurray. The total drainage area of the Athabasca River is 156 928 km², about 25% of the surface area of Alberta. Approximately 17% of this area (26 880 km²) is within the AOSERP study area. The long-term mean discharge of the Athabasca River at Fort McMurray is 645.7 m³/s with the respective minimum and maximum recorded flows being 96.6 m³/s and 4265 m³/s (Kellerhals et al. 1972). Records obtained from Water Survey of Canada (1978) show a mean daily discharge at Fort McMurray of 773.1 m³/s during 1977. Daily fluctuations occurring during the present study are shown in Figures 2 and 3.

Upstream of Fort McMurray, the Athabasca River descends sharply across resistant bedrock formations producing several series of rapids and a gradient of 1.0 m/km (Northwest Hydraulic Consultants Ltd. 1975). At Fort McMurray, the river loses its narrower, gorge-like character and is deflected northward by high bluffs of clay and oil sands overlying Devonian limestone. The stream gradient below Fort McMurray is reduced to about 0.1 m/km, the velocity is approximately 1.0 m/s, and the channel pattern is straight to sinuous. Near the delta, an irregular meander pattern exists, the gradient decreases further, and the banks diminish to the level of the delta.

The width and depth of the Athabasca River vary throughout the year with fluctuations in discharge. The approximate range in width is from 300 to 600 m with a narrower main channel in the lower part of the delta. Upstream of the delta, the river has an estimated depth of 3 m with areas over 9 m deep being common. In the delta, the main channel appears to be much deeper in both average and maximum depth. The Athabasca River remains highly turbid throughout the summer and achieves maximum temperatures of about 23°C. The

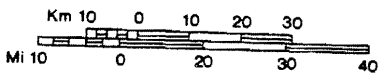
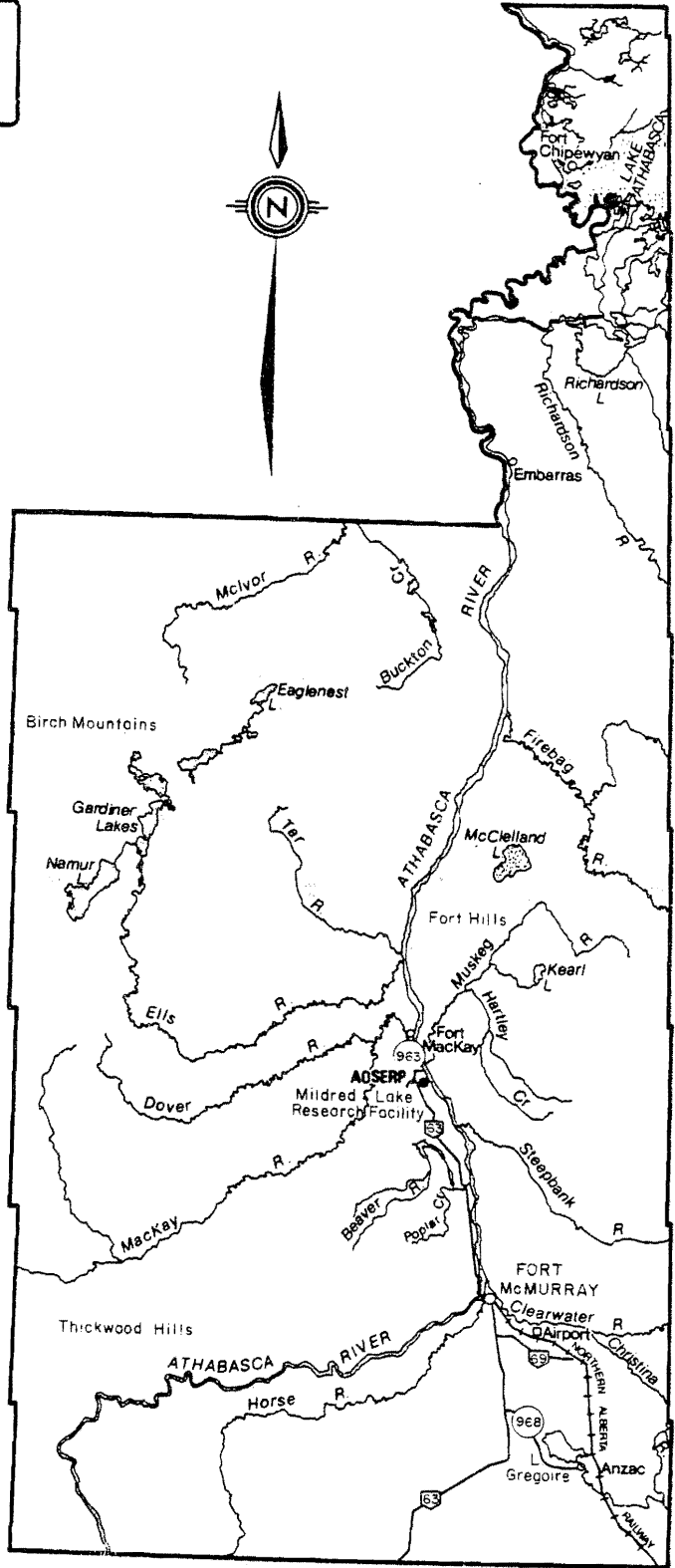


Figure 1. The AOSERP study area.

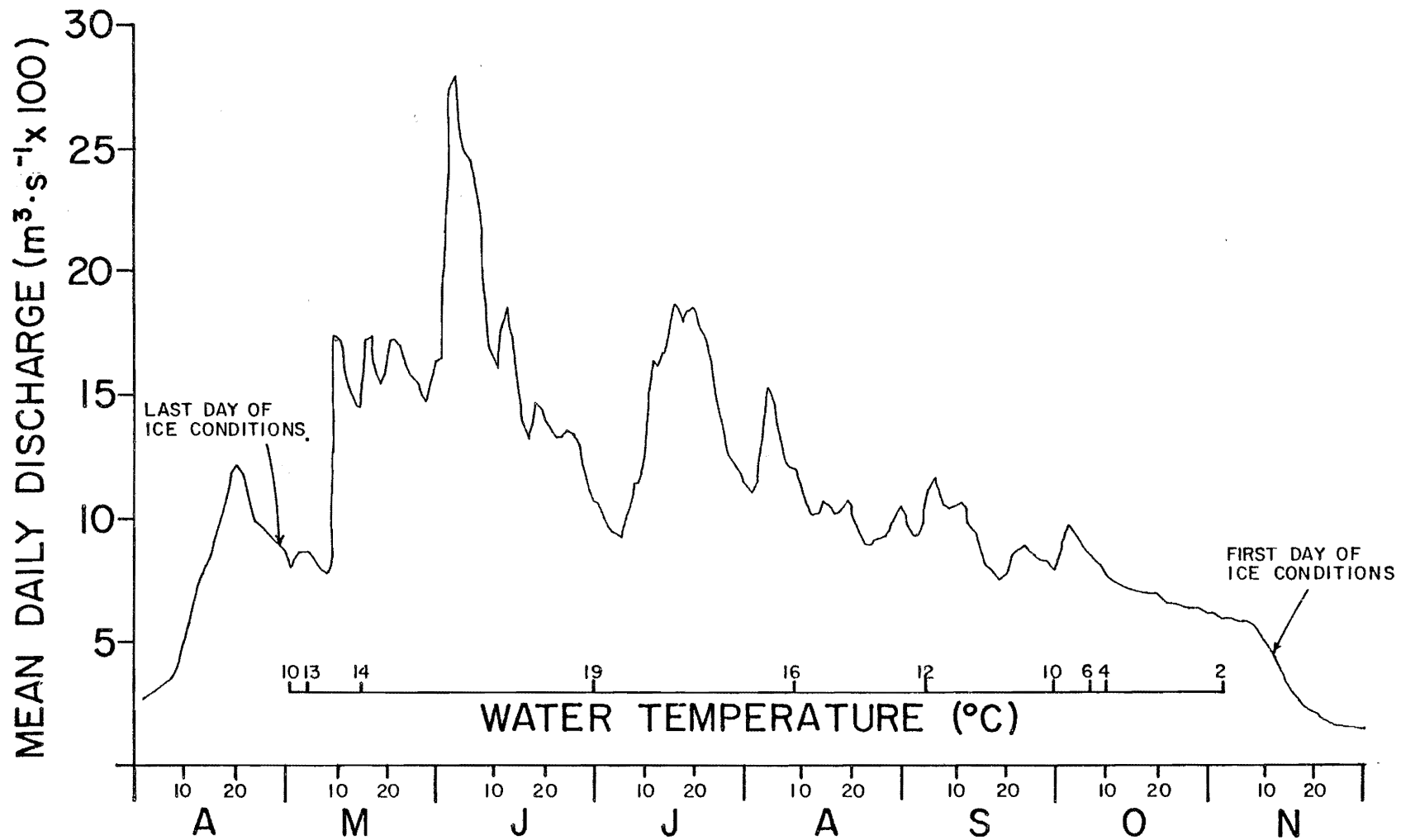


Figure 2. Discharge and miscellaneous water temperatures from the Athabasca River at Fort McMurray, 1 April to 30 November 1977.

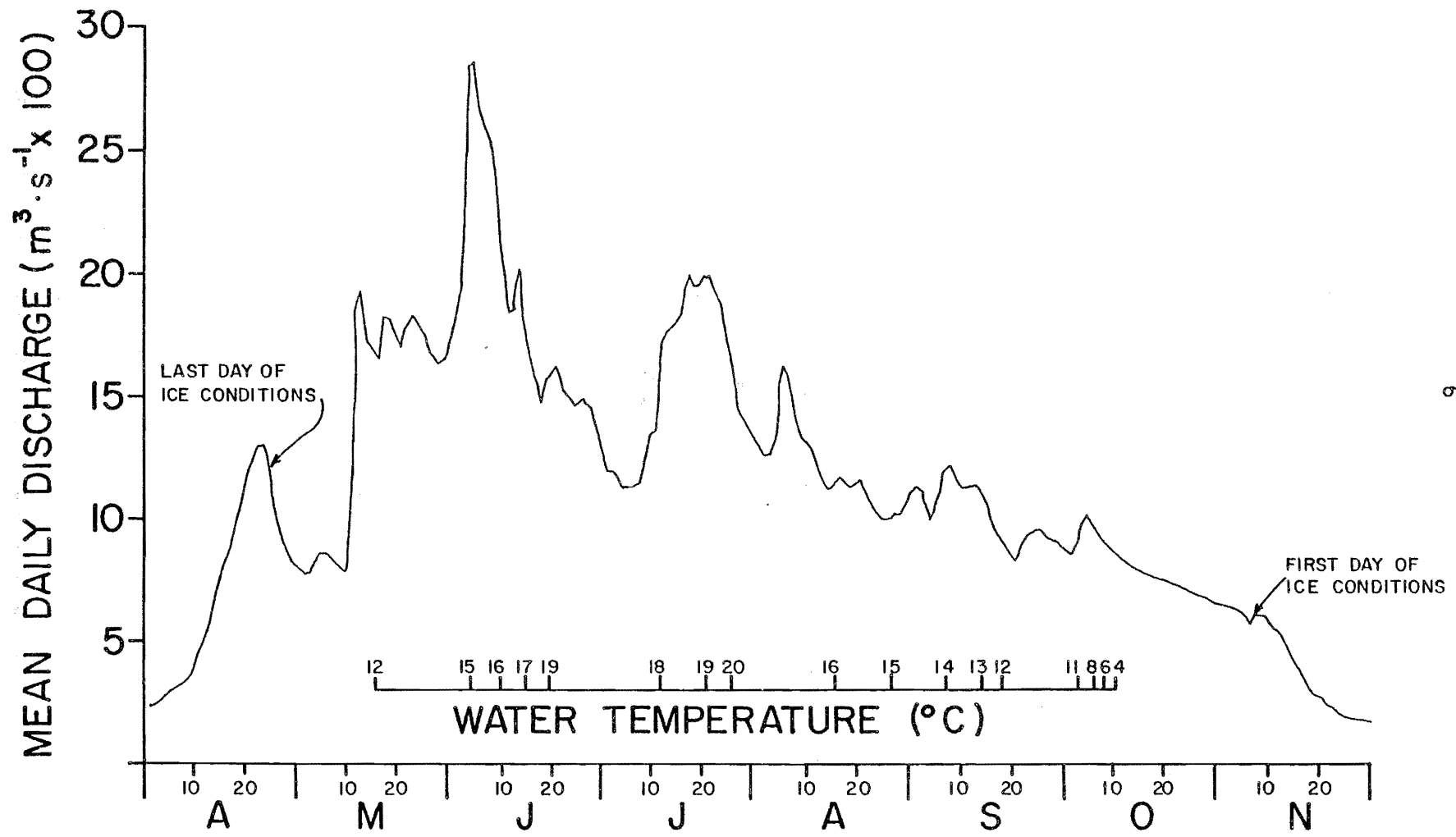


Figure 3. Discharge and miscellaneous water temperatures from the Athabasca River at Embarras, 1 April to 30 November 1977.

respective mean dates of freeze-up and break-up at Fort McMurray are 5 November and 7 May (Kellerhals et al. 1972).

The portion of the Athabasca River studied in 1977 consisted of two reaches, each approximately 80 km in length. The upper reach extended from the confluence of Poplar Creek to the lower end of Sled Island (km 27.2 to 110.1)(Figure 4). This area, referred to as the Mildred Lake study area, included most of the 1976 study area (Bond and Berry in prep.). The lower reach extended from Embarras to the confluence of Jackfish Creek (km 190.4 to 272.0)(Figure 4) and was referred to as the Delta study area. The two study areas were separated by approximately 80 km of river that were not sampled during 1977.

The Mildred Lake study area has a gravel to cobble substrate along most of its length with sloping shorelines of sand, silt, and occasional areas of gravel. The river is occasionally deflected by cliffs of clay, limestone, and oil sands which create eddies that are ideal sampling sites. Side and flood channels are limited but a few side sloughs are associated with the main river. Several major tributaries, all low-gradient, brown-water streams, enter the Athabasca River in this area (Figure 4). Below Fort McKay (Figure 4), islands become larger and more numerous with vertical banks of moderately stable sand and silt. These islands are heavily vegetated with willow (*Salix* sp.), poplar (*Populus balsamifera* and *P. tremuloides*), and some spruce (*Picea mariana*). The dominant river bank vegetation consists of poplar, spruce, willow, birch (*Betula papyrifera*), and dogwood (*Cornus stolonifera*). There is a downstream increase in the number of side bars, point bars, and dunes with frequent mid-channel sand bars being exposed at low water. Once in the delta, the number of islands and bars decreases as distributaries exit from the main channel.

The Delta study area was located at the head of the delta and may be considered an area of transition between the river above and the delta below. At two sites, Embarras and Embarras Portage (Figure 4), the river contacts high and easily eroded sand banks. In other areas, the river banks are low, composed of fluvial silts and

sands, and vegetated with willow and poplar. Below Embarras Portage, the river turns sharply eastward and flows in that direction until its gradual shift northward below Jackfish Creek (Figure 4). The Delta study area contains several tortuous meander bends with large, turbulent eddies. Many flood and back channels exist along this stretch of river, often with connections to side slough areas. The Richardson River (Figure 4) is the only tributary to enter the Athabasca River in the Delta study area. Channels from Dagmar, Limon, and Blanche Lake complexes enter the lower end of the Richardson River. Jackfish Creek, at the lower end of the Delta study area, drains Richardson Lake and the Maybelle River. Most of these shallow lakes experience frequent reversing water flows that are dependent on the prevailing water levels in the delta and on the levels of discharge in the Athabasca River. Exiting from the main channel of this study area are the first two distributaries of the delta, the Embarras River and the Fletcher channel (Figure 4).

MILDRED LAKE STUDY AREA
(km 27.2 to km 110.4)

DELTA STUDY AREA
(km 190.4 to km 272.0)

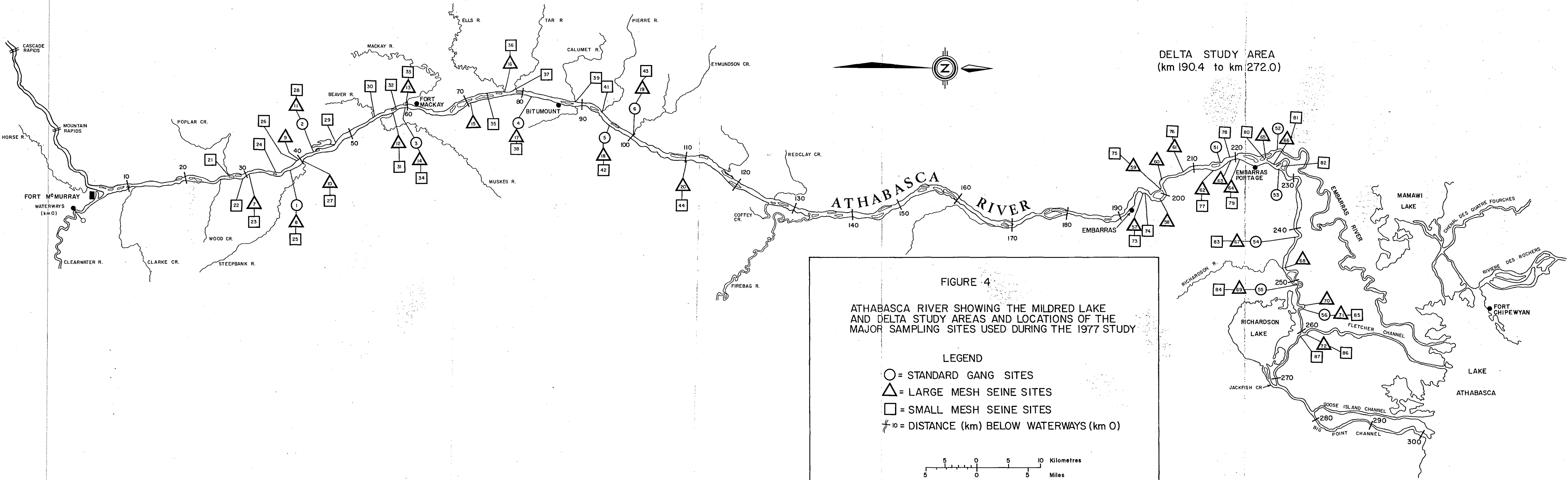
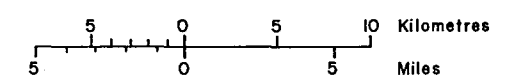


FIGURE 4

ATHABASCA RIVER SHOWING THE MILDRED LAKE AND DELTA STUDY AREAS AND LOCATIONS OF THE MAJOR SAMPLING SITES USED DURING THE 1977 STUDY

LEGEND

- = STANDARD GANG SITES
- △ = LARGE MESH SEINE SITES
- = SMALL MESH SEINE SITES
- 10 = DISTANCE (km) BELOW WATERWAYS (km 0)



3. MATERIALS AND METHODS

3.1 GENERAL

The fish populations of the Athabasca River were sampled in two general areas in 1977 (Figure 4). The Mildred Lake study area was sampled from mid-April to early November, while the Delta study area was sampled from mid-May to mid-October. Fish collection methods included gill netting, seining with large and small mesh seines, and angling. A series of sampling stations was established within each study area and each site was precisely described according to its distance (± 0.1 km) below Waterways (km 0.0) and whether it was on the left or right bank (looking downstream) by reference to Canadian Hydrographic Service chart #6301, Athabasca and Slave Rivers, 1973. Some sites had to be abandoned during the summer as water conditions varied, but other sites persisted. The major sampling sites utilized during 1977 are indicated in Figure 4 and described in Appendix 6.1.

3.2 FIELD TECHNIQUES

3.2.1 Gill Nets

Six gill netting stations were established in each study area (Figure 4, Appendix 6.1). One to six of these sites were sampled in each study area in each two-week period (cycle) during the study using a standard gill net gang. The duration of each set varied from 13.5 to 20.0 h but always included the night time period. The standard gang utilized in 1977 differed from that used in 1976 (Bond and Berry in prep.). The 1977 gang was 18.0 m long by 2.4 m deep and consisted of equal lengths of 3.8, 5.1, 6.4, 7.6, 8.9, and 10.2 cm braided nylon mesh (stretch mesh). Gangs were set on the bottom with the 3.8 cm mesh closest to shore and as perpendicular to the shoreline as possible.

Fish captured in standard gangs were separated according to mesh size and all were subjected to complete biological analysis. Fork length (± 1.0 mm) and body weight (± 10 g) were recorded and either scales or pectoral fins (suckers) were retained for age

determination. In the case of burbot, total length was recorded and otoliths were retained for ageing. Sex and maturity state were determined by gonadal examination. A fish was considered to be mature if it appeared that it would spawn or had already spawned in the year of capture. A ripe fish was a mature fish whose gonads were close to spawning condition and from which sexual products could be expressed by application of light pressure to the abdomen. A spent or spawned-out fish was a mature fish that had obviously spawned shortly prior to its capture. Stomachs were removed from a number of fish of each species and preserved in 10% formalin for evaluation of food habits. Ovaries were removed from several mature females of each species and preserved in Gilson's fluid for fecundity estimation.

Gill nets (tagging nets) were also used on occasion to capture fish for tagging. This practice was employed mainly in the Delta study area where the bag of the large mesh seine tended to fill with silt, making seining difficult. Tagging nets included nets of various mesh sizes and lengths which were usually set for periods of from one to three hours.

3.2.2 Large Mesh Beach Seines

Fourteen sites in the Mildred Lake study area and 16 sites in the Delta study area were sampled regularly in 1977 using large mesh beach seines (Figure 4, Appendix 6.1). The number of seine hauls made within a sampling period ranged from five to 139 although five to 18 hauls were made in most cycles. More hauls were made during migration peaks (spring and fall) in order to acquire fish for tagging. Seine hauls made within a sampling period were always scattered along the entire study area. The seines used were constructed of knotted #9 nylon twine of 3.8 cm stretch mesh, and were 33 m long by 1.8 m deep with a 1.8 x 1.8 x 1.8 m bag. These seines were identical to those used during the 1976 study (Bond and Berry in prep.). Most fish captured in large mesh beach seines were tagged and released. Those too small to tag (< 15 cm) were either subjected to complete biological analysis or identified to species, counted, and released unharmed.

3.2.3 Small Mesh Beach Seines

Small mesh beach seines were utilized to sample forage fish populations and to capture small (young) specimens of larger fish species. Twenty-four sites in the Mildred Lake study area and 25 sites in the Delta study area were sampled regularly with this gear (Figure 4, Appendix 6.1). The seines employed were 1.2 m deep and constructed of 6.3 mm delta nylon mesh. In most cases, the seines used were 9.1 m long; however, in some restricted areas, such as the mouths of small tributaries, 3.0 m lengths were used. When the number of fish taken in a small mesh seine haul was small, the entire catch was usually retained for identification and analysis. When the catch was large, however, a representative subsample was retained and the remainder of the fish were returned to the water after their numbers were estimated. Large fish (> 15 cm) captured in small mesh seines were tagged and released. Small fish were preserved initially in 10% formalin and later transferred to 40% isopropyl alcohol.

3.2.4 Tagging

Fish to be tagged were removed from the gear and held in tubs for a short time (5 to 10 min) to allow them to quiet down. Each fish was measured (± 1.0 mm) and weighed (± 10 g) and scales were taken for ageing. The tags used were numbered Floy anchor tags (Type FD-68B) which were inserted near the base of the dorsal fin. Tags and guns were held in a 10% Dettol solution and rinsed in fresh water prior to insertion to minimize infection. No anaesthetic was used.

The tagging program was well publicized by posters and press releases and a two dollar reward was offered for returned tags. Tag returns were made by sport fishermen along the Athabasca River, by domestic fishermen on the Athabasca River and Lake Athabasca, and by commercial fishermen on Lake Athabasca. Personnel of LGL Ltd., Environmental Research Associates, Edmonton, and Aquatic Environments Ltd., Calgary, also returned tags.

3.2.5 Sexual Dimorphism

In most cases, sex was not recorded for fish whose gonads were not examined by dissection. However, in some cases, sexual dimorphism provided an opportunity to determine the sex of a fish without dissection. During the spring spawning runs, it was possible to identify male longnose and white suckers by the presence of nuptial tubercles, epidermal structures that form prior to spawning and are lost shortly after. Most suckers without tubercles are believed to have been females but this was not assumed and many suckers were recorded as unsexable on the basis of external characteristics.

In the case of goldeye, the sexes were distinguishable throughout the summer by virtue of a distinct lobe on the male anal fin that is formed by an elongation of the anterior fin rays. Battle and Sprules (1960) noted that this feature occurred only in mature males or in males approaching their first spawning period. To test the method, goldeye taken from standard gangs in 1977 were sexed by means of the anal fin prior to gonadal examination and a high level of agreement (90%) was found between the two methods.

Sex determinations based upon external features were not utilized in analyzing the age and growth features of these species.

3.2.6 Habitat Preference Analysis

The habitat preference analysis performed in 1976 (Bond and Berry in prep.) was not done in 1977.

3.3 LABORATORY TECHNIQUES

3.3.1 Fish Identification

Seine catches were identified using taxonomic keys and descriptions given by Paetz and Nelson (1970) and Scott and Crossman (1973). While most fish could be identified to species, some larval forms (suckers) could be identified only to genus.

3.3.2 Age Determination

Ages for longnose and white suckers were determined from cross-sections of pectoral fin rays using the method described by Beamish and Harvey (1969) and Beamish (1973). After embedding in epoxy, thin sections (0.5 to 1.0 mm) were cut using a jeweller's saw with #6 or #7 blades. The sections were then mounted in Permount on glass slides and read under a dissecting microscope.

Scales, removed from the appropriate location on the fish, as described by Hatfield et al. (1972), were used in determining ages for goldeye, walleye, lake whitefish, flathead chub, Arctic grayling, mountain whitefish, and northern pike. Several scales from each fish were cleaned and mounted between acetate slides and the age determined by counting annuli (growth rings) on the image produced by an Eberback #2700 microprojector.

Age determinations for all other fish species included in this report were done by observing growth patterns on otoliths (ear bones). When necessary, the otolith was ground on a glass surface using carborundum powder. The otolith was then cleared in a 3:1 mixture of benzyl benzoate and methyl salicylate and read under a dissecting microscope using reflected light against a black background.

Age determinations presented are the consensus of two readers. Where discrepancies existed between the results obtained by them a third opinion was obtained. The age assigned was equal to the number of completed annuli with the exception that fish taken in the spring were considered to have completed their year's growth and were credited with an additional annulus whether it had formed yet or not.

3.3.3 Food Habits

Food habits of only the smaller fish species were assessed in 1977. Food items found in the stomach contents were identified to order whenever possible and the results of the analysis were expressed in terms of percentage frequency of occurrence.

3.3.4 Length and Weight of Small Fish

Small fish that had been captured in seine hauls and preserved in formalin were measured to the nearest 1.0 mm and weighed either to the nearest 0.1 g on an analytical balance or to the nearest 0.01 g on a torsion balance. Some larval and fry samples (e.g., suckers) that contained many fish of similar size were bulk weighed after removing excess fluid. The fish in the sample were then counted and a mean individual weight was assigned to the sample.

3.3.5 Fecundity

Fecundity for walleye, lake whitefish, northern pike, flathead chub, white sucker, and longnose sucker was estimated gravimetrically using the method described by Healey and Nichol (1975). For small fish species, fecundity was assessed by direct egg counts.

3.3.6 Data Analysis

In most cases, data collected from the two sampling areas have been analyzed and presented separately. The relative abundance of the various fish species was expressed in terms of absolute numbers, percentage composition, percentage frequency of occurrence, and catch-per-unit-effort. Catch-per-unit-effort was expressed as the number of fish per gang per hour for standard gangs and as the number of fish per haul for large and small mesh beach seines. Catch data for large and small mesh seines were summarized for each two-week sampling cycle. Standard gang data were also assessed for each mesh size (Appendix 6.2) and each sampling site (Appendix 6.3).

Biological data for each fish species were analyzed on an IBM computer terminal with statistical programs in VS Basic TS0. Length-weight least squares regression analyses with log base 10 transformation and length as the independent variable were described by the equation:

$$\log_{10}W = a + b (\log_{10}L): sb =$$

where: W = weight (g)

 L = fork length (mm)

a = y-intercept

b = slope of the regression line

sb = standard deviation of b

Data summaries, computer printouts, and raw data are on file at the AOSERP office, 9820 - 106 Street, Edmonton, Alberta, T5K 2J6.

3.4 LIMITATIONS OF METHODS

3.4.1 Fish Collection

The problems associated with sampling the fish populations of large rivers are well known and relate to conditions of current, fluctuating water levels, and water-borne debris. These conditions severely limit the choice of sampling sites as well as the efficiency of the gear employed.

Essentially, sampling sites used in this study were confined to areas in which the current was reduced to such a level as to permit the use of the gear. These, inevitably, were limited to inshore areas and catches made in such areas may not be truly representative of the overall situation.

In order to sample as great a variety of habitats as possible and to collect the greatest variety of fish, both in terms of size of individuals and number of species, it was necessary to employ a variety of collection methods, each of which has certain limitations. We believe, however, that the combination of gillnets, large mesh seines, and small mesh seines has produced reasonably good coverage of all species and all life history stages.

3.4.1.1 Standard gill net gangs. Gill nets are known to be highly selective for size of fish. Essentially, each mesh size tends to capture fish of a particular size range. This range varies with species and depends not only on the size of fish but on whether it is of a species that tends to be captured by wedging itself in a mesh (e.g., lake whitefish, flathead chub) or by entangling itself by teeth or spines (e.g., pike, walleye, goldeye). Fish captured

by entangling usually demonstrate a wider size range in a particular mesh size.

Because of the limited size range over which a gill net of a given mesh size is effective, fish populations are best sampled by employing gangs of gill nets of varying mesh sizes whose selectivity curves overlap broadly. The standard gangs used in 1977 consisted of six mesh sizes and the catches produced are thought to be representative of the larger fish species. Similar gangs were considered effective for collecting most northern fish species by Rawson (1951) and Hatfield et al. (1972). This gang is believed to have eliminated much of the bias inherent in the standard gang of only three mesh sizes that was employed in 1976 (Bond and Berry in prep.).

A feature of the 1976 standard gang that contributed to its inefficiency was its length (27.3 m). Since many of the sampling sites were not large enough to accommodate this entire gang, the offshore end often protruded into the main current where it became fouled with debris more quickly than the portion in the eddy. The shorter 1977 gang is thought to have performed better in this regard. Gill net efficiency is thought to have varied considerably with changes in river conditions. Generally, efficiency decreased during floods when debris tended to clog or damage the nets. Because such effects were not constant from site to site or throughout the summer, comparisons between sites are often meaningless. Because standard gangs were fished on the bottom, they may have tended to select for bottom dwellers (e.g., walleye) and to underestimate those that swim in mid-water or near the surface (e.g., goldeye).

3.4.1.2 Large mesh beach seines. These seines were found to be an extremely useful method of capturing fish for tagging. Using this gear, large numbers of fish could often be taken in a short period of time with minimal physical damage. They were effective for the same species and size of fish as were captured in standard gangs and retained all fish greater than about 200 mm fork length. Large mesh seines were effective under most river conditions; however, in the Delta study area, silt often clogged the bag, making seining difficult

and reducing the efficiency of the operation. Large mesh seines complemented the standard gangs to a certain extent. Whereas the gill nets were fished only on the bottom, large mesh seines fished only the upper metre of the deeper eddies. No standard length or time of haul was employed for large mesh seines and the area seined by each haul did tend to vary somewhat as a result of differences in current or the presence of snags. Overall, however, hauls made with this gear possessed a high degree of uniformity.

3.4.1.3 Small mesh beach seines. These seines were effective for capturing small fish under a wide variety of conditions. They were difficult to use, however, in strong current, in deep water, or where rocks or logs interfered with the haul. Because of mesh limitations, these seines could not sample adequately the early life stages of most species. Few fish less than 20 mm in length were captured. Small mesh seine hauls were not standardized but, in fact, varied considerably in duration depending on the site. Thus, catch-per-unit-effort comparisons between sites may be meaningless. The average catch-per-unit-effort values produced in each sampling cycle, however, are believed to be fairly comparable and to provide a reasonable estimate of the relative abundance of the small fishes.

3.4.2 Age Determination and Growth Analysis

Scales are often used in determining the age of fish because these structures are easily acquired. The method assumes that the fish lays down one annulus on its scales per year and that such annuli can be identified. Such assumptions may not always be justified, however, especially in northern populations where the fish grow slowly and live for long periods of time. Beamish and Harvey (1969) demonstrated that age determinations by the scale method for white suckers in George Lake, Ontario, were unreliable beyond the age of five years and recommended the use of pectoral fin rays. Craig and Poulin (1975) found that scales tended to underestimate the ages of older Arctic grayling in Alaska and recommended the use of otoliths for this species.

With the exception of suckers (fin rays) and burbot (otoliths), the larger fish in the present study were aged by the scale method. While this method may have underestimated the age of some of the older fish, scale ages appeared to be satisfactory for plotting reliable growth curves.

Growth curves were plotted using fish captured throughout the summer, a practice that tends to raise the mean length and weight of fish in a given age group and produce broad overlaps in the ranges for lengths and weights between age groups. Ideally, such comparisons should be made only between fish captured over a short period of time.

3.4.3 Tagging

The recapture of tagged fish can provide useful information concerning the extent and timing of fish movements. A degree of caution must usually be exercised, however, in the interpretation of the results. In the first place, one can never be absolutely certain that the movement exhibited by an individual fish is representative of all fish in the population. Secondly, since no tags will be recovered from areas where no fishing effort occurs, it can be argued that recaptures serve merely to identify fishing areas. As well, low recovery rates sometimes make it impossible to form firm conclusions as to general movement trends.

3.4.4 Winter Conditions

No winter sampling was conducted during the present study. As a result, no direct evidence has been acquired as to the existence or location of overwintering areas in the AOSERP study area.

4. RESULTS AND DISCUSSION

4.1 GENERAL

Sampling of the Athabasca River from mid-April to early November 1977 produced 24 fish species representing 10 families (Table 1). Two species, Dolly Varden and northern redbelly dace, represent additions to the 1976 species list bringing the total number of species taken during the two years to 27. Three species taken in 1976, brassy minnow, pearl dace, and Iowa darter, were not found in 1977 (Table 1). The Mildred Lake study area (24 species) exhibited a greater species diversity than did the Delta study area (18 species). Eleven species were common in the samples (>1.0% of the total catch), while 13 species were uncommon or found rarely (Table 2).

The total 1977 catch for the two study areas combined was 35 308 fish (Table 2). Suckers (longnose and white suckers were combined because of the difficulty in distinguishing between fry of the two species) accounted for 43.8% of the total catch in the Mildred Lake study area (Table 3). Trout-perch (17.1%) was the second most abundant species in this area, followed by lake whitefish (9.3%), goldeye (9.1%), walleye (4.5%), emerald shiner (3.9%), lake chub (3.3%), flathead chub (3.2%), and northern pike (2.6%). In the Delta study area (Table 4), emerald shiner was the most abundant species accounting for 63.2% of the total catch. Trout-perch (8.1%) was second in abundance, followed by goldeye (6.0%), suckers (5.1%), flathead chub (4.9%), lake whitefish (4.4%), spottail shiner (3.2%), northern pike (2.6%), and walleye (1.9%).

The relative abundance of the various species varied according to the capture method and time of year. For a given gear type, most changes in relative abundance are related to migrations of adults, juveniles, and fry into and out of the study area. Fluctuating water levels and gear efficiency are also responsible for some of the variation in the results but such effects could not be quantified.

Table 1. Scientific and common names of fish species captured in the Mildred Lake and Delta study areas, Athabasca River, 1977.

| Family and Generic Names | Common Names | Where Captured | |
|--|------------------------|-------------------|------------|
| | | Mildred Lake Area | Delta Area |
| Family Salmonidae | | | |
| <i>Coregonus clupeaformis</i> (Mitchill) | Lake whitefish | + | + |
| <i>Prosopium williamsoni</i> (Girard) | Mountain whitefish | + | + |
| <i>Thymallus arcticus</i> (Pallas) | Arctic grayling | + | |
| <i>Salvelinus malma</i> (Walbaum) | Dolly Varden | + | |
| Family Hiodontidae | | | |
| <i>Hiodon Alosoides</i> (Rafinesque) | Goldeye | + | + |
| Family Esocidae | | | |
| <i>Esox lucius</i> Linnaeus | Northern pike | + | + |
| Family Cyprinidae | | | |
| <i>Chrosomus eos</i> Cope | Northern redbelly dace | + | |
| <i>Chrosomus neogaeus</i> (Cope) | Finescale dace | + | |
| <i>Couesius plumbeus</i> (Agassiz) | Lake chub | + | + |
| <i>Hybognathus hankinsoni</i> Hubbs | Brassy minnow | +a | |
| <i>Notropis atherinoides</i> Rafinesque | Emerald shiner | + | + |
| <i>Notropis hudsonius</i> (Clinton) | Spottail shiner | + | + |
| <i>Pimephales promelas</i> Rafinesque | Fathead minnow | + | |
| <i>Platygobio gracilis</i> (Richardson) | Flathead chub | + | + |
| <i>Rhinichthys cataractae</i> (Valenciennes) | Longnose dace | + | + |
| <i>Semotilus margarita</i> (Cope) | Pearl dace | +a | |

continued ...

Table 1. Concluded.

| Family and Generic Names | Common Names | Where Captured | |
|---|-----------------------|-------------------|------------|
| | | Mildred Lake Area | Delta Area |
| Family Catostomidae | | | |
| <i>Catostomus catostomus</i> (Forster) | Longnose sucker | + | + |
| <i>Catostomus commersoni</i> (Lacépède) | White sucker | + | + |
| Family Gadidae | | | |
| <i>Lota lota</i> (Linnaeus) | Burbot | + | + |
| Family Gasterosteidae | | | |
| <i>Culaea inconstans</i> (Kirtland) | Brook stickleback | + | + |
| <i>Pungitius pungitius</i> (Linnaeus) | Ninespine stickleback | + | + |
| Family Percopsidae | | | |
| <i>Percopsis omiscomaycus</i> (Walbaum) | Trout-perch | + | + |
| Family Percidae | | | |
| <i>Perca flavescens</i> (Mitchill) | Yellow perch | + | + |
| <i>Stizostedion vitreum</i> (Mitchill) | Walleye | + | + |
| <i>Etheostoma exile</i> (Girard) | Iowa darter | + ^a | |
| Family Cottidae | | | |
| <i>Cottus cognatus</i> Richardson | Slimy sculpin | + | |
| <i>Cottus ricei</i> (Nelson) | Spoonhead sculpin | + | + |

+ Indicates species present.

^a Species captured in 1976 but not in 1977.

Table 2. Number of fish^a taken by each capture method from the Athabasca River, combined study areas, 1977.

| Species | Number of fish | | | | | Total | % of Total |
|------------------------|----------------|----------------|--------------|-------------------|-------------------|--------|------------|
| | Tagging Nets | Standard Gangs | Angling Gear | Large Mesh Seines | Small Mesh Seines | | |
| Goldeye | 419 | 658 | 61 | 1 428 | 54 | 2 620 | 7.4 |
| Walleye | 176 | 249 | 31 | 361 | 262 | 1 079 | 3.1 |
| Yellow perch | 0 | 0 | 0 | 1 | 237 | 238 | 0.7 |
| Northern pike | 179 | 123 | 210 | 315 | 86 | 913 | 2.6 |
| Dolly Varden | 0 | 1 | 0 | 0 | 0 | 1 | 0.1 |
| Lake whitefish | 903 | 208 | 0 | 1 133 | 100 | 2 344 | 6.6 |
| Mountain whitefish | 2 | 1 | 0 | 0 | 4 | 7 | 0.1 |
| Arctic grayling | 1 | 1 | 0 | 17 | 7 | 26 | <0.1 |
| Longnose sucker | 429 | 102 | 1 | 791 | ND | 1 323 | 3.7 |
| White sucker | 63 | 6 | 1 | 489 | ND | 559 | 1.6 |
| Sucker spp. | 0 | 0 | 0 | 0 | 6 100 | 6 100 | 17.3 |
| Trout-perch | 0 | 0 | 0 | 0 | 4 308 | 4 308 | 12.2 |
| Burbot | 10 | 4 | 9 | 17 | 90 | 130 | 0.4 |
| Flathead chub | 12 | 107 | 2 | 199 | 1 125 | 1 445 | 4.1 |
| Lake chub | 0 | 0 | 0 | 0 | 541 | 541 | 1.5 |
| Emerald shiner | 0 | 0 | 0 | 0 | 12 811 | 12 811 | 36.3 |
| Spottail shiner | 0 | 0 | 0 | 0 | 735 | 735 | 2.1 |
| Longnose dace | 0 | 0 | 0 | 0 | 27 | 27 | 0.1 |
| Finescale dace | 0 | 0 | 0 | 0 | 19 | 19 | <0.1 |
| Northern redbelly dace | 0 | 0 | 0 | 0 | 4 | 4 | <0.1 |
| Fathead minnow | 0 | 0 | 0 | 0 | 13 | 13 | <0.1 |
| Ninespine stickleback | 0 | 0 | 0 | 0 | 4 | 4 | <0.1 |

continued ...

Table 2. Concluded.

| Species | Number of Fish | | | | | Total | % of Total |
|-------------------|----------------|----------------|--------------|-------------------|-------------------|--------|------------|
| | Tagging Nets | Standard Gangs | Angling Gear | Large Mesh Seines | Small Mesh Seines | | |
| Brook stickleback | 0 | 0 | 0 | 0 | 9 | 9 | <0.1 |
| Slimy sculpin | 0 | 0 | 0 | 0 | 13 | 13 | <0.1 |
| Spoonhead sculpin | 0 | 0 | 0 | 0 | 39 | 39 | 0.1 |
| Total | 2 194 | 1 460 | 315 | 4 751 | 26 588 | 35 308 | |

^a Numbers are actual except for those shown for small mesh seines. In some cases, fish captured in a small mesh seine haul were only partially counted and then the total number was estimated.

Table 3. Number of fish^a taken by each capture method from the Mildred Lake study area, Athabasca River, 1977.

| Species | Number of Fish | | | | | Total | % of Total |
|------------------------|----------------|----------------|--------------|-------------------|-------------------|-------|------------|
| | Tagging Nets | Standard Gangs | Angling Gear | Large Mesh Seines | Small Mesh Seines | | |
| Goldeye | 103 | 475 | 0 | 252 | 28 | 1 458 | 9.1 |
| Walleye | 98 | 135 | 23 | 281 | 182 | 719 | 4.5 |
| Yellow perch | 0 | 0 | 0 | 1 | 212 | 213 | 1.3 |
| Northern pike | 68 | 56 | 32 | 201 | 59 | 416 | 1.6 |
| Dolly Varden | 0 | 1 | 0 | 0 | 0 | 1 | 0.1 |
| Lake whitefish | 210 | 134 | 0 | 1 058 | 90 | 1 492 | 9.3 |
| Mountain whitefish | 2 | 1 | 0 | 0 | 3 | 6 | <0.1 |
| Arctic grayling | 1 | 1 | 0 | 17 | 7 | 26 | 0.2 |
| Longnose sucker | 299 | 75 | 1 | 780 | ND | 1 155 | 7.2 |
| White sucker | 55 | 6 | 1 | 481 | ND | 543 | 3.4 |
| Sucker spp. | 0 | 0 | 0 | 0 | 5 312 | 5 312 | 33.2 |
| Trout-perch | 0 | 0 | 0 | 0 | 2 737 | 2 737 | 17.1 |
| Burbot | 8 | 4 | 9 | 16 | 16 | 53 | 0.3 |
| Flathead chub | 8 | 94 | 1 | 142 | 263 | 508 | 3.2 |
| Lake chub | 0 | 0 | 0 | 0 | 536 | 536 | 3.3 |
| Emerald shiner | 0 | 0 | 0 | 0 | 620 | 620 | 3.9 |
| Spottail shiner | 0 | 0 | 0 | 0 | 116 | 116 | 0.7 |
| Longnose dace | 0 | 0 | 0 | 0 | 26 | 26 | 0.2 |
| Finescale dace | 0 | 0 | 0 | 0 | 19 | 19 | 0.1 |
| Northern redbelly dace | 0 | 0 | 0 | 0 | 4 | 4 | <0.1 |
| Fathead minnow | 0 | 0 | 0 | 0 | 13 | 13 | 0.1 |
| Ninespine stickleback | 0 | 0 | 0 | 0 | 2 | 2 | <0.1 |

continued ...

Table 3. Concluded.

| Species | Number of Fish | | | | | Total | % of Total |
|-------------------|----------------|----------------|--------------|-------------------|-------------------|--------|------------|
| | Tagging Nets | Standard Gangs | Angling Gear | Large Mesh Seines | Small Mesh Seines | | |
| Brook stickleback | 0 | 0 | 0 | 0 | 8 | 8 | <0.1 |
| Slimy Sculpin | 0 | 0 | 0 | 0 | 13 | 13 | 0.1 |
| Spoonhead Sculpin | 0 | 0 | 0 | 0 | 26 | 26 | 0.2 |
| Total | 852 | 982 | 67 | 3 829 | 10 292 | 16 022 | |

^a Numbers are actual except for those shown for small mesh seines. In some cases, fish captured in a small mesh seine haul were only partially counted and then the total number was estimated.

Table 4. Number of fish^a taken by each capture method from the Delta study area, Athabasca River, 1977.

| Species | Number of fish | | | | | Total | % of Total |
|-----------------------|----------------|----------------|--------------|-------------------|-------------------|--------|------------|
| | Tagging Nets | Standard Gangs | Angling Gear | Large Mesh Seines | Small Mesh Seines | | |
| Goldeye | 316 | 183 | 61 | 576 | 26 | 1 162 | 6.0 |
| Walleye | 78 | 114 | 8 | 80 | 80 | 360 | 1.9 |
| Yellow perch | 0 | 0 | 0 | 0 | 25 | 25 | 0.1 |
| Northern pike | 111 | 67 | 178 | 114 | 27 | 497 | 2.6 |
| Lake whitefish | 693 | 74 | 0 | 75 | 10 | 852 | 4.4 |
| Mountain whitefish | 0 | 0 | 0 | 0 | 1 | 1 | <0.1 |
| Longnose sucker | 135 | 27 | 0 | 11 | ND | 173 | 0.9 |
| White sucker | 8 | 0 | 0 | 8 | ND | 16 | 0.1 |
| Sucker spp. | 0 | 0 | 0 | 0 | 788 | 788 | 4.1 |
| Trout-perch | 0 | 0 | 0 | 0 | 1 571 | 1 571 | 8.1 |
| Burbot | 2 | 0 | 0 | 1 | 74 | 77 | 0.4 |
| Flathead chub | 4 | 13 | 1 | 57 | 862 | 937 | 4.9 |
| Lake chub | 0 | 0 | 0 | 0 | 5 | 5 | <0.1 |
| Emerald shiner | 0 | 0 | 0 | 0 | 12 191 | 12 191 | 63.2 |
| Spottail shiner | 0 | 0 | 0 | 0 | 619 | 619 | 3.2 |
| Longnose dace | 0 | 0 | 0 | 0 | 1 | 1 | <0.1 |
| Ninespine stickleback | 0 | 0 | 0 | 0 | 2 | 2 | <0.1 |
| Brook stickleback | 0 | 0 | 0 | 0 | 1 | 1 | <0.1 |
| Spoonhead sculpin | 0 | 0 | 0 | 0 | 13 | 13 | 0.1 |
| Total | 1 347 | 478 | 248 | 922 | 16 296 | 19 291 | |

^a Numbers are actual except for those shown for small mesh seines. In some cases, fish captured in a small mesh seine haul were only partially counted and then the total number was estimated.

Regular use of standard gangs began on 26 April in the Mildred Lake study area where they were fished for a total of 818.0 hours and captured 982 fish of 11 species. Table 5 summarizes standard gang results for each sampling cycle in the Mildred Lake study area.

Sampling with standard gangs began on 1 June in the Delta study area. In this area the gangs were fished for 793.5 hours and captured 478 fish of six species. The catch data for each sampling cycle in the Delta study area are summarized in Table 6. Standard gang results from each sampling site in both study area are presented in Appendix 6.3.

Large mesh seines captured 4751 fish of 10 species. In the Mildred Lake study area, 410 hauls with large mesh seines produced 3829 fish. The results of these hauls in terms of percentage composition, percentage frequency of occurrence, and catch-per-unit-effort for each species are summarized by sampling period in Table 7. A total of 278 large mesh seine hauls were made in the Delta study area producing 922 fish (Table 8).

An estimated 26 588 fish of 23 species were captured in 340 small mesh seine hauls. In the Mildred Lake study area, 234 seine hauls took 10 292 fish, while 106 hauls captured 16 296 fish in the Delta study area. The percentage composition, percentage frequency of occurrence, and average catch per seine haul for the various species by sampling period in each of the two study areas are presented in Tables 9 and 10.

Angling gear was not employed as a regular capture method during the study and only 315 fish were taken by this method in 1977 (Table 11).

Floy tags were applied to 6783 fish of nine species during 1977 (Table 12). This brought to 9311 the number of tags applied during the two years of the study. Goldeye accounted for 32.6% of this total and lake whitefish made up 25.7%. Other species to which tags were applied included longnose sucker (13.6%), walleye (10.3%), northern pike (10.1%), white sucker (6.3%), flathead chub (0.8%), burbot (0.5%), and Arctic grayling (0.1%) (Table 13). As of

Table 5. Numbers (N), percentage composition (%), catch-per-unit-effort (C/E)^a, and percentage frequency of occurrence (FO) for fish captured in standard gangs from the Mildred Lake study area, Athabasca River, 1977.

| Species | Date of Sample | | | | | | | | | | | | | | | |
|--------------------|----------------|------|-------|-----|------------|------|-------|-----|-------------|------|-------|----|---------------|------|-------|-----|
| | 26 to 27 April | | | | 4 to 5 May | | | | 1 to 6 June | | | | 15 to 16 June | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 16 | 40.0 | 0.941 | 100 | 38 | 52.8 | 2.170 | 100 | 68 | 47.6 | 0.731 | 80 | 61 | 58.0 | 1.020 | 100 |
| Walleye | 9 | 22.5 | 0.529 | 100 | 8 | 11.1 | 0.457 | 100 | 7 | 4.9 | 0.075 | 40 | 18 | 17.1 | 0.302 | 100 |
| Northern pike | 2 | 5.0 | 0.117 | 100 | 5 | 6.9 | 0.285 | 100 | 3 | 2.0 | 0.032 | 40 | 2 | 1.9 | 0.033 | 50 |
| Lake whitefish | 8 | 20.0 | 0.470 | 100 | 4 | 5.5 | 0.228 | 100 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Mountain whitefish | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 1.0 | 0.016 | 25 |
| Arctic grayling | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 0.7 | 0.010 | 20 | 0 | 0.0 | 0.000 | 0 |
| Dolly Varden | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 0.7 | 0.010 | 20 | 0 | 0.0 | 0.000 | 0 |
| Longnose sucker | 3 | 7.5 | 0.176 | 100 | 6 | 8.3 | 0.342 | 100 | 21 | 14.7 | 0.225 | 80 | 10 | 9.5 | 0.168 | 100 |
| White sucker | 1 | 2.5 | 0.058 | 100 | 1 | 1.4 | 0.057 | 100 | 0 | 0.0 | 0.000 | 0 | 1 | 1.0 | 0.016 | 25 |
| Burbot | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 1.0 | 0.016 | 25 |
| Flathead chub | 1 | 2.5 | 0.058 | 100 | 10 | 13.9 | 0.571 | 100 | 42 | 29.4 | 0.451 | 80 | 11 | 10.5 | 0.184 | 100 |
| Total | 40 | | | | 72 | | | | 143 | | | | 105 | | | |
| Total Hours Fished | 17.0 | | | | 17.5 | | | | 93.0 | | | | 59.5 | | | |

continued ...

Table 5. Continued.

| Species | Date of Sample | | | | | | | | | | | | | | | |
|--------------------|----------------|------|-------|-----|---------------|------|-------|-----|---------------|------|-------|-----|----------------|------|-------|----|
| | 27 to 29 June | | | | 12 to 13 July | | | | 26 to 27 July | | | | 8 to 10 August | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 88 | 75.2 | 1.478 | 100 | 8 | 36.4 | 0.228 | 100 | 40 | 78.4 | 1.212 | 100 | 39 | 60.0 | 0.600 | 75 |
| Walleye | 15 | 12.8 | 0.252 | 100 | 5 | 22.7 | 0.142 | 100 | 2 | 3.9 | 0.060 | 50 | 12 | 18.5 | 0.184 | 75 |
| Northern pike | 9 | 7.7 | 0.151 | 75 | 1 | 4.5 | 0.028 | 50 | 2 | 3.9 | 0.060 | 50 | 0 | 0.0 | 0.000 | 0 |
| Lake whitefish | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 2 | 3.1 | 0.030 | 50 |
| Mountain whitefish | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Arctic grayling | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Dolly Varden | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Longnose sucker | 3 | 2.6 | 0.050 | 75 | 2 | 9.0 | 0.057 | 50 | 2 | 3.9 | 0.060 | 50 | 1 | 1.5 | 0.015 | 25 |
| White sucker | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 1.5 | 0.015 | 25 |
| Burbot | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 1.5 | 0.015 | 25 |
| Flathead chub | 2 | 1.7 | 0.033 | 50 | 6 | 27.3 | 0.171 | 100 | 5 | 9.8 | 0.151 | 100 | 7 | 10.8 | 0.107 | 75 |
| Total | 117 | | | | 22 | | | | 51 | | | | 63 | | | |
| Total Hours Fished | 59.5 | | | | 35.0 | | | | 33.0 | | | | 65.0 | | | |

continued ...

Table 5. Continued.

| Species | Date of Sample | | | | | | | | | | | | | | | |
|--------------------|-----------------|------|-------|-----|------------------|------|-------|-----|--------------------|------|-------|-----|----------------|------|-------|----|
| | 23 to 24 August | | | | 5 to 7 September | | | | 20 to 22 September | | | | 4 to 5 October | | | |
| | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 |
| Goldeye | 11 | 52.4 | 0.328 | 50 | 42 | 55.3 | 0.656 | 75 | 25 | 34.7 | 0.364 | 100 | 15 | 17.8 | 0.146 | 83 |
| Walleye | 1 | 4.7 | 0.029 | 50 | 10 | 13.1 | 0.156 | 100 | 19 | 26.4 | 0.277 | 75 | 12 | 14.3 | 0.117 | 67 |
| Northern pike | 2 | 9.5 | 0.059 | 50 | 3 | 3.9 | 0.046 | 50 | 5 | 6.9 | 0.072 | 50 | 8 | 9.5 | 0.078 | 67 |
| Lake whitefish | 4 | 19.0 | 0.119 | 100 | 14 | 18.4 | 0.218 | 100 | 18 | 25.0 | 0.262 | 75 | 36 | 42.8 | 0.351 | 83 |
| Mountain whitefish | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Arctic grayling | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Dolly Varden | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Longnose sucker | 0 | 0.0 | 0.000 | 0 | 4 | 5.3 | 0.062 | 75 | 3 | 4.2 | 0.043 | 50 | 9 | 10.7 | 0.087 | 67 |
| White sucker | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 |
| Burbot | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 2 | 2.4 | 0.020 | 33 |
| Flathead chub | 3 | 9.5 | 0.089 | 100 | 3 | 39.9 | 0.046 | 50 | 2 | 2.8 | 0.029 | 50 | 2 | 2.4 | 0.020 | 33 |
| Total | 21 | | | | 76 | | | | 72 | | | | 84 | | | |
| Total Hours Fished | 33.5 | | | | 64.0 | | | | 68.5 | | | | 102.5 | | | |

continued ...

Table 5. Concluded.

| Species | Date of Sample | | | | | | | | Total | | | |
|--------------------|------------------|------|-------|----|-----------------|------|-------|-----|-------|------|-------|----|
| | 17 to 18 October | | | | 1 to 2 November | | | | N | % | C/E | FO |
| | N | % | C/E | FO | N | % | C/E | FO | | | | |
| Goldeye | 16 | 19.5 | 0.150 | 67 | 8 | 23.5 | 0.148 | 67 | 475 | 48.4 | 0.580 | 83 |
| Walleye | 11 | 13.4 | 0.103 | 67 | 6 | 17.6 | 0.111 | 67 | 135 | 13.7 | 0.165 | 75 |
| Northern pike | 10 | 12.2 | 0.093 | 50 | 4 | 11.8 | 0.074 | 67 | 56 | 5.7 | 0.068 | 52 |
| Lake whitefish | 35 | 42.7 | 0.328 | 83 | 13 | 38.2 | 0.240 | 100 | 134 | 13.6 | 0.163 | 54 |
| Mountain whitefish | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 0.1 | 0.001 | 2 |
| Arctic grayling | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 0.1 | 0.001 | 2 |
| Dolly Varden | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 1 | 0.1 | 0.001 | 2 |
| Longnose sucker | 8 | 9.7 | 0.075 | 83 | 3 | 8.8 | 0.055 | 33 | 75 | 7.6 | 0.091 | 65 |
| White sucker | 2 | 2.4 | 0.018 | 33 | 0 | 0.0 | 0.000 | 0 | 6 | 0.6 | 0.007 | 13 |
| Burbot | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 4 | 0.4 | 0.004 | 8 |
| Flathead chub | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 94 | 9.6 | 0.114 | 58 |
| Total | 82 | | | | 34 | | | | 982 | | | |
| Total Hours Fished | 106.5 | | | | 54.0 | | | | 818.0 | | | |

^a Catch-per-unit-effort is expressed as number of fish per standard gang per hour.

Table 6. Numbers (N), percentage composition (%), catch-per-unit-effort (C/E)^a, and percentage frequency of occurrence (FO) for fish captured in standard gangs from the Delta study area, Athabasca River, 1977.

| Species | Date of Sample | | | | | | | | | | | | | | | |
|--------------------|----------------|------|-------|-----|---------------|------|-------|-----|---------------|------|-------|----|---------------|------|-------|-----|
| | 1 to 6 June | | | | 15 to 16 June | | | | 27 to 29 June | | | | 11 to 13 July | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 6 | 16.6 | 0.056 | 67 | 48 | 59.2 | 0.448 | 83 | 31 | 55.3 | 0.287 | 83 | 16 | 42.1 | 0.231 | 100 |
| Walleye | 17 | 47.2 | 0.159 | 100 | 14 | 17.3 | 0.130 | 100 | 5 | 8.9 | 0.046 | 67 | 5 | 13.1 | 0.072 | 75 |
| Northern pike | 1 | 2.8 | 0.009 | 17 | 13 | 16.0 | 0.121 | 50 | 15 | 26.8 | 0.138 | 50 | 9 | 23.7 | 0.130 | 50 |
| Lake whitefish | 0 | 0.0 | 0.000 | 0 | 1 | 1.2 | 0.009 | 17 | 2 | 3.6 | 0.018 | 33 | 6 | 15.8 | 0.086 | 25 |
| Longnose sucker | 9 | 25.0 | 0.084 | 67 | 1 | 1.2 | 0.009 | 17 | 1 | 1.8 | 0.009 | 17 | 1 | 2.6 | 0.014 | 25 |
| Flathead chub | 3 | 8.3 | 0.028 | 50 | 4 | 4.9 | 0.037 | 33 | 2 | 3.6 | 0.018 | 33 | 1 | 2.6 | 0.014 | 25 |
| Total | 36 | | | | 81 | | | | 56 | | | | 38 | | | |
| Total Hours Fished | 106.5 | | | | 107.0 | | | | 108.0 | | | | 69.0 | | | |

continued ...

Table 6. Continued.

| Species | Date of Sample | | | | | | | | | | | | | | | |
|-----------------------|----------------|------|-------|-----|---------------|------|-------|----|-----------------|------|-------|-----|------------------|------|-------|----|
| | 25 to 27 July | | | | 8 to 9 August | | | | 22 to 24 August | | | | 6 to 7 September | | | |
| | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 |
| Goldeye | 18 | 42.8 | 0.264 | 75 | 18 | 45.0 | 0.268 | 75 | 22 | 42.3 | 0.321 | 100 | 15 | 29.4 | 0.225 | 75 |
| Walleye | 13 | 30.9 | 0.191 | 100 | 4 | 10.0 | 0.059 | 75 | 10 | 19.2 | 0.145 | 75 | 8 | 15.7 | 0.120 | 50 |
| Northern pike | 4 | 9.5 | 0.058 | 25 | 14 | 35.0 | 0.208 | 75 | 6 | 11.5 | 0.087 | 50 | 4 | 7.8 | 0.060 | 75 |
| Lake whitefish | 6 | 14.3 | 0.088 | 25 | 2 | 5.0 | 0.029 | 25 | 13 | 25.0 | 0.189 | 50 | 21 | 41.2 | 0.315 | 50 |
| Longnose sucker | 0 | 0.0 | 0.000 | 0 | 1 | 2.5 | 0.014 | 25 | 0 | 0.0 | 0.000 | 0 | 3 | 5.9 | 0.045 | 50 |
| Flathead chub | 1 | 2.4 | 0.014 | 25 | 1 | 2.5 | 0.014 | 25 | 1 | 1.9 | 0.014 | 25 | 0 | 0.0 | 0.000 | 0 |
| Total | 42 | | | | 40 | | | | 52 | | | | 51 | | | |
| Total Hours Fished | 68.0 | | | | 67.0 | | | | 68.5 | | | | 66.5 | | | |

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continued ...

Table 6. Concluded.

| Species | Date of Sample | | | | | | | | Total | | | |
|--------------------|--------------------|------|-------|-----|----------------|------|-------|----|-------|------|-------|----|
| | 19 to 21 September | | | | 3 to 7 October | | | | N | % | C/E | FO |
| | N | % | C/E | FO | N | % | C/E | FO | | | | |
| Goldeye | 7 | 10.8 | 0.109 | 100 | 2 | 11.8 | 0.028 | 50 | 183 | 38.3 | 0.230 | 80 |
| Walleye | 37 | 56.9 | 0.578 | 100 | 1 | 5.9 | 0.014 | 25 | 114 | 23.8 | 0.143 | 78 |
| Northern pike | 1 | 1.5 | 0.015 | 25 | 0 | 0.0 | 0.000 | 0 | 67 | 14.0 | 0.084 | 41 |
| Lake whitefish | 16 | 24.6 | 0.250 | 75 | 7 | 41.2 | 0.101 | 50 | 74 | 15.5 | 0.093 | 33 |
| Longnose sucker | 4 | 6.1 | 0.062 | 50 | 7 | 41.2 | 0.101 | 75 | 27 | 5.6 | 0.034 | 33 |
| Flathead chub | 0 | 0.0 | 0.000 | 0 | 0 | 0.0 | 0.000 | 0 | 13 | 2.7 | 0.016 | 24 |
| Total | 65 | | | | 17 | | | | 478 | | | |
| Total Hours Fished | 64.0 | | | | 69.0 | | | | 793.5 | | | |

^a Catch-per-unit-effort is expressed as number of fish per standard gang per hour.

Table 7. Numbers (N), percentage composition (%), average catch per seine haul (C/E), and percentage frequency of occurrence (FO) for fish captured in large mesh beach seines in the Mildred Lake study area, Athabasca River, 1977.

| Species | Date of Sample | | | | | | | | | | | | |
|-----------------------|----------------|------|------|----|------------|------|-----|----|--------------|------|-----|----|----|
| | 22 to 29 April | | | | 2 to 6 May | | | | 11 to 15 May | | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO | |
| Goldeye | 120 | 9.2 | 2.9 | 67 | 74 | 37.6 | 6.2 | 92 | 66 | 35.3 | 3.7 | 62 | |
| Walleye | 166 | 12.7 | 4.0 | 57 | 15 | 7.6 | 1.2 | 25 | 24 | 12.8 | 1.3 | 56 | |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | |
| Northern pike | 22 | 1.7 | 0.5 | 21 | 2 | 1.0 | 0.2 | 17 | 12 | 6.4 | 0.7 | 23 | |
| Lake whitefish | 25 | 1.9 | 0.6 | 38 | 7 | 3.6 | 0.6 | 42 | 13 | 7.0 | 0.7 | 28 | |
| Arctic grayling | 9 | 0.7 | 0.2 | 12 | 0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.1 | 6 | |
| Longnose sucker | 649 | 49.8 | 15.5 | 72 | 8 | 4.0 | 0.7 | 42 | 15 | 8.0 | 0.8 | 34 | |
| White sucker | 285 | 21.9 | 6.8 | 69 | 87 | 44.2 | 7.2 | 34 | 33 | 17.6 | 1.8 | 23 | |
| Burbot | 9 | 0.7 | 0.2 | 19 | 0 | 0.0 | 0.0 | 0 | 5 | 2.7 | 0.3 | 23 | |
| Flathead chub | 18 | 1.4 | 0.4 | 26 | 4 | 2.0 | 0.3 | 25 | 18 | 9.6 | 0.1 | 45 | |
| Total | 1303 | | | | 197 | | | | 187 | | | | |
| Number of Seine Hauls | | | | | 42 | | | | 12 | | | | 18 |

continued ...

Table 7. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|-----------------------|----------------|------|-----|----|-------------|------|-----|----|---------------|------|-----|----|
| | 18 May | | | | 6 to 8 June | | | | 16 to 19 June | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 22 | 59.5 | 4.4 | 80 | 6 | 28.6 | 0.5 | 42 | 41 | 65.1 | 3.2 | 77 |
| Walleye | 2 | 5.4 | 0.4 | 40 | 1 | 4.7 | 0.1 | 9 | 3 | 4.8 | 0.2 | 23 |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Northern pike | 1 | 2.7 | 0.2 | 20 | 1 | 4.7 | 0.1 | 9 | 7 | 11.1 | 0.5 | 39 |
| Lake whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 3.2 | 0.2 | 16 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Longnose sucker | 5 | 13.5 | 1.0 | 60 | 1 | 4.7 | 0.1 | 9 | 0 | 0.0 | 0.0 | 0 |
| White sucker | 1 | 2.7 | 0.2 | 20 | 1 | 4.7 | 0.1 | 9 | 1 | 1.6 | 0.1 | 8 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 2 | 9.5 | 0.2 | 17 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 6 | 16.2 | 1.2 | 60 | 9 | 42.9 | 0.7 | 17 | 9 | 14.3 | 0.7 | 54 |
| Total | 37 | | | | 21 | | | | 63 | | | |
| Number of Seine Hauls | | | | 5 | | | | 12 | | | | 13 |

continued ...

Table 7. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|-----------------------|----------------|------|-----|----|---------------|------|-----|-----|---------------|------|-----|----|
| | 28 to 29 June | | | | 11 to 13 July | | | | 25 to 27 July | | | |
| | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 |
| Goldeye | 21 | 84.0 | 2.3 | 56 | 15 | 83.3 | 2.1 | 100 | 25 | 83.3 | 2.5 | 60 |
| Walleye | 1 | 4.0 | 0.1 | 12 | 1 | 5.6 | 0.1 | 15 | 4 | 13.3 | 0.4 | 30 |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Northern pike | 0 | 0.0 | 0.0 | 0 | 1 | 5.6 | 0.1 | 15 | 1 | 3.3 | 0.1 | 10 |
| Lake whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Longnose sucker | 1 | 4.0 | 0.1 | 12 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| White sucker | 0 | 0.0 | 0.0 | 0 | 1 | 5.6 | 0.1 | 15 | 0 | 0.0 | 0.0 | 0 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 2 | 8.0 | 0.2 | 23 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Total | 25 | | | | 18 | | | | 30 | | | |
| Number of Seine Hauls | | | | 9 | | | | 7 | | | | 10 |

continued ...

Table 7. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|-----------------------|----------------|------|-----|----|-----------------|------|-----|----|------------------|------|-----|----|
| | 9 to 10 August | | | | 22 to 24 August | | | | 6 to 7 September | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 13 | 48.1 | 1.1 | 34 | 73 | 91.2 | 5.6 | 62 | 35 | 50.7 | 3.2 | 64 |
| Walleye | 1 | 3.7 | 0.1 | 9 | 1 | 1.2 | 0.1 | 8 | 0 | 0.0 | 0.0 | 0 |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Northern pike | 0 | 0.0 | 0.0 | 0 | 2 | 2.5 | 0.2 | 16 | 2 | 2.9 | 0.2 | 9 |
| Lake whitefish | 12 | 44.4 | 1.0 | 17 | 1 | 1.2 | 0.1 | 8 | 12 | 17.4 | 1.1 | 46 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Longnose sucker | 0 | 0.0 | 0.0 | 0 | 1 | 1.2 | 0.1 | 8 | 0 | 0.0 | 0.0 | 0 |
| White sucker | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 1 | 3.7 | 0.1 | 9 | 2 | 2.5 | 0.2 | 16 | 20 | 29.0 | 1.8 | 55 |
| Total | 27 | | | | 80 | | | | 69 | | | |
| Number of Seine Hauls | | | | 12 | | | | 13 | | | | 11 |

continued ...

Table 7. Continued.

| Species | Date of Sample | | | | | | | | | | | | |
|-----------------------|--------------------|------|-----|----|---------------------------|------|------|----|----------------|------|------|----|----|
| | 20 to 22 September | | | | 25 September to 1 October | | | | 6 to 8 October | | | | |
| | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 | |
| Goldeye | 39 | 26.0 | 3.0 | 70 | 265 | 22.1 | 1.9 | 45 | 21 | 8.5 | 0.4 | 14 | |
| Walleye | 2 | 1.3 | 0.2 | 16 | 47 | 3.9 | 0.3 | 16 | 8 | 3.2 | 0.1 | 9 | |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | |
| Northern pike | 7 | 4.7 | 0.5 | 39 | 74 | 6.2 | 0.5 | 26 | 33 | 13.3 | 0.6 | 39 | |
| Lake whitefish | 91 | 60.7 | 7.0 | 93 | 761 | 63.5 | 5.5 | 68 | 122 | 49.2 | 2.1 | 51 | |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 3 | 1.2 | <0.1 | 5 | |
| Longnose sucker | 2 | 1.3 | 0.2 | 16 | 5 | 0.4 | <0.1 | 4 | 38 | 15.3 | 0.7 | 18 | |
| White sucker | 0 | 0.0 | 0.0 | 0 | 37 | 3.1 | 0.3 | 16 | 20 | 8.1 | 0.3 | 26 | |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | |
| Flathead chub | 9 | 6.0 | 0.7 | 39 | 9 | 0.7 | 0.1 | 5 | 3 | 1.2 | <0.1 | 5 | |
| Total | 150 | | | | 1198 | | | | 248 | | | | |
| Number of Seine Hauls | | | | | 13 | | | | 139 | | | | 57 |

continued ...

Table 7. Concluded.

| Species | Date of Sample | | | | Total | | | |
|-----------------------|------------------|------|------|----|-------|------|------|-----|
| | 18 to 20 October | | | | N | % | C/E | FO |
| | N | % | C/E | FO | | | | |
| Goldeye | 16 | 9.1 | 0.4 | 17 | 852 | 22.2 | 2.1 | 47 |
| Walleye | 5 | 2.9 | 0.1 | 9 | 281 | 7.3 | 0.7 | 20 |
| Yellow perch | 1 | 0.9 | <0.1 | 3 | 1 | <0.1 | <0.1 | <1 |
| Northern pike | 36 | 20.6 | 0.9 | 36 | 201 | 5.2 | 0.5 | 25 |
| Lake whitefish | 12 | 6.9 | 0.3 | 17 | 1058 | 27.6 | 2.6 | 41 |
| Arctic grayling | 4 | 2.3 | 0.1 | 11 | 17 | 0.4 | <0.1 | 3 |
| Longnose sucker | 55 | 31.4 | 1.5 | 22 | 780 | 20.4 | 1.9 | 18 |
| White sucker | 15 | 8.6 | 0.4 | 27 | 481 | 12.6 | 1.2 | 22 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 16 | 0.4 | <0.1 | 4 |
| Flathead chub | 32 | 18.3 | 0.9 | 3 | 142 | 3.7 | 0.3 | 15 |
| Total | 176 | | | | 3829 | | | |
| Number of Seine Hauls | | | | 37 | | | | 410 |

Table 8. Numbers (N), percentage composition (%), average catch per seine haul (C/E), and percentage frequency of occurrence (FO) for fish captured in large mesh beach seines in the Delta study area, Athabasca River, 1977.

| Species | Date of Sample | | | | | | | | | | | | | | | |
|-----------------------|----------------|------|-----|-----|--------------|------|-----|----|---------------|------|-----|----|----|--|--|--|
| | 15 to 17 May | | | | 6 to 12 June | | | | 16 to 26 June | | | | | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO | | | | |
| Goldeye | 25 | 58.1 | 5.0 | 100 | 51 | 67.1 | 4.6 | 82 | 85 | 57.8 | 2.8 | 67 | | | | |
| Walleye | 6 | 14.0 | 1.2 | 80 | 17 | 22.4 | 1.5 | 82 | 29 | 19.7 | 1.0 | 60 | | | | |
| Northern pike | 5 | 12.0 | 1.0 | 40 | 4 | 5.3 | 0.4 | 36 | 14 | 9.5 | 0.5 | 37 | | | | |
| Lake whitefish | 2 | 5.0 | 0.4 | 40 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | | | | |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | | | | |
| Longnose sucker | 5 | 12.0 | 1.0 | 60 | 2 | 2.6 | 0.2 | 9 | 0 | 0.0 | 0.0 | 0 | | | | |
| White sucker | 0 | 0.0 | 0.0 | 0 | 1 | 1.3 | 0.1 | 9 | 0 | 0.0 | 0.0 | 0 | | | | |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | | | | |
| Flathead chub | 0 | 0.0 | 0.0 | 0 | 1 | 1.3 | 0.1 | 9 | 19 | 12.9 | 0.6 | 43 | | | | |
| Total | 43 | | | | 76 | | | | 147 | | | | | | | |
| Number of Seine Hauls | | | | | 5 | | | | 11 | | | | 30 | | | |

continued ...

Table 8. Continued.

| Species | Date of Sample | | | | | | | | | | | | |
|-----------------------|--------------------|------|------|----|---------------|------|------|----|---------------------|------|-----|----|----|
| | 24 June to 10 July | | | | 14 to 21 July | | | | 25 July to 7 August | | | | |
| | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 | |
| Goldeye | 177 | 74.0 | 2.8 | 65 | 59 | 58.4 | 1.4 | 36 | 40 | 63.5 | 1.3 | 35 | |
| Walleye | 9 | 3.8 | 0.1 | 14 | 16 | 15.8 | 0.4 | 26 | 2 | 3.2 | 0.1 | 6 | |
| Northern pike | 31 | 13.0 | 0.5 | 49 | 16 | 15.8 | 0.4 | 26 | 16 | 25.4 | 0.5 | 26 | |
| Lake whitefish | 1 | 0.4 | 0.1 | 2 | 3 | 3.0 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 | |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | |
| Longnose sucker | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | |
| White sucker | 1 | 0.4 | <0.1 | 2 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | |
| Burbot | 0 | 0.0 | 0.0 | 0 | 1 | 1.0 | <0.1 | 2 | 0 | 0.0 | 0.0 | 0 | |
| Flathead chub | 20 | 8.4 | 0.3 | 32 | 6 | 5.9 | 0.1 | 10 | 5 | 7.9 | 0.2 | 10 | |
| Total | 239 | | | | 101 | | | | 63 | | | | |
| Number of Seine Hauls | | | | | 63 | | | | 42 | | | | 31 |

continued ...

Table 8. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|-----------------------|----------------|------|------|----|--------------------------|------|-----|----|------------------|------|-----|----|
| | 9 to 20 August | | | | 23 August to 3 September | | | | 6 to 7 September | | | |
| | N | % | C/E | F0 | N | % | C/E | F0 | N | % | C/E | F0 |
| Goldeye | 96 | 78.0 | 1.9 | 60 | 13 | 48.1 | 0.7 | 44 | 24 | 41.0 | 2.4 | 50 |
| Walleye | 1 | 0.8 | <0.1 | 2 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Northern pike | 8 | 6.5 | 0.2 | 16 | 7 | 25.9 | 0.4 | 28 | 6 | 10.2 | 0.6 | 30 |
| Lake whitefish | 10 | 8.1 | 0.2 | 20 | 3 | 11.1 | 0.2 | 6 | 25 | 42.4 | 2.5 | 60 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Longnose sucker | 3 | 2.4 | 0.1 | 6 | 1 | 3.7 | 0.1 | 6 | 0 | 0.0 | 0.0 | 0 |
| White sucker | 2 | 1.6 | <0.1 | 4 | 1 | 3.7 | 0.1 | 6 | 3 | 5.1 | 0.3 | 20 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 3 | 2.4 | 0.1 | 4 | 2 | 7.4 | 0.1 | 11 | 1 | 1.7 | 0.1 | 10 |
| Total | 123 | | | | 27 | | | | 59 | | | |
| Number of Seine Hauls | 50 | | | | 18 | | | | 10 | | | |

continued ...

Table 8. Concluded.

| Species | Date of Sample | | | | | | | | Total | | | | |
|-----------------------|--------------------|------|-----|----|----------------|------|-----|----|-------|------|------|----|-----|
| | 20 to 21 September | | | | 6 to 7 October | | | | N | % | C/E | FO | |
| | N | % | C/E | FO | N | % | C/E | FO | | | | | |
| Goldeye | 3 | 9.4 | 0.3 | 10 | 3 | 25.0 | 0.4 | 13 | 576 | 62.5 | 2.1 | 52 | |
| Walleye | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 80 | 8.7 | 0.3 | 19 | |
| Northern pike | 5 | 15.6 | 0.5 | 40 | 2 | 16.7 | 0.2 | 25 | 114 | 12.4 | 0.4 | 29 | |
| Lake whitefish | 24 | 75.0 | 2.4 | 50 | 7 | 58.3 | 0.9 | 50 | 75 | 8.1 | 0.3 | 11 | |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | |
| Longnose sucker | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 11 | 1.2 | <0.1 | 3 | |
| White sucker | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 8 | 0.9 | <0.1 | 2 | |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.1 | <0.1 | <1 | |
| Flathead chub | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 57 | 6.2 | 0.2 | 12 | |
| Total | 32 | | | | 12 | | | | 922 | | | | |
| Number of Seine Hauls | | | | | 10 | | | | 8 | | | | 278 |

Table 9. Numbers (N), percentage composition (%), average catch per seine haul (C/E), and percentage frequency of occurrence (FO) for fish captured in small mesh beach seines in the Mildred Lake study area, Athabasca River, 1977.

| Species | Date of Sample | | | | | | | | | | | |
|--------------------------|----------------|------|------|----|------------|------|-----|----|--------------|------|-----|----|
| | 17 to 19 April | | | | 3 to 7 May | | | | 15 to 18 May | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 0 | 0.0 | 0.0 | ND | 6 | 2.9 | 0.4 | 29 | 4 | 3.1 | 0.3 | 12 |
| Walleye | 0 | 0.0 | 0.0 | ND | 0 | 0.0 | 0.0 | 0 | 6 | 4.7 | 0.4 | 25 |
| Yellow perch | 0 | 0.0 | 0.0 | ND | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Northern pike | 22 | 10.6 | 1.8 | ND | 0 | 0.0 | 0.0 | 0 | 1 | 0.8 | 0.1 | 6 |
| Lake whitefish | 0 | 0.0 | 0.0 | ND | 2 | 1.0 | 0.1 | 14 | 1 | 0.8 | 0.1 | 6 |
| Mountain whitefish | 0 | 0.0 | 0.0 | ND | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Arctic grayling | 0 | 0.0 | 0.0 | ND | 2 | 1.0 | 0.1 | 14 | 4 | 3.1 | 0.3 | 19 |
| Sucker spp. ^a | 7 | 3.4 | 0.6 | ND | 7 | 3.4 | 0.5 | 43 | 1 | 0.8 | 0.1 | 6 |
| Trout-perch | 150 | 12.1 | 12.5 | ND | 73 | 35.3 | 5.2 | 64 | 83 | 65.4 | 5.2 | 75 |
| Burbot | 2 | 1.0 | 0.2 | ND | 1 | 0.5 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 1 | 0.5 | 0.1 | ND | 6 | 2.9 | 0.4 | 29 | 3 | 2.4 | 0.2 | 12 |
| Lake chub | 19 | 9.1 | 1.6 | ND | 81 | 39.1 | 5.8 | 50 | 3 | 2.4 | 0.2 | 19 |
| Emerald shiner | 0 | 0.0 | 0.0 | ND | 3 | 1.4 | 0.2 | 21 | 6 | 4.7 | 0.4 | 19 |
| Spottail shiner | 6 | 2.9 | 0.5 | ND | 5 | 2.4 | 0.4 | 14 | 3 | 2.4 | 0.2 | 6 |
| Longnose dace | 0 | 0.0 | 0.0 | ND | 1 | 0.5 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Northern redbelly dace | 0 | 0.0 | 0.0 | ND | 0 | 0.0 | 0.0 | 0 | 1 | 0.8 | 0.1 | 6 |
| Finescale dace | 0 | 0.0 | 0.0 | ND | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Fathead minnow | 0 | 0.0 | 0.0 | ND | 3 | 1.4 | 0.2 | 14 | 4 | 3.1 | 0.3 | 25 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | ND | 0 | 0.0 | 0.0 | 0 | 2 | 1.6 | 0.1 | 12 |
| Brook stickleback | 1 | 0.5 | 0.1 | ND | 2 | 1.0 | 0.1 | 7 | 2 | 1.6 | 0.1 | 12 |
| Slimy sculpin | 0 | 0.0 | 0.0 | ND | 12 | 5.8 | 0.9 | 36 | 1 | 0.8 | 0.1 | 6 |
| Spoonhead sculpin | 0 | 0.0 | 0.0 | ND | 3 | 1.4 | 0.2 | 14 | 2 | 1.6 | 0.1 | 12 |
| Total | 208 | | | | 207 | | | | 127 | | | |
| Number of Seine Hauls | | | | 12 | | | | 14 | | | | 16 |

continued ...

Table 9. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|--------------------------|----------------|------|-----|----|---------------|------|-------|----|---------------|------|------|-----|
| | 6 to 8 June | | | | 16 to 19 June | | | | 28 to 29 June | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 5 | 8.2 | 0.3 | 33 | 8 | 0.2 | 0.3 | 14 | 0 | 0.0 | 0.0 | 0 |
| Walleye | 1 | 1.6 | 0.1 | 7 | 21 | 0.4 | 0.7 | 17 | 79 | 7.2 | 5.6 | 64 |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.2 | 0.1 | 14 |
| Northern pike | 0 | 0.0 | 0.0 | 0 | 17 | 0.3 | 0.6 | 24 | 12 | 1.1 | 0.9 | 29 |
| Lake whitefish | 8 | 13.1 | 0.5 | 7 | 63 | 1.3 | 2.2 | 17 | 7 | 0.6 | 0.5 | 29 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 3 | 0.1 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Sucker spp. ^a | 2 | 3.3 | 0.1 | 13 | 4634 | 92.0 | 159.8 | 72 | 361 | 33.0 | 25.8 | 93 |
| Trout-perch | 7 | 11.5 | 0.5 | 33 | 119 | 2.4 | 4.1 | 45 | 480 | 43.9 | 34.3 | 100 |
| Burbot | 4 | 6.6 | 0.3 | 27 | 4 | 0.1 | 0.1 | 14 | 4 | 0.4 | 0.3 | 21 |
| Flathead chub | 1 | 1.6 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 | 10 | 0.9 | 0.7 | 29 |
| Lake chub | 7 | 11.5 | 0.5 | 20 | 60 | 1.2 | 2.1 | 28 | 78 | 7.1 | 5.6 | 57 |
| Emerald shiner | 13 | 21.3 | 0.9 | 27 | 48 | 1.0 | 1.7 | 34 | 27 | 2.5 | 1.9 | 43 |
| Spottail shiner | 10 | 16.4 | 0.7 | 20 | 41 | 0.8 | 1.4 | 28 | 11 | 1.0 | 0.8 | 29 |
| Longnose dace | 0 | 0.0 | 0.0 | 0 | 3 | 0.1 | 0.1 | 3 | 5 | 0.5 | 0.4 | 7 |
| Northern redbelly dace | 0 | 0.0 | 0.0 | 0 | 2 | <0.1 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Finescale dace | 2 | 3.3 | 0.1 | 7 | 10 | 0.2 | 0.3 | 14 | 0 | 0.0 | 0.0 | 0 |
| Fathead minnow | 0 | 0.0 | 0.0 | 0 | 5 | 0.1 | 0.2 | 10 | 1 | 0.1 | 0.1 | 7 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Brook stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Slimy sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Spoonhead sculpin | 1 | 1.6 | 0.1 | 7 | 1 | <0.1 | <0.1 | 3 | 16 | 1.5 | 1.1 | 50 |
| Total | 61 | | | | 5039 | | | | 1093 | | | |
| Number of Seine Hauls | | | | 15 | | | | 29 | | | | 14 |

continued ...

Table 9. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|--------------------------|----------------|------|-----|----|---------------|------|------|----|----------------|------|------|----|
| | 11 to 13 July | | | | 25 to 27 July | | | | 9 to 10 August | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 5 | 2.0 | 0.4 | 25 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Walleye | 24 | 9.4 | 2.0 | 33 | 10 | 1.3 | 0.8 | 38 | 35 | 5.8 | 2.1 | 35 |
| Yellow perch | 6 | 2.3 | 0.5 | 17 | 32 | 4.3 | 2.5 | 61 | 105 | 17.4 | 6.2 | 53 |
| Northern pike | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.3 | 0.1 | 6 |
| Lake whitefish | 4 | 1.6 | 0.3 | 17 | 2 | 0.3 | 0.2 | 8 | 0 | 0.0 | 0.0 | 0 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Sucker spp. ^a | 50 | 19.5 | 4.2 | 75 | 132 | 17.6 | 10.2 | 69 | 16 | 2.6 | 0.9 | 35 |
| Trout-perch | 79 | 30.9 | 6.6 | 58 | 320 | 42.6 | 24.6 | 46 | 416 | 68.8 | 24.5 | 82 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.2 | 0.1 | 6 |
| Flathead chub | 2 | 0.8 | 0.2 | 8 | 8 | 1.1 | 0.6 | 23 | 4 | 0.7 | 0.2 | 18 |
| Lake chub | 27 | 10.6 | 2.3 | 42 | 186 | 24.8 | 14.3 | 38 | 7 | 1.2 | 0.4 | 35 |
| Emerald shiner | 44 | 17.2 | 3.7 | 42 | 44 | 5.9 | 3.4 | 54 | 13 | 2.2 | 0.8 | 6 |
| Spottail shiner | 3 | 1.2 | 0.3 | 17 | 14 | 1.9 | 1.1 | 8 | 4 | 0.7 | 0.2 | 12 |
| Longnose dace | 10 | 3.9 | 0.8 | 25 | 1 | 0.1 | 0.1 | 8 | 1 | 0.2 | 0.1 | 6 |
| Northern redbelly dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Finescale dace | 0 | 0.0 | 0.0 | 0 | 1 | 0.1 | 0.1 | 8 | 0 | 0.0 | 0.0 | 0 |
| Fathead minnow | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Brook stickleback | 2 | 0.8 | 0.2 | 17 | 0 | 0.0 | 0.0 | 0 | 1 | 0.2 | 0.1 | 6 |
| Slimy sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Spoonhead sculpin | 0 | 0.0 | 0.0 | 0 | 1 | 0.1 | 0.1 | 8 | 0 | 0.0 | 0.0 | 0 |
| Total | 256 | | | | 751 | | | | 605 | | | |
| Number of Seine Hauls | | | | 12 | | | | 13 | | | | 17 |

continued ...

Table 9. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|--------------------------|-----------------|------|------|----|------------------|------|------|----|--------------------|------|------|----|
| | 22 to 24 August | | | | 6 to 7 September | | | | 20 to 22 September | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Walleye | 2 | 0.6 | 0.1 | 6 | 1 | 0.3 | 0.1 | 7 | 3 | 0.6 | 0.2 | 11 |
| Yellow perch | 24 | 7.4 | 1.4 | 41 | 16 | 4.4 | 1.1 | 40 | 12 | 2.3 | 0.7 | 28 |
| Northern pike | 2 | 0.6 | 0.1 | 12 | 1 | 0.3 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Lake whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 3 | 0.6 | 0.2 | 11 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 1 | 0.3 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Sucker spp. ^a | 42 | 12.9 | 2.5 | 53 | 19 | 5.2 | 1.3 | 40 | 29 | 5.5 | 1.6 | 33 |
| Trout-perch | 201 | 61.8 | 11.8 | 71 | 275 | 74.9 | 18.3 | 87 | 294 | 56.1 | 16.3 | 61 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 1 | 0.3 | 0.1 | 6 | 22 | 6.0 | 1.5 | 60 | 8 | 1.5 | 0.4 | 11 |
| Lake chub | 41 | 12.6 | 2.4 | 23 | 10 | 2.7 | 0.7 | 46 | 11 | 2.1 | 0.6 | 33 |
| Emerald shiner | 5 | 1.5 | 0.3 | 12 | 18 | 4.9 | 1.2 | 13 | 157 | 30.0 | 8.7 | 44 |
| Spottail shiner | 3 | 0.9 | 0.2 | 12 | 1 | 0.3 | 0.1 | 7 | 6 | 1.1 | 0.3 | 22 |
| Longnose dace | 3 | 0.9 | 0.2 | 18 | 2 | 0.5 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Northern redbelly dace | 0 | 0.0 | 0.0 | 0 | 1 | 0.3 | 0.1 | 7 | 0 | 0.0 | 0.0 | 0 |
| Finescale dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Fathead minnow | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Brook stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Slimy sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Spoonhead sculpin | 1 | 0.3 | 0.1 | 6 | 0 | 0.0 | 0.0 | 0 | 1 | 0.2 | 0.1 | 6 |
| Total | 325 | | | | 367 | | | | 524 | | | |
| Number of Seine Hauls | | | | 17 | | | | 15 | | | | 18 |

continued ...

Table 9. Concluded.

| Species | Date of Sample | | | | | | | | Total | | | |
|--------------------------|-----------------|------|-----|----|------------------|------|-----|----|--------|------|------|-----|
| | 6 to 10 October | | | | 18 to 19 October | | | | N | % | C/E | FO |
| | N | % | C/E | FO | N | % | C/E | FO | | | | |
| Goldeye | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 28 | 0.3 | 0.1 | 8 |
| Walleye | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 182 | 1.8 | 0.8 | 17 |
| Yellow perch | 15 | 4.1 | 0.7 | 33 | 0 | 0.0 | 0.0 | 0 | 212 | 2.1 | 0.9 | 21 |
| Northern pike | 0 | 0.0 | 0.0 | 0 | 2 | 0.6 | 0.1 | 10 | 59 | 0.6 | 0.3 | 8 |
| Lake whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 90 | 0.9 | 0.4 | 8 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 3 | <0.1 | <0.1 | 1 |
| Arctic grayling | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 7 | 0.1 | <0.1 | 2 |
| Sucker spp. ^a | 6 | 1.6 | 0.3 | 19 | 6 | 1.7 | 0.3 | 19 | 5 312 | 51.6 | 22.7 | 43 |
| Trout-perch | 197 | 53.2 | 9.4 | 67 | 43 | 12.0 | 2.1 | 38 | 2 737 | 26.6 | 11.7 | 62 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 16 | 0.2 | 0.1 | 6 |
| Flathead chub | 9 | 2.4 | 0.4 | 14 | 188 | 52.4 | 9.0 | 14 | 263 | 2.6 | 1.1 | 16 |
| Lake chub | 6 | 1.6 | 0.3 | 14 | 0 | 0.0 | 0.0 | 0 | 536 | 5.2 | 2.3 | 29 |
| Emerald shiner | 124 | 33.5 | 5.9 | 38 | 118 | 32.9 | 5.6 | 43 | 620 | 6.0 | 2.7 | 31 |
| Spottail shiner | 7 | 1.9 | 0.3 | 10 | 2 | 0.6 | 0.1 | 5 | 116 | 1.1 | 0.5 | 15 |
| Longnose dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 26 | 0.3 | 0.1 | 5 |
| Northern redbelly dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 4 | <0.1 | <0.1 | 2 |
| Finescale dace | 6 | 1.6 | 0.3 | 14 | 0 | 0.0 | 0.0 | 0 | 19 | 0.2 | 0.1 | 4 |
| Fathead minnow | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 13 | 0.1 | 0.1 | 4 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | <0.1 | <0.1 | 1 |
| Brook stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 8 | 0.1 | <0.1 | 3 |
| Slimy sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 13 | 0.1 | 0.1 | 3 |
| Spoonhead sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 26 | 0.3 | 0.1 | 7 |
| Total | 370 | | | | 359 | | | | 10 292 | | | |
| Number of Seine Hauls | | | | 21 | | | | 21 | | | | 234 |

^a Includes both longnose and white suckers.

Table 10. Numbers (N), percentage composition (%), average catch per seine haul (C/E), and percentage frequency of occurrence (FO) for fish captured in small mesh beach seines in the Delta study area, Athabasca River, 1977.

| Species | Date of Sample | | | | | | | | | | | |
|--------------------------|----------------|------|------|-----|--------------|------|------|----|---------------|------|------|----|
| | 15 to 17 May | | | | 7 to 10 June | | | | 17 to 20 June | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 3 | 1.9 | 0.4 | 29 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Walleye | 1 | 0.6 | 0.1 | 14 | 3 | 2.9 | 0.6 | 60 | 36 | 3.8 | 3.6 | 60 |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Northern pike | 5 | 3.2 | 0.7 | 43 | 0 | 0.0 | 0.0 | 0 | 5 | 0.5 | 0.5 | 30 |
| Lake whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.2 | 0.2 | 10 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Sucker spp. ^a | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 80 | 8.4 | 8.0 | 90 |
| Trout-perch | 88 | 56.4 | 12.6 | 100 | 53 | 52.0 | 10.6 | 80 | 361 | 37.9 | 36.1 | 90 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 41 | 40.2 | 8.2 | 40 | 31 | 3.2 | 3.1 | 50 |
| Flathead chub | 19 | 12.2 | 2.7 | 71 | 1 | 1.0 | 0.2 | 20 | 120 | 12.6 | 12.0 | 30 |
| Lake chub | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Emerald shiner | 26 | 16.7 | 3.7 | 57 | 4 | 3.9 | 0.8 | 40 | 235 | 24.7 | 23.5 | 70 |
| Spottail shiner | 14 | 9.0 | 2.0 | 71 | 0 | 0.0 | 0.0 | 0 | 70 | 7.3 | 7.0 | 50 |
| Longnose dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.1 | 0.1 | 10 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Brook stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Spoonhead sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 11 | 1.1 | 1.1 | 50 |
| Total | 156 | | | | 102 | | | | 952 | | | |
| Number of Seine Hauls | | | | 7 | | | | 5 | | | | 10 |

continued ...

Table 10. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|--------------------------|-------------------|------|------|----|---------------|------|------|----|---------------|------|------|----|
| | 29 June to 2 July | | | | 14 to 15 July | | | | 27 to 28 July | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 0 | 0.0 | 0.0 | 0 | 15 | 1.2 | 1.3 | 25 | 7 | 1.2 | 0.6 | 25 |
| Walleye | 7 | 1.3 | 0.6 | 17 | 19 | 1.6 | 1.6 | 42 | 5 | 0.9 | 0.4 | 17 |
| Yellow perch | 6 | 1.1 | 0.5 | 8 | 5 | 0.4 | 0.4 | 25 | 5 | 0.9 | 0.4 | 33 |
| Northern pike | 3 | 0.6 | 0.3 | 8 | 7 | 0.6 | 0.6 | 42 | 3 | 0.5 | 0.3 | 17 |
| Lake whitefish | 4 | 0.8 | 0.3 | 25 | 1 | 0.1 | 0.1 | 8 | 2 | 0.3 | 0.2 | 8 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.2 | 0.1 | 8 |
| Sucker spp. ^a | 160 | 30.3 | 13.3 | 67 | 171 | 14.0 | 14.3 | 83 | 64 | 11.0 | 5.3 | 50 |
| Trout-perch | 141 | 26.7 | 11.8 | 67 | 82 | 6.7 | 6.8 | 67 | 343 | 59.2 | 28.6 | 83 |
| Burbot | 2 | 0.4 | 0.2 | 17 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 69 | 13.1 | 5.8 | 42 | 176 | 14.5 | 14.7 | 83 | 72 | 12.4 | 6.0 | 75 |
| Lake chub | 3 | 0.6 | 0.3 | 17 | 0 | 0.0 | 0.0 | 0 | 1 | 0.2 | 0.1 | 8 |
| Emerald shiner | 70 | 13.2 | 5.8 | 75 | 550 | 45.2 | 45.8 | 58 | 36 | 6.2 | 3.0 | 58 |
| Spottail shiner | 63 | 11.9 | 5.3 | 67 | 189 | 15.5 | 15.8 | 42 | 40 | 6.9 | 3.3 | 67 |
| Longnose dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Brook stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Spoonhead sculpin | 0 | 0.0 | 0.0 | 0 | 2 | 0.2 | 0.2 | 8 | 0 | 0.0 | 0.0 | 0 |
| Total | 528 | | | | 1217 | | | | 579 | | | |
| Number of Seine Hauls | | | | 12 | | | | 12 | | | | 12 |

continued ...

Table 10. Continued.

| Species | Date of Sample | | | | | | | | | | | |
|--------------------------|----------------|------|------|----|-----------------|------|------|----|------------------|------|-------|----|
| | 9 to 10 August | | | | 23 to 27 August | | | | 6 to 7 September | | | |
| | N | % | C/E | FO | N | % | C/E | FO | N | % | C/E | FO |
| Goldeye | 1 | 0.2 | 0.1 | 10 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Walleye | 3 | 0.6 | 0.3 | 20 | 6 | 1.6 | 0.6 | 10 | 0 | 0.0 | 0.0 | 0 |
| Yellow perch | 4 | 0.8 | 0.4 | 20 | 2 | 0.5 | 0.2 | 10 | 3 | <0.1 | 0.3 | 18 |
| Northern pike | 2 | 0.4 | 0.2 | 10 | 0 | 0.0 | 0.0 | 0 | 1 | <0.1 | 0.1 | 9 |
| Lake whitefish | 0 | 0.0 | 0.0 | 0 | 1 | 0.3 | 0.1 | 10 | 0 | 0.0 | 0.0 | 0 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Sucker spp. ^a | 278 | 52.9 | 27.8 | 20 | 21 | 5.6 | 2.1 | 40 | 4 | <0.1 | 0.4 | 18 |
| Trout-perch | 104 | 19.8 | 10.4 | 80 | 153 | 40.6 | 15.3 | 90 | 77 | 0.7 | 7.0 | 54 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Flathead chub | 57 | 10.8 | 5.7 | 70 | 61 | 16.2 | 6.1 | 50 | 27 | 0.2 | 2.5 | 36 |
| Lake chub | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Emerald shiner | 36 | 6.8 | 3.6 | 70 | 79 | 21.0 | 7.9 | 50 | 10 866 | 98.3 | 987.8 | 64 |
| Spottail shiner | 40 | 7.6 | 4.0 | 70 | 53 | 14.0 | 5.3 | 90 | 71 | 0.6 | 6.5 | 64 |
| Longnose dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Ninespine stickleback | 1 | 0.2 | 0.1 | 10 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Brook stickleback | 0 | 0.0 | 0.0 | 0 | 1 | 0.3 | 0.1 | 10 | 0 | 0.0 | 0.0 | 0 |
| Spoonhead sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 |
| Total | 526 | | | | 377 | | | | 11 049 | | | |
| Number of Seine Hauls | | | | 10 | | | | 10 | | | | 11 |

continued ...

Table 10. Concluded.

| Species | Date of Sample | | | | | | | | Total | | | |
|--------------------------|--------------------|------|------|----|----------------|------|------|----|---------------------|------|-------|-----|
| | 20 to 22 September | | | | 6 to 7 October | | | | N | % | C/E | FO |
| | N | % | C/E | FO | N | % | C/E | FO | | | | |
| Goldeye | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 26 | 0.1 | 0.2 | 9 |
| Walleye | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 80 | 0.5 | 0.8 | 21 |
| Yellow perch | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 25 | 0.1 | 0.2 | 13 |
| Northern pike | 1 | 0.1 | 0.1 | 10 | 0 | 0.0 | 0.0 | 0 | 27 | 0.2 | 0.3 | 17 |
| Lake whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 10 | <0.1 | 0.1 | 7 |
| Mountain whitefish | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | <0.1 | <0.1 | 1 |
| Sucker spp. ^a | 10 | 1.5 | 1.0 | 10 | 0 | 0.0 | 0.0 | 0 | 788 | 4.8 | 7.4 | 40 |
| Trout-perch | 79 | 12.2 | 7.9 | 60 | 90 | 55.2 | 12.9 | 86 | 1 571 | 9.6 | 14.8 | 76 |
| Burbot | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 74 | 0.4 | 0.7 | 8 |
| Flathead chub | 224 | 34.6 | 22.4 | 40 | 36 | 22.1 | 5.1 | 57 | 862 | 5.3 | 8.1 | 63 |
| Lake chub | 1 | 0.1 | 0.1 | 10 | 0 | 0.0 | 0.0 | 0 | 5 | <0.1 | <0.1 | 4 |
| Emerald shiner | 274 | 42.3 | 27.4 | 70 | 15 | 9.2 | 2.1 | 43 | 12 191 ^b | 74.8 | 115.0 | 61 |
| Spottail shiner | 58 | 9.0 | 5.8 | 80 | 21 | 12.9 | 3.0 | 43 | 619 | 3.8 | 5.8 | 58 |
| Longnose dace | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | <0.1 | <0.1 | 1 |
| Ninespine stickleback | 0 | 0.0 | 0.0 | 0 | 1 | 0.6 | 0.1 | 14 | 2 | <0.1 | <0.1 | 2 |
| Brook stickleback | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 1 | <0.1 | <0.1 | 1 |
| Spoonhead sculpin | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | 0 | 13 | <0.1 | 0.1 | 2 |
| Total | 647 | | | | 163 | | | | 16 296 | | | |
| Number of Seine Hauls | | | | 10 | | | | 7 | | | | 106 |

^a Includes both longnose and white suckers.

^b An estimated 10 000 emerald shiners were taken in one seine haul.

Table 11. Numbers (N), percentage composition (%), and number of fish per hour of effort (C/E) for fish captured by angling in the Athabasca River, 1977.

| Species | Mildred Lake Study Area | | | Delta Study Area | | |
|-----------------|-------------------------|------|------------------|------------------|------|------------------|
| | N | % | C/E ^a | N | % | C/E ^b |
| Goldeye | 0 | 0.0 | 0.0 | 61 | 24.6 | 1.5 |
| Walleye | 23 | 34.3 | 1.5 | 8 | 3.2 | 0.2 |
| Northern pike | 32 | 48.0 | 2.1 | 178 | 71.8 | 4.3 |
| Burbot | 9 | 13.4 | 0.6 | 0 | 0.0 | 0.0 |
| Flathead chub | 1 | 1.5 | 0.1 | 1 | 0.4 | <0.1 |
| White sucker | 1 | 1.5 | 0.1 | 0 | 0.0 | 0.0 |
| Longnose sucker | 1 | 1.5 | 0.1 | 0 | 0.0 | 0.0 |
| Total | 67 | | | 248 | | |

^a Based on a total effort of 15 angler-hours.

^b Based on a total effort of 41.5 angler-hours.

Table 12. Summary of tagged fish released in the Athabasca River in 1977 and recaptured as of 31 October 1979.

| Species | Mildred Lake Study Area | | | | Delta Study Area | | | | Combined Study Areas | | | |
|-----------------|-------------------------|------|------------|------|------------------|------|------------|-----|----------------------|------|------------|-----|
| | Released | | Recaptured | | Released | | Recaptured | | Released | | Recaptured | |
| | N | % | N | % | N | % | N | % | N | % | N | % |
| Walleye | 378 | 8.4 | 38 | 10.1 | 147 | 6.4 | 10 | 6.8 | 525 | 7.7 | 48 | 9.1 |
| Goldeye | 1 006 | 22.4 | 24 | 2.4 | 906 | 39.4 | 24 | 2.6 | 1 912 | 28.2 | 48 | 2.5 |
| Northern pike | 287 | 6.4 | 30 | 10.5 | 370 | 16.1 | 31 | 8.4 | 657 | 9.7 | 61 | 9.3 |
| Lake whitefish | 1 206 | 26.9 | 34 | 2.8 | 719 | 31.3 | 12 | 1.7 | 1 925 | 28.4 | 46 | 2.4 |
| Longnose sucker | 1 041 | 23.2 | 31 | 3.0 | 123 | 5.4 | 0 | 0.0 | 1 164 | 17.2 | 31 | 2.7 |
| White sucker | 494 | 11.0 | 37 | 7.5 | 12 | 0.5 | 1 | 8.3 | 506 | 7.5 | 38 | 7.5 |
| Flathead chub | 28 | 0.6 | 1 | 3.6 | 18 | 0.8 | 0 | 0.0 | 46 | 0.7 | 1 | 2.2 |
| Burbot | 32 | 0.7 | 1 | 3.1 | 3 | 0.1 | 0 | 0.0 | 35 | 0.5 | 1 | 2.9 |
| Arctic grayling | 13 | 0.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 13 | 0.2 | 0 | 0.0 |
| Total | 4 485 | | 196 | 4.4 | 2 298 | | 78 | 3.4 | 6 783 | | 274 | 4.0 |

Table 13. Summary of fish tagged during 1976 and 1977 and recaptured as of 31 October 1979.

| Species | Tag Releases | | | | | | Tag Recaptures | |
|-----------------|--------------|------|-------|------|-------|------|----------------|------|
| | 1976 | | 1977 | | Total | | N | % |
| | N | % | N | % | N | % | | |
| Walleye | 434 | 17.2 | 525 | 7.7 | 959 | 10.3 | 82 | 8.6 |
| Goldeye | 1 123 | 44.4 | 1 912 | 28.2 | 3 035 | 32.6 | 66 | 2.2 |
| Northern pike | 282 | 11.2 | 657 | 9.7 | 939 | 10.1 | 96 | 10.2 |
| Lake whitefish | 464 | 18.3 | 1 925 | 28.4 | 2 389 | 25.7 | 65 | 2.7 |
| Longnose sucker | 103 | 4.1 | 1 164 | 17.2 | 1 267 | 13.6 | 34 | 2.7 |
| White sucker | 77 | 3.1 | 506 | 7.5 | 583 | 6.3 | 48 | 8.2 |
| Flathead chub | 32 | 1.3 | 46 | 0.7 | 78 | 0.8 | 2 | 2.6 |
| Burbot | 13 | 0.5 | 35 | 0.5 | 48 | 0.5 | 1 | 2.1 |
| Arctic grayling | 0 | 0.0 | 13 | 0.2 | 13 | 0.1 | 0 | 0.0 |
| Total | 2 528 | | 6 783 | | 9 311 | | 394 | 4.2 |

31 October 1979, 394 tagged fish had been recaptured for a recapture rate of 4.2% (Table 13). Fish recaptured at the original tagging site on the same day or on the following day were not included in the analysis. Complete details of all tag recaptures are presented in Appendix 6.4.

4.2 LIFE HISTORIES OF FISH SPECIES

4.2.1 Goldeye

4.2.1.1 Distribution and relative abundance. Among the larger fish species (those susceptible to capture by standard gangs and large mesh seines), goldeye was the most abundant species taken during 1977. In the Mildred Lake study area, goldeye were taken in 83% of all standard gangs, accounting for 48.4% of the total catch (Table 5). This species also dominated standard gang catches in the Delta study area where it occurred in 80% of all lifts and made up 38.3% of all fish taken (Table 6). Goldeye were taken in 47% of all large mesh seine hauls in the Mildred Lake study area and accounted for 22.2% of the total catch, second in overall abundance to lake whitefish (Table 7). These figures, however, are misleading because a disproportionate number of large mesh seine hauls in the Mildred Lake study area were made during the autumn as a result of a concerted effort to tag as many lake whitefish as possible during their spawning migration. As indicated in Table 7, 34% of all large mesh seine hauls made in the Mildred Lake study area were made between 25 September and 1 October when lake whitefish were at their greatest abundance and the numbers of goldeye were decreasing. Furthermore, 23% of all large mesh seine hauls were made during October when the numbers of goldeye in this area were at their lowest level. In the Delta study area, goldeye were taken in 52% of all large mesh seine hauls and comprised 62.5% of the total catch in that gear (Table 8).

Catch-per-unit-effort values produced by standard gangs (Table 5) and large mesh seines (Table 7) indicated that goldeye were present in abundance in the Mildred Lake study area by late April.

While generally remaining high throughout the summer, the catch-per-unit-effort tended to fluctuate, due in part to the effects of floods. This was especially true for standard gangs whose efficiency was greatly reduced during the high water levels of early June and mid-July (Figure 2). In the Delta study area, catch-per-unit-effort values for goldeye also remained fairly high throughout June, July, and August (Tables 6 and 8). Catch-per-unit-effort values in both study areas decreased during September and goldeye were seldom captured during October. This decrease in abundance in the autumn suggests that goldeye had left the Athabasca River.

During 1977, most goldeye were captured at Sites 1 to 6, 7 to 20, 21 to 24, 26, 28, 33 to 35, 37, 42, and 44 in the Mildred Lake study area. Most goldeye taken in the Delta study area were caught at Sites 51 to 56, 57 to 67, 59 to 72, 74 to 76, 83, 85, and 87 (Figure 4, Appendix 6.1). Goldeye were also taken by angling at Sites 68 and 78 (Figure 4).

4.2.1.2 Age and growth. Goldeye captured in 1977 ranged in fork length from 28 to 409 mm, with the vast majority (93%) falling within the 230 to 319 mm range (Tables 14 and 15). Length-frequency distributions in the two study areas were similar, with fish in the Delta study area tending to be slightly larger than those in the Mildred Lake study area.

During 1977, age determinations were performed on 692 goldeye, most of which were captured in standard gangs. While goldeye ranged from age 1 to age 9, the population inhabiting the Athabasca River was composed principally of age 4 (13%), 5 (34%), and 6 (43%) fish (Tables 16, 17, 18, and 19), which correspond to the 1973, 1972, and 1971 year classes respectively. The 1971 and 1972 year classes were also well represented in 1976 when they were captured as 4- and 5-year olds (Bond and Berry in prep.). The abundance of the 1971 year class was predictable as 1971 is known to have been an excellent year for goldeye production in the Claire-Mamawi system of the Peace-Athabasca Delta (Kooyman 1973; Donald and Kooyman 1974). The 1972 and 1973 year classes, however, are reputed to have been

Table 14. Length-frequency distribution by gear type for goldeye from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|-------|-------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | N | % |
| 160 to 169 | 0 | 0 | 2 | 0 | 2 | 0.1 |
| 170 to 179 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 180 to 189 | 1 | 0 | 0 | 0 | 1 | 0.1 |
| 190 to 199 | 1 | 0 | 0 | 0 | 1 | 0.1 |
| 200 to 209 | 1 | 0 | 2 | 0 | 3 | 0.2 |
| 210 to 219 | 4 | 0 | 2 | 0 | 6 | 0.4 |
| 220 to 229 | 5 | 0 | 5 | 1 | 11 | 0.8 |
| 230 to 239 | 15 | 3 | 13 | 0 | 31 | 2.1 |
| 240 to 249 | 35 | 14 | 50 | 0 | 99 | 6.9 |
| 250 to 259 | 73 | 23 | 137 | 8 | 241 | 16.7 |
| 260 to 269 | 86 | 13 | 170 | 9 | 278 | 19.3 |
| 270 to 279 | 94 | 15 | 164 | 4 | 277 | 19.2 |
| 280 to 289 | 60 | 11 | 104 | 0 | 175 | 12.1 |
| 290 to 299 | 41 | 5 | 98 | 0 | 144 | 10.0 |
| 300 to 309 | 33 | 7 | 47 | 1 | 88 | 6.1 |
| 310 to 319 | 14 | 4 | 34 | 0 | 52 | 3.6 |
| 320 to 329 | 7 | 2 | 12 | 0 | 21 | 1.5 |
| 330 to 339 | 2 | 0 | 2 | 0 | 4 | 0.3 |
| 340 to 349 | 1 | 1 | 1 | 0 | 3 | 0.2 |
| 350 to 359 | 0 | 1 | 2 | 0 | 3 | 0.2 |
| 360 to 369 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 370 to 379 | 0 | 0 | 1 | 0 | 1 | 0.1 |
| 380 to 389 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 390 to 399 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 400 to 409 | 0 | 0 | 1 | 0 | 1 | 0.1 |
| Totals | 473 | 99 | 847 | 23 | 1442 | 100.1 |

Table 15. Length-frequency distribution by gear type for goldeye from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 130 to 139 | 0 | 0 | 1 | 0 | 0 | 1 | 0.1 |
| 140 to 149 | 0 | 0 | 3 | 0 | 0 | 3 | 0.3 |
| 150 to 159 | 0 | 0 | 7 | 0 | 0 | 7 | 0.6 |
| 160 to 169 | 0 | 0 | 2 | 0 | 0 | 2 | 0.2 |
| 170 to 179 | 0 | 0 | 4 | 0 | 0 | 4 | 0.4 |
| 180 to 189 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 190 to 199 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 200 to 209 | 1 | 0 | 4 | 0 | 0 | 5 | 0.4 |
| 210 to 219 | 3 | 0 | 15 | 0 | 0 | 18 | 1.6 |
| 220 to 229 | 6 | 4 | 26 | 0 | 0 | 36 | 3.2 |
| 230 to 239 | 3 | 3 | 43 | 0 | 1 | 49 | 4.3 |
| 240 to 249 | 16 | 6 | 37 | 0 | 6 | 65 | 5.8 |
| 250 to 259 | 17 | 11 | 69 | 1 | 10 | 108 | 9.6 |
| 260 to 269 | 31 | 31 | 113 | 0 | 13 | 188 | 16.7 |
| 270 to 279 | 28 | 60 | 89 | 4 | 12 | 193 | 17.1 |
| 280 to 289 | 29 | 84 | 75 | 1 | 9 | 198 | 17.5 |
| 290 to 299 | 21 | 49 | 40 | 0 | 8 | 118 | 10.5 |
| 300 to 309 | 13 | 26 | 24 | 0 | 0 | 63 | 5.6 |
| 310 to 319 | 7 | 19 | 16 | 0 | 0 | 42 | 3.7 |
| 320 to 329 | 6 | 10 | 4 | 0 | 1 | 21 | 1.9 |
| 330 to 339 | 2 | 0 | 1 | 0 | 0 | 3 | 0.3 |
| 340 to 349 | 0 | 1 | 0 | 0 | 0 | 1 | 0.1 |
| 350 to 359 | 0 | 2 | 0 | 0 | 0 | 2 | 0.2 |
| 360 to 369 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 370 to 379 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 380 to 389 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 390 to 399 | 0 | 0 | 1 | 0 | 0 | 1 | 0.1 |
| Totals | 183 | 306 | 574 | 6 | 60 | 1129 | 100.2 |

Table 16. Age-length (mm) relationship for goldeye from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | ND | | | | ND | | | | 1 | 193.0 | | | |
| 4 | 27 | 247.7 | 17.80 | 209 to 282 | 31 | 249.6 | 21.22 | 211 to 300 | 63 | 247.7 | 19.31 | 209 to 300 | 0.373 |
| 5 | 85 | 264.2 | 14.31 | 141 to 318 | 86 | 271.3 | 17.22 | 232 to 306 | 174 | 267.7 | 16.13 | 232 to 318 | 2.929 ^a |
| 6 | 67 | 273.3 | 16.48 | 240 to 315 | 142 | 286.7 | 19.96 | 245 to 332 | 216 | 281.7 | 19.99 | 240 to 332 | 5.136 ^a |
| 7 | 1 | 252.0 | | | 3 | 287.0 | 21.12 | 274 to 307 | 4 | 278.2 | 24.57 | 252 to 307 | |
| 8 | 0 | | | | 0 | | | | 0 | | | | |
| 9 | 0 | | | | 0 | | | | 0 | | | | |
| Total | 180 | | | | 262 | | | | 458 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 17. Age-weight (g) relationship for goldeye from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | ND | | | | ND | | | | 1 | 60.0 | | | |
| 4 | 27 | 151.8 | 35.09 | 90 to 220 | 31 | 153.9 | 69.17 | 100 to 300 | 63 | 150.8 | 69.80 | 90 to 300 | 0.143 |
| 5 | 85 | 189.8 | 42.93 | 100 to 350 | 86 | 206.4 | 53.07 | 120 to 330 | 174 | 198.0 | 48.71 | 100 to 350 | 2.255 ^a |
| 6 | 67 | 219.1 | 59.31 | 120 to 340 | 142 | 256.5 | 70.94 | 140 to 440 | 216 | 242.1 | 69.68 | 120 to 440 | 3.986 ^a |
| 7 | 1 | 180.0 | | | 3 | 253.3 | 61.10 | 200 to 320 | 4 | 235.0 | 61.91 | 180 to 320 | |
| 8 | 0 | | | | 0 | | | | 0 | | | | |
| 9 | 0 | | | | 0 | | | | 0 | | | | |
| Total | 180 | | | | 262 | | | | 458 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 18. Age-length (mm) relationship for goldeye from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|-------|-------|------------|-----------------|-------|-------|------------|-----------------|-------|-------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | ND | | | | ^a 10 | 156.7 | 12.72 | 133 to 177 | ^a 13 | 157.5 | 11.76 | 133 to 177 | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 0 | | | | 0 | | | | 0 | | | | |
| 4 | 6 | 261.8 | 22.97 | 242 to 297 | 16 | 239.4 | 19.52 | 208 to 270 | 30 | 242.7 | 21.06 | 204 to 297 | 2.123 ^b |
| 5 | 27 | 274.1 | 20.41 | 245 to 314 | 33 | 268.8 | 11.71 | 249 to 290 | 63 | 270.2 | 16.63 | 241 to 314 | 1.186 |
| 6 | 17 | 277.2 | 14.50 | 245 to 300 | 64 | 290.7 | 18.67 | 249 to 330 | 83 | 287.2 | 19.00 | 245 to 330 | 3.211 ^b |
| 7 | 1 | 276.0 | | | 3 | 306.3 | 20.43 | 294 to 325 | 4 | 298.7 | 22.54 | 276 to 325 | |
| 8 | 0 | | | | 0 | | | | 0 | | | | |
| 9 | 0 | | | | 1 | 339.0 | | | 1 | 339.0 | | | |
| Total | 51 | | | | 127 | | | | 234 | | | | |

^a Fish from large mesh beach seines.

^b Significant difference between means for males and females ($P < 0.05$).

Table 19. Age-weight (g) relationship for goldeye from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|-------|-------|------------|-----------------|-------|-------|------------|-----------------|-------|-------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | ND | | | | ^a 10 | 40.3 | 12.01 | 20 to 64 | ^a 13 | 41.4 | 11.59 | 20 to 64 | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 0 | | | | 0 | | | | 0 | | | | |
| 4 | 6 | 195.0 | 50.89 | 140 to 280 | 16 | 146.9 | 43.32 | 80 to 210 | 30 | 149.7 | 47.60 | 80 to 280 | 2.054 |
| 5 | 27 | 219.3 | 62.26 | 130 to 350 | 33 | 200.0 | 29.58 | 150 to 250 | 63 | 206.5 | 47.63 | 130 to 350 | 1.476 |
| 6 | 17 | 233.5 | 47.03 | 160 to 320 | 64 | 278.6 | 62.56 | 150 to 420 | 83 | 267.0 | 62.95 | 150 to 420 | 3.258 ^b |
| 7 | 1 | 240.0 | | | 3 | 333.3 | 49.33 | 300 to 390 | 4 | 310.0 | 61.64 | 240 to 390 | |
| 8 | 0 | | | | 0 | | | | 0 | | | | |
| 9 | 0 | | | | 1 | 390.0 | | | 1 | 390.0 | | | |
| Total | 51 | | | | 117 | | | | 234 | | | | |

^a Fish from large mesh beach seines.

^b Significant difference between means for males and females ($P < 0.05$).

relatively less successful and their numbers in the Athabasca River in 1976 and 1977 were larger than expected. Intensive gill netting in the Claire-Mamawi system and the western end of Lake Athabasca in 1976 (Kristensen and Pidge 1977) showed the 1971, 1972, and 1973 year classes to make up the majority of the goldeye catch (95%). These authors pointed out that the 1972 and 1973 year classes were better represented in their Lake Athabasca samples than in samples taken at other locations. They disputed the suggestion, however, that the observed differences in age structure were related to the existence of two discrete populations. The 1972 and 1973 year classes from the Claire-Mamawi system may have been more successful than previously thought. On the other hand, spawning may occur in areas outside that complex, perhaps in Lake Athabasca itself.

Tables 16 and 17 summarize age-length and age-weight data, respectively, for goldeye captured in the Mildred Lake study area in 1977 while the corresponding information from the Delta area is shown in Tables 18 and 19. Bond and Berry (in prep.) reported that male and female goldeye captured from the Athabasca River in 1976 grew at the same rate. A different picture, however, emerged in 1977. Female goldeye from the Mildred Lake study area were significantly larger than males ($P < 0.05$), both in fork length and weight, at ages 5 and 6. In the Delta sample, males were significantly larger than females at age 4 (small sample), no difference existed at age 5, and at age 6, females were significantly larger than males. More efficient sampling of the goldeye population in 1977, as a result of the different standard gang utilized, is likely responsible for the identification of these divergent growth rates. Kennedy and Sprules (1967) reported that among older goldeye, females tend to be larger than males of equal age.

Length-weight relationships for goldeye captured from the Mildred Lake and Delta study areas are presented in Tables 20 and 21, respectively. Apart from the July sample in the Mildred Lake study area (Table 20), no statistically significant differences were found between the slopes of the regressions for males and females, either on a month-to-month basis or in the overall sample.

Table 20. Length-weight relationship by month for goldeye from the Mildred Lake study area, Athabasca River, 1977.

| Date | Sex | Number of Fish | Range in Fork Length (mm) | Slope (b) | Intercept (a) | sb | Correlation Coefficient (r) | Difference Test |
|---------------------|--------|----------------|---------------------------|-----------|---------------|-------|-----------------------------|--------------------|
| April to May | Male | 22 | 242 to 290 | 2.831 | -4.623 | 0.622 | 0.628 | 1.221 |
| | Female | 29 | 231 to 306 | 3.721 | -6.772 | 0.072 | 0.937 | |
| June | Male | 80 | 209 to 284 | 3.312 | -5.750 | 0.144 | 0.932 | 0.469 |
| | Female | 115 | 211 to 318 | 3.229 | -5.558 | 0.009 | 0.955 | |
| July | Male | 32 | 225 to 310 | 3.500 | -6.212 | 0.087 | 0.910 | 3.275 ^a |
| | Female | 14 | 264 to 290 | 5.336 | -10.714 | 0.047 | 0.806 | |
| August | Male | 20 | 248 to 306 | 2.966 | -4.889 | 0.107 | 0.883 | 1.312 |
| | Female | 30 | 242 to 329 | 3.482 | -6.169 | 0.030 | 0.967 | |
| September | Male | 18 | 265 to 318 | 2.807 | -4.480 | 0.062 | 0.904 | 1.517 |
| | Female | 44 | 250 to 330 | 3.385 | -5.908 | 0.050 | 0.957 | |
| October to November | Male | 9 | 180 to 315 | 3.283 | -5.630 | 0.020 | 0.994 | 1.222 |
| | Female | 30 | 258 to 315 | 2.943 | -4.787 | 0.048 | 0.917 | |
| Totals | Male | 181 | 180 to 318 | 3.406 | -5.976 | 0.013 | 0.917 | 1.364 |
| | Female | 262 | 209 to 330 | 3.581 | -6.406 | 0.005 | 0.951 | |

^a Significant difference between slopes ($P < 0.05$) for males and females.

Table 21. Length-weight relationships by month for goldeye from the Delta study area, Athabasca River, 1977.

| Date | Sex | Number of Fish | Range in Fork Length (mm) | Slope (b) | Intercept (a) | sb | Correlation Coefficient (r) | Difference Test |
|-----------|--------|----------------|---------------------------|-----------|---------------|-------|-----------------------------|-----------------|
| June | Male | 20 | 243 to 314 | 3.754 | -6.823 | 0.075 | 0.953 | 0.936 |
| | Female | 51 | 208 to 330 | 3.453 | -6.081 | 0.019 | 0.965 | |
| July | Male | 12 | 243 to 303 | 2.960 | -4.873 | 0.020 | 0.974 | 1.004 |
| | Female | 22 | 224 to 322 | 3.305 | -5.706 | 0.027 | 0.975 | |
| August | Male | 14 | 242 to 314 | 3.236 | -5.553 | 0.151 | 0.917 | 0.256 |
| | Female | 25 | 223 to 339 | 3.123 | -5.266 | 0.048 | 0.947 | |
| September | Male | 5 | 268 to 296 | 2.535 | -3.810 | 0.018 | 0.993 | 0.775 |
| | Female | 17 | 255 to 328 | 3.258 | -5.591 | 0.058 | 0.963 | |
| Totals | Male | 51 | 242 to 314 | 3.423 | -6.009 | 0.031 | 0.941 | 0.349 |
| | Female | 115 | 208 to 339 | 3.354 | -5.835 | 0.008 | 0.964 | |

4.2.1.3 Sex and maturity. Females tended to outnumber males in each age class, the deviation from a sex ratio of 1:1 being significant in age group 4 from the Delta sample and at age 6 in both study areas (Tables 22 and 23). The greatest deviation from a sex ratio of unity occurred among age 6 fish. Within this age class, females made up 68% in the Mildred Lake study area and 79% in the Delta study area. Of 2464 goldeye for which sex was determined (by inspection of gonads or anal fin differences), 64% were females. Male goldeye in Lake Claire first reach sexual maturity at age 6 while females do not begin to mature until age 7 (Scott and Crossman 1973). Since the Athabasca River below Fort McMurray is utilized solely by immature goldeye (Tables 22 and 23), the difference in age of maturity may explain why females dominated the 6-year-old age class in the samples. In 1976, when few age 6 fish were taken, males and females (age 4 and 5) were captured in approximately equal numbers (Bond and Berry in prep.).

4.2.1.4 Spawning. Approximately 99% of all goldeye examined in 1977 were sexually immature. A similar situation was observed in 1976 (Bond and Berry in prep.). It is evident, therefore, that goldeye do not utilize either the Mildred Lake or Delta study area for spawning purposes. Rather, it seems likely that upon reaching sexual maturity, the goldeye utilizing these sections of the Athabasca River as juveniles will contribute to the spawning population in the Lake Claire-Lake Mamawi area of the Peace-Athabasca Delta or in Lake Athabasca proper. During 1977, only one young-of-the-year goldeye (29 mm FL) was captured in the Mildred Lake study area while 20 (mean FL 38.3 mm; range 28 to 55 mm) were taken in the Delta study area.

4.2.1.5 Migrations and movements. Evidence from catch data and tag returns in 1976 (Bond and Berry in prep.) and 1977 (Tables 5, 6, 7, and 8; Appendix 6.4) indicates that, in both years, a large upstream run of immature goldeye occurred in the lower Athabasca River. The high catch-per-unit-effort values obtained for goldeye in the Mildred Lake study area in late April 1977 (Tables 5 and 7), shortly after

Table 22. Age-specific sex ratios and maturity for goldeye from the Mildred Lake study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|-----------|---------|------|----------|-------|-------|----------|--------------|-------|------|---------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 1 | 100.0 | 0.0 | 0 | 1 | 0.2 | |
| 2 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 3 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1 | 1 | 0.2 | |
| 4 | 31 | 53.4 | 0.0 | 27 | 46.6 | 0.0 | 5 | 63 | 13.7 | 0.276 |
| 5 | 86 | 50.3 | 1.2 | 85 | 49.7 | 0.0 | 3 | 174 | 37.9 | 0.006 |
| 6 | 142 | 67.9 | 0.7 | 67 | 32.1 | 0.0 | 7 | 216 | 47.0 | 16.914 ^a |
| 7 | 3 | 75.0 | 0.0 | 1 | 25.0 | 0.0 | 0 | 4 | 0.9 | |
| 8 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 9 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| Totals | 262 | 59.1 | 0.8 | 181 | 40.9 | 0.0 | 16 | 459 | 99.9 | 14.810 ^a |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

Table 23. Age-specific sex ratios and maturity for goldeye from the Delta study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ ² |
|-----------|---------|-------|----------|-------|------|----------|--------------|-------|-------|---------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 2 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 3 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 4 | 16 | 72.7 | 0.0 | 6 | 27.3 | 0.0 | 8 | 30 | 16.6 | 4.545 ^a |
| 5 | 33 | 55.0 | 0.0 | 27 | 45.0 | 0.0 | 3 | 63 | 34.8 | 0.600 |
| 6 | 64 | 79.0 | 3.1 | 17 | 21.0 | 0.0 | 2 | 83 | 45.9 | 27.272 ^a |
| 7 | 3 | 75.0 | 0.0 | 1 | 25.0 | 0.0 | 0 | 4 | 2.2 | |
| 8 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 9 | 1 | 100.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.5 | |
| Totals | 117 | 69.6 | 1.7 | 51 | 30.4 | 0.0 | 13 | 181 | 100.0 | 25.928 ^a |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

ice break-up, indicate that this migration was initiated under ice-cover. A decrease in catch-per-unit-effort in September and October suggests a downstream movement out of the Athabasca River at that time to overwintering areas in Lake Athabasca and/or the Lower Peace River.

Tag returns suggest that goldeye move long distances within the lower Athabasca system during the course of their spring and fall migrations but that movement is restricted during the summer months. Goldeye tagged in the Mildred Lake and Delta study areas in 1976 and 1977 have been recaptured in Lake Athabasca (N = 7), at Chenal des Quatre Fourches (N = 5), at Révillon Coupe (N = 1), and near Peace Point, 257 km upstream on the Peace River (N = 1). The maximum downstream movement observed for goldeye during the present study was 294 km. This fish was tagged at km 42.1 of the Athabasca River on 15 September 1976 and recaptured on 30 August 1977 at Quatre Fourches. During 1977, a maximum upstream movement of 131 km was recorded in the Athabasca River. This goldeye was tagged on 15 May at km 242.4 and was recaptured at km 110.1 on 28 June. In total, 1006 goldeye were tagged in the Mildred Lake study area during 1977 of which 24 have been recaptured (Appendix 6.4). Nineteen goldeye were recaptured in the Mildred Lake study area during 1977 after from 3 to 155 days, exhibiting movements of from 0 to 38 km. Nine of these fish were recaptured upstream from the point of tagging, six had moved downstream, and four were recaptured at the original tagging site. Of 906 goldeye tagged in the Delta study area in 1977, 24 were recaptured (Appendix 6.4). Fourteen were recaptured in the Delta study area, having moved from 0 to 32 km in from 2 to 36 days. Seven of these fish had moved upstream, two downstream, and five were recaptured at the original tagging site.

4.2.2 Walleye

4.2.2.1 Distribution and relative abundance. In the Mildred Lake study area, walleye made up 13.7% of the catch in standard gangs (Table 5) and 7.3% of the catch in large mesh seines (Table 7). High

catch-per-unit-effort values in late April and early May indicated that walleye were abundant in the Mildred Lake study area at that time (Tables 5 and 7). After mid-May, catch-per-unit-effort values produced by both standard gangs and large mesh seines decreased although walleye continued to be common, occurring in 75% of all standard gangs and 20% of all large mesh seine hauls in the Mildred Lake study area.

In the Delta study area, walleye were taken in 78% of all standard gangs and accounted for 23.8% of the catch in that gear (Table 6). They were taken in 19% of all hauls and made up 8.7% of the fish captured in large mesh seines (Table 8). For most of the summer, catch-per-unit-effort in standard gangs was approximately the same in the Delta study area as in the Mildred Lake study area. It rose sharply, however, on 19 to 21 September as a result of the capture of 32 walleye in a single overnight set at Site 56 (Figure 4). This increase in abundance in mid-September suggests that some walleye may have returned recently to the lower Athabasca River after having spent the summer upstream in the Athabasca River or in tributaries such as the Firebag and Richardson rivers. A similar, although less pronounced, increase in catch-per-unit-effort occurred in standard gangs in the Mildred Lake study area in mid-September (Table 5).

Young-of-the-year walleye occurred in greatest abundance in the Mildred Lake study area on 28 to 29 June. At that time they were caught in 64% of all small mesh seine hauls and accounted for 7.2% of the total catch in this gear (Table 9). By late August, few young-of-the-year walleye were to be found in the Mildred Lake study area of the Athabasca River. Although young-of-the-year walleye were not captured in large numbers in the Delta study area, they appeared to be most numerous in mid-June when they made up 3.8% of the catch in small mesh beach seines and occurred in 60% of all seine hauls (Table 10).

Most walleye in the Mildred Lake study area were captured at Sites 1 to 5, 7 to 17, 19 to 22, 25 to 28, 31, 33, 34, 36, 37, and 41 to 44 (Figure 4, Appendix 6.1). In the Delta study area, the largest walleye catches occurred at Sites 51 to 56, 57, 58, 61, 63 to 67, 69,

71, 72, 74 to 76, 78, 79, and 82 to 85. A few walleye were angled at Site 68 (Figure 4, Appendix 6.1).

4.2.2.2 Age and growth. Length-frequency distributions for walleye (excluding young-of-the-year) are shown by gear type for each study area in Tables 24 and 25. The length-frequency distributions for the two study areas are similar, with greater than 75% of all fish lying in the 300 to 479 mm range. Fork lengths ranged from 160 to 729 mm in the Mildred Lake study area and from 140 to 629 mm in the Delta study area.

Walleye captured in the Mildred Lake and Delta study areas of the Athabasca River in 1977 ranged in scale age from 1 to 13 years with 85% of all fish being age 4 to 8 inclusive (Tables 26, 27, 28, and 29). Jones et al. (1978) and Kristensen and Pidge (1977) reported walleye up to age 15 in the Athabasca River and Lake Athabasca, respectively. Age determinations by the former authors were based on otoliths.

The mean fork lengths for each age group (Tables 26 and 28) were considerably smaller than those found for the same age groups in 1976 (Bond and Berry in prep.) but larger than those shown by Jones et al. (1978). Kristensen and Pidge (1977) reported wide variations in mean fork length at each age for walleye captured at different locations in the west end of Lake Athabasca. The observed differences in mean size of walleye in 1977 as compared to 1976 (Bond and Berry in prep.) probably result from the use of a different standard gang in 1977. During 1976, the 10.2 cm mesh accounted for 43% of all walleye taken in standard gangs while the 5.1 cm mesh took 38%. In 1977, the 8.9, 6.3, and 3.8 cm mesh sizes that were not used in 1976 accounted for 14%, 19%, and 6%, respectively, of walleye captured in standard gangs while the 10.2 cm mesh captured only 21% of the total (Appendix 6.2). It is felt that the 1977 standard gang provided better coverage of each age group than did the 1976 gang which may have been more selective of the larger fish in some age classes.

Length-weight relationships for walleye captured from the Mildred Lake and Delta study area in 1977 are shown in Table 30. No

Table 24. Length-frequency distribution by gear type for walleye from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-----|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 160 to 169 | 0 | 0 | 2 | 0 | 0 | 2 | 0.4 |
| 170 to 179 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 180 to 189 | 1 | 0 | 1 | 0 | 0 | 2 | 0.4 |
| 190 to 199 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 200 to 209 | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| 210 to 219 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 220 to 229 | 2 | 0 | 1 | 0 | 0 | 3 | 0.6 |
| 230 to 239 | 3 | 1 | 2 | 1 | 0 | 7 | 1.3 |
| 240 to 249 | 1 | 0 | 1 | 0 | 0 | 2 | 0.4 |
| 250 to 259 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 260 to 269 | 3 | 0 | 2 | 0 | 0 | 5 | 0.9 |
| 270 to 279 | 2 | 1 | 0 | 0 | 0 | 3 | 0.6 |
| 280 to 289 | 2 | 0 | 0 | 0 | 2 | 4 | 0.7 |
| 290 to 299 | 4 | 0 | 6 | 1 | 0 | 11 | 2.1 |
| 300 to 309 | 3 | 0 | 5 | 0 | 0 | 8 | 1.5 |
| 310 to 319 | 3 | 0 | 3 | 1 | 1 | 8 | 1.5 |
| 320 to 329 | 6 | 0 | 7 | 0 | 1 | 14 | 2.6 |
| 330 to 339 | 3 | 0 | 13 | 0 | 1 | 17 | 3.2 |
| 340 to 349 | 8 | 0 | 7 | 1 | 0 | 16 | 3.0 |
| 350 to 359 | 4 | 1 | 8 | 0 | 2 | 15 | 2.8 |
| 360 to 369 | 8 | 1 | 10 | 1 | 3 | 23 | 4.3 |
| 370 to 379 | 12 | 3 | 15 | 0 | 1 | 31 | 5.8 |
| 380 to 389 | 10 | 1 | 18 | 0 | 0 | 29 | 5.4 |
| 390 to 399 | 3 | 1 | 12 | 0 | 1 | 17 | 3.2 |
| 400 to 409 | 7 | 4 | 12 | 1 | 1 | 25 | 4.7 |
| 410 to 419 | 13 | 3 | 23 | 0 | 2 | 41 | 7.6 |

continued ...

Table 24. Concluded.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 420 to 429 | 5 | 10 | 20 | 0 | 0 | 35 | 6.5 |
| 430 to 439 | 6 | 8 | 14 | 1 | 0 | 29 | 5.4 |
| 440 to 449 | 1 | 12 | 12 | 0 | 0 | 25 | 4.7 |
| 450 to 459 | 6 | 14 | 10 | 0 | 4 | 34 | 6.3 |
| 460 to 469 | 5 | 3 | 7 | 0 | 0 | 15 | 2.8 |
| 470 to 479 | 1 | 9 | 13 | 0 | 1 | 24 | 4.5 |
| 480 to 489 | 2 | 4 | 10 | 0 | 0 | 16 | 3.0 |
| 490 to 499 | 4 | 2 | 5 | 0 | 1 | 12 | 2.2 |
| 500 to 509 | 0 | 2 | 9 | 0 | 0 | 11 | 2.1 |
| 510 to 519 | 0 | 3 | 4 | 0 | 2 | 9 | 1.7 |
| 520 to 529 | 1 | 2 | 1 | 0 | 0 | 4 | 0.7 |
| 530 to 539 | 1 | 2 | 4 | 0 | 0 | 7 | 1.3 |
| 540 to 549 | 0 | 0 | 3 | 0 | 0 | 3 | 0.6 |
| 550 to 559 | 1 | 0 | 3 | 0 | 0 | 4 | 0.7 |
| 560 to 569 | 0 | 0 | 2 | 0 | 0 | 2 | 0.4 |
| 570 to 579 | 0 | 1 | 2 | 0 | 0 | 3 | 0.6 |
| 580 to 589 | 1 | 1 | 2 | 0 | 0 | 4 | 0.7 |
| 590 to 599 | 0 | 2 | 3 | 0 | 0 | 5 | 0.9 |
| 600 to 609 | 0 | 1 | 2 | 0 | 0 | 3 | 0.6 |
| 610 to 619 | 1 | 0 | 1 | 0 | 0 | 2 | 0.4 |
| 620 to 629 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 630 to 639 | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| 640 to 649 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 720 to 729 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| Totals | 135 | 93 | 278 | 7 | 23 | 536 | 100.3 |

Table 25. Length-frequency distribution by gear type for walleye from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-----|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 140 to 149 | 0 | 0 | 2 | 0 | 0 | 2 | 0.7 |
| 150 to 159 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 160 to 169 | 0 | 0 | 4 | 0 | 0 | 4 | 1.5 |
| 170 to 179 | 0 | 0 | 1 | 0 | 0 | 1 | 0.4 |
| 180 to 189 | 0 | 0 | 2 | 0 | 0 | 2 | 0.7 |
| 190 to 199 | 2 | 0 | 1 | 0 | 0 | 3 | 1.1 |
| 200 to 209 | 0 | 0 | 2 | 0 | 0 | 2 | 0.7 |
| 210 to 219 | 1 | 0 | 3 | 0 | 0 | 4 | 1.5 |
| 220 to 229 | 0 | 0 | 3 | 0 | 0 | 3 | 1.1 |
| 230 to 239 | 0 | 1 | 0 | 0 | 0 | 1 | 0.4 |
| 240 to 249 | 0 | 1 | 2 | 0 | 0 | 3 | 1.1 |
| 250 to 259 | 0 | 0 | 2 | 0 | 0 | 2 | 0.7 |
| 260 to 269 | 3 | 0 | 3 | 0 | 0 | 6 | 2.2 |
| 270 to 279 | 0 | 0 | 2 | 0 | 0 | 2 | 0.7 |
| 280 to 289 | 2 | 0 | 0 | 0 | 0 | 2 | 0.7 |
| 290 to 299 | 3 | 2 | 4 | 1 | 0 | 10 | 3.6 |
| 300 to 309 | 4 | 0 | 3 | 0 | 0 | 7 | 2.6 |
| 310 to 319 | 3 | 2 | 5 | 0 | 1 | 11 | 4.0 |
| 320 to 329 | 2 | 2 | 4 | 0 | 1 | 9 | 3.3 |
| 330 to 339 | 4 | 3 | 7 | 0 | 0 | 14 | 5.1 |
| 340 to 349 | 7 | 2 | 1 | 0 | 0 | 10 | 3.6 |
| 350 to 359 | 5 | 2 | 4 | 0 | 3 | 14 | 5.1 |
| 360 to 369 | 3 | 1 | 2 | 0 | 0 | 6 | 2.2 |
| 370 to 379 | 5 | 6 | 2 | 0 | 0 | 13 | 4.7 |
| 380 to 389 | 7 | 2 | 1 | 0 | 1 | 11 | 4.0 |
| 390 to 399 | 6 | 2 | 1 | 1 | 1 | 11 | 4.0 |

continued ...

Table 25. Concluded.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 400 to 409 | 11 | 3 | 1 | 0 | 0 | 15 | 5.5 |
| 410 to 419 | 12 | 4 | 1 | 0 | 0 | 17 | 6.2 |
| 420 to 429 | 10 | 7 | 3 | 0 | 0 | 20 | 7.3 |
| 430 to 439 | 8 | 5 | 2 | 0 | 1 | 16 | 5.8 |
| 440 to 449 | 5 | 6 | 2 | 0 | 0 | 13 | 4.7 |
| 450 to 459 | 1 | 7 | 1 | 0 | 0 | 9 | 3.3 |
| 460 to 469 | 1 | 7 | 0 | 0 | 0 | 8 | 2.9 |
| 470 to 479 | 3 | 4 | 2 | 0 | 0 | 9 | 3.3 |
| 480 to 489 | 0 | 3 | 1 | 0 | 0 | 4 | 1.5 |
| 490 to 499 | 0 | 1 | 0 | 0 | 0 | 1 | 0.4 |
| 500 to 509 | 1 | 5 | 0 | 0 | 0 | 6 | 2.2 |
| 510 to 519 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 520 to 529 | 1 | 0 | 1 | 0 | 0 | 2 | 0.7 |
| 530 to 539 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 620 to 629 | 0 | 0 | 1 | 0 | 0 | 1 | 0.4 |
| Totals | 110 | 78 | 76 | 2 | 8 | 274 | 99.9 |

Table 26. Age-length (mm) relationship for walleye from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | ND | | | | ND | | | | 3 | 222.0 | 13.11 | 208 to 234 | |
| 2 | ND | | | | 1 | 278.0 | | | 5 | 235.0 | 32.79 | 186 to 278 | |
| 3 | ND | | | | 1 | 263.0 | | | 4 | 266.0 | 7.53 | 260 to 277 | |
| 4 | 1 | 328.0 | | | 2 | 331.0 | 50.91 | 295 to 367 | 6 | 319.8 | 26.01 | 295 to 367 | |
| 5 | 10 | 386.7 | 34.24 | 334 to 454 | 6 | 373.7 | 18.43 | 350 to 407 | 27 | 361.8 | 42.75 | 286 to 454 | 0.988 |
| 6 | 22 | 387.3 | 27.36 | 327 to 432 | 12 | 387.9 | 41.38 | 326 to 444 | 42 | 379.2 | 37.37 | 287 to 444 | 0.048 |
| 7 | 6 | 404.2 | 26.50 | 365 to 434 | 4 | 455.0 | 31.80 | 411 to 487 | 11 | 418.4 | 40.95 | 358 to 487 | 2.640 ^a |
| 8 | 11 | 435.0 | 32.95 | 367 to 491 | 3 | 466.0 | 17.43 | 454 to 486 | 14 | 441.6 | 32.50 | 367 to 491 | 2.192 ^a |
| 9 | 3 | 457.7 | 3.79 | 445 to 462 | 1 | 585.0 | | | 4 | 489.5 | 63.76 | 445 to 585 | |
| 10 | 3 | 488.3 | 8.62 | 479 to 496 | 0 | | | | 3 | 488.3 | 8.62 | 479 to 496 | |
| 11 | 0 | | | | 1 | 635.0 | | | 1 | 635.0 | | | |
| 12 | 2 | 509.0 | 26.87 | 490 to 528 | 2 | 570.5 | 55.86 | 531 to 610 | 4 | 539.7 | 50.41 | 490 to 610 | 1.403 |
| 13 | 0 | | | | 1 | 550.0 | | | 1 | 550.0 | | | |
| Total | 58 | | | | 34 | | | | 125 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 27. Age-weight (g) relationship for walleye from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|--------|--------|--------------|---------|--------|--------|-------------|----------|--------|--------|--------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | ND | | | | ND | | | | 3 | 113.3 | 30.55 | 80 to 140 | |
| 2 | ND | | | | 1 | 220.0 | | | 5 | 120.0 | 61.24 | 50 to 220 | |
| 3 | ND | | | | 1 | 180.0 | | | 4 | 180.0 | 16.33 | 160 to 200 | |
| 4 | 1 | 380.0 | | | 2 | 310.0 | 141.42 | 210 to 410 | 6 | 301.7 | 86.12 | 210 to 410 | |
| 5 | 10 | 622.0 | 217.70 | 350 to 1060 | 6 | 545.0 | 63.79 | 460 to 620 | 27 | 511.8 | 215.07 | 210 to 1000 | 1.046 |
| 6 | 22 | 650.9 | 140.57 | 390 to 880 | 12 | 655.0 | 230.20 | 300 to 1030 | 42 | 603.8 | 191.96 | 200 to 1030 | 0.056 |
| 7 | 6 | 713.3 | 213.51 | 480 to 1030 | 4 | 1070.0 | 274.71 | 810 to 1450 | 11 | 820.9 | 299.18 | 470 to 1450 | 2.192 |
| 8 | 11 | 903.6 | 179.12 | 590 to 1230 | 3 | 1120.0 | 208.09 | 990 to 1360 | 14 | 950.0 | 199.58 | 590 to 1360 | 1.643 |
| 9 | 2 | 1105.0 | 21.21 | 1090 to 1120 | 1 | 2170.0 | | | 3 | 1460.0 | 615.06 | 1090 to 2170 | |
| 10 | 3 | 1333.3 | 130.51 | 1230 to 1480 | 0 | | | | 3 | 1333.3 | 130.51 | 1230 to 1480 | |
| 11 | 0 | | | | 0 | | | | 0 | | | | |
| 12 | 2 | 1495.0 | 148.49 | 1390 to 1600 | 1 | 1630.0 | | | 3 | 1540.0 | 130.77 | 1390 to 1630 | |
| 13 | 0 | | | | 1 | 2130.0 | | | 1 | 2130.0 | | | |
| Total | 58 | | | | 34 | | | | 125 | | | | |

Table 28. Age-length (mm) relationship for walleye from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|--------|--------|-------------|---------|-------|--------|-------------|----------|--------|--------|-------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | ND | | | | ND | | | | 3 | 83.3 | 5.78 | 80 to 90 | |
| 3 | ND | | | | ND | | | | 2 | 160.0 | | 160 to 160 | |
| 4 | 1 | 500.0 | | | 8 | 292.5 | 82.42 | 170 to 420 | 10 | 309.0 | 99.83 | 170 to 500 | |
| 5 | 1 | 600.0 | | | 4 | 350.0 | 100.99 | 250 to 460 | 12 | 403.3 | 134.66 | 250 to 660 | |
| 6 | 12 | 657.5 | 189.12 | 430 to 950 | 10 | 644.0 | 187.21 | 400 to 920 | 24 | 628.3 | 192.37 | 350 to 950 | 0.167 |
| 7 | 16 | 755.0 | 203.80 | 400 to 1080 | 10 | 745.0 | 149.31 | 540 to 960 | 27 | 731.1 | 206.27 | 210 to 1080 | 0.144 |
| 8 | 17 | 857.6 | 102.01 | 680 to 1010 | 7 | 907.1 | 245.88 | 580 to 1220 | 24 | 872.1 | 153.42 | 580 to 1220 | 0.515 |
| 9 | 2 | 890.0 | 127.28 | 800 to 980 | 0 | | | | 2 | 890.0 | 127.28 | 800 to 980 | |
| 10 | 1 | 1070.0 | | | 0 | | | | 1 | 1070.0 | | | |
| 11 | 1 | 1620.0 | | | 0 | | | | 1 | 1620.0 | | | |
| 12 | 0 | | | | 0 | | | | 0 | | | | |
| 13 | 1 | 1740.0 | | | 0 | | | | 1 | 1740.0 | | | |
| Total | 52 | | | | 39 | | | | 107 | | | | |

Table 29. Age-weight (g) relationship for walleye from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|---------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | ND | | | | ND | | | | 3 | 203.3 | 12.10 | 194 to 217 | |
| 3 | ND | | | | ND | | | | 2 | 261.0 | 1.41 | 260 to 262 | |
| 4 | 1 | 356.0 | | | 8 | 307.7 | 24.91 | 265 to 344 | 10 | 311.7 | 27.06 | 265 to 356 | |
| 5 | 1 | 400.0 | | | 4 | 324.0 | 29.06 | 298 to 353 | 12 | 344.7 | 36.23 | 298 to 400 | |
| 6 | 12 | 388.4 | 30.26 | 344 to 430 | 10 | 383.6 | 37.10 | 322 to 428 | 24 | 381.9 | 34.69 | 325 to 430 | 0.329 |
| 7 | 16 | 396.6 | 44.71 | 282 to 449 | 10 | 407.1 | 25.67 | 375 to 444 | 27 | 396.6 | 42.95 | 282 to 449 | 26.229 ^a |
| 8 | 17 | 419.0 | 24.85 | 376 to 473 | 7 | 437.4 | 34.23 | 381 to 474 | 24 | 424.4 | 28.44 | 376 to 474 | 1.290 |
| 9 | 2 | 415.0 | 18.38 | 402 to 428 | 0 | | | | 2 | 415.0 | 18.38 | 402 to 428 | |
| 10 | 1 | 405.0 | | | 0 | | | | 1 | 405.0 | | | |
| 11 | 1 | 502.0 | | | 0 | | | | 1 | 502.0 | | | |
| 12 | 0 | | | | 0 | | | | 0 | | | | |
| 13 | 1 | 520.0 | | | 0 | | | | 1 | 520.0 | | | |
| Total | 52 | | | | 39 | | | | 107 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 30. Length-weight relationships for walleye, lake whitefish, northern pike, and longnose suckers from the Mildred Lake and Delta study areas, Athabasca River, 1977.

| Species | Sex | Number of Fish | Range in Fork Length (mm) | Slope (b) | Intercept (a) | sb | Correlation Coefficient (r) | Difference Test |
|--------------------------|--------|----------------|---------------------------|-----------|---------------|-------|-----------------------------|--------------------|
| <u>Mildred Lake Area</u> | | | | | | | | |
| Walleye | Male | 57 | 327 to 528 | 3.292 | -5.716 | 0.072 | 0.855 | 0.046 |
| | Female | 32 | 263 to 585 | 3.278 | -5.700 | 0.010 | 0.986 | |
| Lake whitefish | Male | 63 | 323 to 466 | 2.977 | -4.769 | 0.019 | 0.940 | 0.092 |
| | Female | 62 | 327 to 478 | 2.956 | -4.696 | 0.032 | 0.904 | |
| Northern pike | Male | 19 | 230 to 684 | 3.036 | -5.230 | 0.006 | 0.995 | 0.928 |
| | Female | 32 | 377 to 790 | 3.181 | -5.630 | 0.018 | 0.974 | |
| Longnose suckers | Male | 28 | 329 to 447 | 2.638 | -3.950 | 0.017 | 0.970 | 0.794 |
| | Female | 31 | 315 to 514 | 2.816 | -4.419 | 0.024 | 0.958 | |
| <u>Delta Area</u> | | | | | | | | |
| Walleye | Male | 52 | 282 to 520 | 2.630 | -3.970 | 0.045 | 0.869 | 2.729 ^a |
| | Female | 39 | 265 to 474 | 3.242 | -5.598 | 0.008 | 0.986 | |
| Lake whitefish | Male | 36 | 309 to 450 | 3.066 | -4.968 | 0.021 | 0.964 | 1.880 |
| | Female | 26 | 238 to 451 | 3.391 | -5.795 | 0.008 | 0.991 | |
| Northern pike | Male | 25 | 328 to 580 | 2.819 | -4.666 | 0.015 | 0.979 | 0.920 |
| | Female | 30 | 378 to 632 | 2.603 | -4.085 | 0.039 | 0.927 | |
| Longnose suckers | Male | 9 | 371 to 440 | 1.988 | -2.232 | 0.182 | 0.870 | 0.942 |
| | Female | 13 | 377 to 522 | 2.545 | -3.690 | 0.082 | 0.937 | |

^a Significant difference between slopes ($P < 0.05$) for males and females.

significant difference was found between the slopes of the regression lines for males and females in the Mildred Lake study area but in the Delta sample the difference between slopes was significant ($P < 0.05$).

4.2.2.3 Sex and maturity. Age-specific sex ratios and maturity data for walleye collected in 1977 from the Mildred Lake and Delta study areas are presented in Tables 31 and 32, respectively. In the Mildred Lake sample, males outnumbered females significantly in the overall sample and at age 8 accounted for 83% of all walleye examined. Males and females occurred in approximately equal numbers overall in the Delta sample ($\chi^2 = 2.167$) although males outnumbered females significantly at age 8.

Sex ratios obtained for walleye can vary greatly according to the time of year at which the sample is taken and the proximity to the spawning area as a result of behavioural differences between the sexes. Priegel (1970) states that male walleye precede the females onto the spawning grounds and remain there throughout the spawning season whereas females arrive on the spawning grounds later and leave immediately after spawning. Thus, male walleye usually outnumber females during the spawning run (Machniak 1975a). The greater abundance of males in the Mildred Lake samples as compared with the Delta samples in 1977 is probably related to the fact that sampling began earlier in the season in the former study area (i.e., closer to the spawning period).

The youngest mature male walleye examined in 1977 in both study areas were four years old. In the Mildred Lake study area, the youngest mature female was age 5 while in the Delta study area two females were found to be mature at age 4. Virtually all males examined were sexually mature from age 4 on while females did not achieve 100% maturity until age 8.

When the maturity data for both years of the study are examined (see also Bond and Berry in prep.), it is apparent that male walleye from the Athabasca River tend to be mature at a younger age than females. At age 3, 20.0% of the males but none of the females examined were sexually mature. Mature females were first observed

Table 31. Age-specific sex ratios and maturity for walleye from the Mildred Lake study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex were determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|-----------|---------|-------|----------|-------|-------|----------|--------------|-------|-------|--------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 3 | 3 | 2.4 | |
| 2 | 1 | 100.0 | 0.0 | 0 | 0.0 | 0.0 | 4 | 5 | 4.0 | |
| 3 | 1 | 100.0 | 0.0 | 0 | 0.0 | 0.0 | 3 | 4 | 3.2 | |
| 4 | 2 | 66.7 | 0.0 | 1 | 33.3 | 100.0 | 3 | 6 | 4.8 | |
| 5 | 6 | 37.5 | 66.7 | 10 | 62.5 | 80.0 | 11 | 27 | 21.6 | 1.000 |
| 6 | 12 | 35.3 | 75.0 | 22 | 64.7 | 100.0 | 8 | 42 | 33.6 | 2.940 |
| 7 | 4 | 40.0 | 75.0 | 6 | 60.0 | 83.3 | 1 | 11 | 8.8 | 0.400 |
| 8 | 3 | 21.4 | 100.0 | 11 | 78.6 | 100.0 | 0 | 14 | 11.7 | 4.570 ^a |
| 9 | 1 | 25.0 | 100.0 | 3 | 75.0 | 100.0 | 0 | 4 | 3.2 | |
| 10 | 0 | 0.0 | 0.0 | 3 | 100.0 | 100.0 | 0 | 3 | 2.4 | |
| 11 | 1 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.8 | |
| 12 | 2 | 50.0 | 100.0 | 2 | 50.0 | 100.0 | 0 | 4 | 3.2 | |
| 13 | 1 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.8 | |
| Totals | 34 | 37.0 | 82.4 | 58 | 63.0 | 94.8 | 33 | 125 | 100.5 | 6.260 ^a |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

Table 32. Age-specific sex ratios and maturity for walleye from the Delta study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ ² |
|-----------|---------|------|----------|-------|-------|----------|--------------|-------|------|--------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 2 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 3 | 3 | 2.8 | |
| 3 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 2 | 2 | 1.9 | |
| 4 | 8 | 88.9 | 25.0 | 1 | 11.1 | 100.0 | 1 | 10 | 9.3 | |
| 5 | 4 | 80.0 | 50.0 | 1 | 20.0 | 0.0 | 7 | 12 | 11.2 | |
| 6 | 10 | 45.5 | 60.0 | 12 | 54.5 | 75.0 | 2 | 24 | 22.4 | 0.182 |
| 7 | 10 | 38.5 | 90.0 | 16 | 62.5 | 100.0 | 1 | 27 | 25.2 | 1.385 |
| 8 | 7 | 29.2 | 100.0 | 17 | 70.8 | 100.0 | 0 | 24 | 22.4 | 4.167 ^a |
| 9 | 0 | 0.0 | 0.0 | 2 | 100.0 | 100.0 | 0 | 2 | 1.9 | |
| 10 | 0 | 0.0 | 0.0 | 1 | 100.0 | 100.0 | 0 | 1 | 0.9 | |
| 11 | 0 | 0.0 | 0.0 | 1 | 100.0 | 100.0 | 0 | 1 | 0.9 | |
| 12 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 13 | 0 | 0.0 | 0.0 | 1 | 100.0 | 100.0 | 0 | 1 | 0.9 | |
| Totals | 39 | 42.9 | 66.7 | 52 | 57.1 | 92.3 | 16 | 107 | 99.8 | 2.167 |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

at age 4 when 11.1% of the specimens were mature while 68.4% of the males examined were mature at this age. At ages 5, 6, and 7, 89.1, 93.4, and 98.0%, respectively, of males were sexually mature. The corresponding values for females at the same ages were 52.9, 79.4, and 92.9%. All walleye of both sexes were mature at age 8. Bidgood (1971) reported that male walleye spawned for the first time at age 4 in Richardson Lake (Figure 1) while females first matured at four to six years of age.

4.2.2.4 Spawning. Walleye spawning was not observed in 1977 although a spawning migration was clearly underway when sampling began in the Mildred Lake study area in mid-April. Ripe males were captured as early as 22 April while the first ripe female was taken 1 May. The first spent female was captured 1 May and spent females were taken as late as 12 July. No spent male was reported until 13 July. Spent males were undoubtedly in the area much earlier than this but may have been mistaken for ripe if not dissected since spent males may continue to exude milt for some time after spawning. Machniak and Bond (1979) reported 222 walleye moving upstream in the Steepbank River between 2 and 28 May 1977 (most between 9 and 12 May). Virtually all of these fish were males and were observed to be running milt. However, upon gonadal inspection, they were found to be spawned out. Sixty-two percent (62%) of these fish remained in the Steepbank River beyond 28 May.

Young-of-the-year walleye (N = 79) captured in the Mildred Lake study area on 28 to 29 June had a mean fork length of 34.7 mm (range 24 to 56 mm). By 10 August, young-of-the-year walleye (N = 35) averaged 76.5 mm with a range of 49 to 98 mm.

Sampling in the Delta study area began on 14 May, by which time it is suspected most walleye spawning had been completed. No ripe females were taken in this area but spent females were captured between 3 and 28 June. Ripe and spent males were reported on 16 May and 6 June, respectively. Spawning in the Delta is known to occur in Richardson Lake (Figure 1) but it is doubtful that any spawning occurs in the main river in this area because of the unsuitable substrate.

It is suspected that walleye spawn in the Athabasca and/or Clearwater rivers upstream from Fort McMurray although some tributary spawning may occur. Walleye did not spawn, however, in the Muskeg River in 1976 or 1977 (Bond and Machniak 1977, 1979), the Steepbank River in 1977 (Machniak and Bond 1979), or the MacKay River in 1978 (Machniak et al. in prep.).

4.2.2.5 Fecundity. Fecundity was estimated gravimetrically for six mature female walleye captured between 29 April and 4 May 1977 in the Mildred Lake study area. For these fish, which ranged from 473 to 613 mm in fork length, fecundity estimates ranged from 39 466 to 117 588 eggs, with a mean of 79 970 eggs per female (Table 33). Length-relative fecundity ranged from 834.4 to 1918.2 ova per cm of fork length while weight-relative fecundity varied from 41.3 to 46.4 ova per gram of body weight.

4.2.2.6 Migrations and movements. High catch-per-unit-effort values and the presence of ripe fish indicated that a walleye spawning migration was in progress in the Mildred Lake study area when sampling began on 17 April 1977. Most walleye, however, had completed spawning and left the area by mid-May (Tables 5 and 7). It is likely that most female walleye returned downstream shortly after spawning as few were captured in the Athabasca River. Males, however, apparently tended to remain in the Mildred Lake study area for a longer period of time following the spawning period. Post-spawning migrations of spent walleye have been observed in the Steepbank River in May 1977 (Machniak and Bond 1979) and in the MacKay River in May 1978 (Machniak et al. in prep.). The length of time spent in the tributaries by male walleye is uncertain but the available evidence suggests that they leave during the summer (McCart et al. 1979; Machniak and Bond 1979; Machniak et al. in prep.). Machniak and Bond (1979) reported that of 222 walleye counted upstream in the Steepbank River during May, 85 had returned downstream by 29 May while only three were captured at a downstream trap operated from 12 September to 15 October.

Table 33. Fecundity estimates for walleye from the Athabasca River, 24 April to 4 May 1977.

| Fork Length (mm) | Weight (g) | Estimated Number of Eggs | Relative Fecundity ^a | |
|---------------------|---------------|-----------------------------|---------------------------------|--------|
| | | | Eggs/cm | Eggs/g |
| 473 | ND | 39 466 | 834.4 | ND |
| 475 | 1 300 | 60 348 | 1 270.5 | 46.4 |
| 500 | 1 480 | 61 142 | 1 222.8 | 41.3 |
| 557 | 1 890 | 86 602 | 1 554.8 | 45.8 |
| 608 | 2 640 | 114 671 | 1 886.0 | 43.4 |
| 613 | 2 590 | 117 588 | 1 918.2 | 45.4 |

^a Number of eggs per cm of fork length and per g of body weight.

During the two years of the present study, a total of 959 walleye were tagged and 82 were recovered for a return rate of 8.6% (Table 13, Appendix 6.4). Twenty-four tagged walleye were recaptured in Lake Athabasca or the Peace-Athabasca Delta suggesting that some walleye that spawn in or upstream of the Mildred Lake study area belong to the Lake Athabasca population and return to the lake to overwinter. The post-spawning downstream movement back to the lake may be very rapid (females?) as shown by Bond and Berry (in prep.). Further evidence of rapid downstream movement to the lake was gathered in 1977 as three fish were recaptured there after having travelled 246 to 272 km in 34 to 55 days. Five walleye, tagged in the Delta study area in June, were recaptured in Lake Athabasca after 22 to 30 days. On the other hand some walleye (males?) apparently wander extensively, often entering tributaries. Tagged walleye have been recaptured 1 km upstream in the Muskeg River (N = 2), at the Poplar Creek bridge 1 km upstream of the tributary mouth (N = 3), and from 2 to 60 km upstream in the MacKay River (N = 6). One walleye, tagged at km 27.5 on 29 April 1977, was recaptured at the town of Jarvie on the Pembina River in March 1978 after having travelled approximately 600 km upstream.

4.2.3 Lake Whitefish

4.2.3.1 Distribution and relative abundance. In the Mildred Lake study area, lake whitefish accounted for 13.6% of all fish captured in standard gangs (Table 5) and 27.6% of the total catch in large mesh seines (Table 7). As indicated earlier, however, the latter figure was inflated by efforts to capture as many whitefish as possible for tagging during their spawning migration. Of 410 large mesh seine hauls made in this area during the year, 34% were made between 25 September and 1 October and these hauls produced 72% of all whitefish caught in this gear. In the Delta study area, lake whitefish made up 15.5% of the total catch from standard gangs (Table 6) and 8.1% in large mesh seines (Table 8).

Fluctuations in lake whitefish abundance in the two study areas in 1977 are indicated by variations in the catch-per-unit-effort values presented in Tables 5, 6, 7, and 8. Considerable numbers of lake whitefish were present in the Mildred Lake study area in late April and early May. This event was not detected in 1976 (Bond and Berry in prep.) because of a late start in the sampling program that year but suggests strongly that some whitefish overwinter in the Athabasca River, or they may simply have accompanied other spring migrants during their spawning runs (walleye, longnose suckers, and white suckers). The catch-per-unit-effort decreased sharply in May indicating that whitefish had left the study area. Small numbers are reported to have entered the Muskeg River (Bond and Machniak 1979) as well as the Steepbank River (Machniak and Bond 1979) during May 1977. Thirty-nine lake whitefish (age 4 to 7) were counted moving upstream in the Steepbank River, of which only four had returned downstream by 29 May. None was taken during a fall fence operation suggesting that they had left the tributary during the summer. Lake whitefish were seldom captured in the Mildred Lake study area from the end of May to mid-August. Beginning in mid-August, however, catch-per-unit-effort values for lake whitefish increased rapidly and reached a peak between 20 September and 5 October. Catch-per-unit-effort then decreased steadily until the end of October as the migration passed upstream through the study area. Standard gangs indicated that lake whitefish were still numerous but decreasing in abundance in early November (Table 5).

Lake whitefish were seldom taken in the Delta study area prior to the commencement of the spawning run in late August (Tables 6 and 8). The peak of the spawning run passed the Delta on 6 September, approximately two to three weeks prior to its arrival in the Mildred Lake study area.

Only 94 young-of-the-year lake whitefish were captured in the Athabasca River in 1977. Of this number, 84 were caught in the Mildred Lake study area, 75% of them being taken on 16 to 19 June (Table 9).

During 1977, the majority of lake whitefish were captured at Sites 1 to 5, 7 to 23, 25 to 28, 36, 37, and 42 in the Mildred Lake area and at Sites 51, 53, 54, 56, 57, 59, 62, 63, 66 to 69, 71, 78, 79, and 83 to 85 in the Delta study area (Figure 4, Appendix 6.1).

4.2.3.2 Age and growth. Lake whitefish captured during 1977 ranged in fork length from 22 to 539 mm. Young-of-the-year had fork lengths of 22 to 130 mm. The length-frequency distributions for larger lake whitefish taken by each gear type in the Mildred Lake and Delta study areas are shown in Tables 34 and 35, respectively. In the Mildred Lake sample, 92% of the whitefish were within the 340 to 449 mm range in fork length, while in the Delta, the corresponding figure was 87%.

Lake whitefish captured in 1977 ranged in age from 1 to 13 years although the majority (95%) belonged to age groups 4 to 8 inclusive. Tables 36 and 37 present age-length and age-weight summaries for lake whitefish captured from the Mildred Lake study area while the corresponding information for the Delta study area is summarized in Tables 38 and 39. Age-length relationships compare quite closely with 1976 results (Bond and Berry in prep.). Mean weights at age showed more variation from 1976 results than did mean lengths but considering the wide ranges in weight reported within age groups, this variation does not seem excessive.

Male and female lake whitefish appear to increase in fork length at approximately equal rates, although age 7 females were significantly larger than males of the same age in the Mildred Lake study area ($t = 2.598$; $P < 0.05$). Females tended to be heavier than males of equal age but a significant difference occurred only among age 7 fish in the Mildred sample ($t = 2.983$; $P < 0.05$).

Length-weight relationships for male and female lake whitefish captured from the Mildred Lake and Delta study areas in 1977 are presented in Table 30. No significant differences occurred between the slopes of the regression lines for males and females in either study area ($P > 0.05$).

Table 34. Length-frequency distribution by gear type for lake whitefish from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|-------|------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | N | % |
| 150 to 159 | 0 | 0 | 0 | 1 | 1 | 0.1 |
| 180 to 189 | 0 | 0 | 0 | 1 | 1 | 0.1 |
| 290 to 299 | 0 | 0 | 2 | 0 | 2 | 0.1 |
| 300 to 309 | 0 | 0 | 2 | 0 | 2 | 0.1 |
| 310 to 319 | 0 | 4 | 2 | 0 | 6 | 0.4 |
| 320 to 329 | 4 | 8 | 9 | 0 | 21 | 1.5 |
| 330 to 339 | 0 | 10 | 10 | 1 | 21 | 1.5 |
| 340 to 349 | 8 | 29 | 24 | 1 | 62 | 4.5 |
| 350 to 359 | 5 | 31 | 63 | 0 | 99 | 7.2 |
| 360 to 369 | 15 | 22 | 85 | 0 | 122 | 8.8 |
| 370 to 379 | 11 | 34 | 100 | 1 | 146 | 10.6 |
| 380 to 389 | 23 | 17 | 134 | 0 | 174 | 12.6 |
| 390 to 399 | 18 | 20 | 132 | 0 | 170 | 12.3 |
| 400 to 409 | 16 | 9 | 130 | 0 | 155 | 11.2 |
| 410 to 419 | 6 | 6 | 105 | 0 | 117 | 8.5 |
| 420 to 429 | 5 | 5 | 93 | 0 | 103 | 7.4 |
| 430 to 439 | 7 | 2 | 73 | 0 | 82 | 5.9 |
| 440 to 449 | 6 | 2 | 41 | 0 | 49 | 3.5 |
| 450 to 459 | 1 | 1 | 22 | 0 | 24 | 1.7 |
| 460 to 469 | 2 | 0 | 6 | 0 | 8 | 0.6 |
| 470 to 479 | 3 | 0 | 7 | 0 | 10 | 0.7 |
| 480 to 489 | 0 | 0 | 2 | 0 | 2 | 0.1 |
| 490 to 499 | 0 | 0 | 2 | 0 | 2 | 0.1 |
| 500 to 599 | 0 | 0 | 2 | 0 | 2 | 0.1 |
| 510 to 519 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 520 to 529 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 530 to 539 | 0 | 0 | 1 | 0 | 1 | 0.1 |
| Totals | 131 | 200 | 1047 | 5 | 1383 | 99.7 |

Table 35. Length-frequency distribution by gear type for lake whitefish from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | Total | |
|---------------------|-------------------|----------------------|----------------------|-------|------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | N | % |
| 120 to 129 | 0 | 0 | 6 | 6 | 0.7 |
| 130 to 139 | 1 | 0 | 6 | 7 | 0.9 |
| 140 to 149 | 0 | 0 | 5 | 5 | 0.6 |
| 210 to 219 | 0 | 0 | 2 | 2 | 0.2 |
| 230 to 239 | 1 | 0 | 0 | 1 | 0.1 |
| 240 to 249 | 3 | 2 | 1 | 6 | 0.7 |
| 250 to 259 | 0 | 1 | 0 | 1 | 0.1 |
| 260 to 269 | 0 | 2 | 2 | 4 | 0.5 |
| 270 to 279 | 0 | 2 | 0 | 2 | 0.2 |
| 280 to 289 | 1 | 1 | 0 | 2 | 0.2 |
| 290 to 299 | 2 | 2 | 0 | 4 | 0.5 |
| 300 to 309 | 2 | 5 | 0 | 7 | 0.9 |
| 310 to 319 | 3 | 4 | 0 | 7 | 0.9 |
| 320 to 329 | 0 | 7 | 1 | 8 | 1.0 |
| 330 to 339 | 1 | 14 | 0 | 15 | 1.8 |
| 340 to 349 | 4 | 14 | 3 | 21 | 2.6 |
| 350 to 359 | 2 | 39 | 3 | 44 | 5.3 |
| 360 to 369 | 2 | 60 | 0 | 62 | 7.5 |
| 370 to 379 | 5 | 78 | 5 | 88 | 10.7 |
| 380 to 389 | 5 | 87 | 6 | 98 | 11.9 |
| 390 to 399 | 11 | 87 | 5 | 103 | 12.5 |
| 400 to 409 | 6 | 72 | 6 | 84 | 10.2 |
| 410 to 419 | 8 | 78 | 9 | 95 | 11.5 |
| 420 to 429 | 7 | 44 | 2 | 53 | 6.4 |
| 430 to 439 | 4 | 35 | 3 | 42 | 5.1 |
| 440 to 449 | 2 | 18 | 4 | 24 | 2.9 |
| 450 to 459 | 2 | 10 | 3 | 15 | 1.8 |
| 460 to 469 | 0 | 7 | 1 | 8 | 1.0 |
| 470 to 479 | 0 | 3 | 2 | 5 | 0.6 |
| 480 to 489 | 0 | 4 | 0 | 4 | 0.5 |
| 490 to 499 | 0 | 0 | 0 | 0 | 0.0 |
| Totals | 72 | 676 | 75 | 823 | 99.8 |

Table 36. Age-length (mm) relationship for lake whitefish from the Mildred Lake study area, Athabasca River 1977. Sexes separate and combined (include unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 1 | 380.0 | | | 1 | 384.0 | | | 2 | 382.0 | 2.80 | 380 to 384 | |
| 4 | 6 | 368.5 | 21.65 | 340 to 403 | 2 | 359.0 | 16.97 | 347 to 371 | 8 | 366.1 | 19.88 | 340 to 403 | 0.637 |
| 5 | 16 | 359.1 | 19.67 | 323 to 390 | 9 | 368.0 | 24.89 | 327 to 407 | 25 | 362.3 | 21.62 | 323 to 407 | 0.921 |
| 6 | 12 | 400.0 | 16.46 | 382 to 436 | 18 | 391.7 | 17.22 | 363 to 436 | 30 | 395.1 | 17.13 | 363 to 436 | 1.325 |
| 7 | 13 | 374.7 | 26.33 | 329 to 408 | 15 | 400.8 | 26.73 | 342 to 445 | 28 | 388.7 | 29.23 | 329 to 445 | 2.598 ^a |
| 8 | 10 | 397.9 | 27.95 | 366 to 463 | 9 | 413.7 | 28.29 | 361 to 444 | 19 | 405.4 | 28.49 | 361 to 463 | 1.220 |
| 9 | 3 | 433.0 | 7.21 | 427 to 441 | 5 | 429.2 | 43.85 | 362 to 478 | 8 | 430.6 | 33.43 | 362 to 478 | 0.190 |
| 10 | 1 | 385.0 | | | 1 | 387.0 | | | 2 | 386.0 | 1.41 | 385 to 387 | |
| 11 | 0 | | | | 2 | 451.5 | 30.40 | 430 to 473 | 2 | 451.5 | 30.40 | 430 to 473 | |
| 12 | 0 | | | | 0 | | | | 0 | | | | |
| 13 | 1 | 466.0 | | | 0 | | | | 1 | 466.0 | | | |
| Total | 63 | | | | 62 | | | | 125 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 37. Age-weight (g) relationship for lake whitefish from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|--------|--------|--------------|---------|--------|--------|--------------|----------|--------|--------|--------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 1 | 800.0 | | | 1 | 800.0 | | | 2 | 800.0 | 0 | | |
| 4 | 6 | 753.3 | 150.69 | 610 to 1030 | 2 | 815.0 | 91.92 | 750 to 880 | 8 | 768.7 | 135.06 | 610 to 1030 | 0.689 |
| 5 | 16 | 706.9 | 132.50 | 510 to 920 | 9 | 804.4 | 189.94 | 480 to 1060 | 25 | 742.4 | 157.05 | 480 to 1060 | 1.396 |
| 6 | 12 | 960.8 | 162.73 | 670 to 1260 | 18 | 983.3 | 189.40 | 690 to 1400 | 30 | 947.3 | 175.15 | 670 to 1400 | 0.347 |
| 7 | 13 | 779.2 | 176.28 | 500 to 1040 | 15 | 1000.0 | 215.21 | 590 to 1310 | 28 | 897.5 | 224.49 | 500 to 1310 | 2.983 ^a |
| 8 | 10 | 944.0 | 228.77 | 680 to 1490 | 9 | 1107.8 | 269.39 | 660 to 1580 | 19 | 1021.6 | 255.89 | 660 to 1580 | 1.420 |
| 9 | 3 | 1190.0 | 60.83 | 1120 to 1230 | 5 | 1178.0 | 333.05 | 750 to 1600 | 8 | 1182.5 | 253.93 | 750 to 1600 | 0.078 |
| 10 | 1 | 810.0 | | | 1 | 900.0 | | | 2 | 855.0 | 63.64 | 810 to 900 | |
| 11 | 0 | | | | 2 | 1545.0 | 530.33 | 1170 to 1920 | 2 | 1545.0 | 530.33 | 1170 to 1920 | |
| 12 | 0 | | | | 0 | | | | 0 | | | | |
| 13 | 1 | 1480.0 | | | 0 | | | | 1 | 1480.0 | | | |
| Total | 63 | | | | 62 | | | | 125 | | | | |

^a Significant difference between means for males and females (P < 0.05).

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Table 38. Age-length (mm) relationship for lake whitefish from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 1 | 138.0 | | | |
| 1 | 0 | | | | 0 | | | | 2 | 242.0 | 1.41 | 241 to 243 | |
| 2 | 1 | 314.0 | | | 1 | 246.0 | | | 2 | 280.0 | 48.08 | 246 to 314 | |
| 3 | 1 | 377.0 | | | 4 | 296.5 | 47.87 | 238 to 350 | 5 | 312.6 | 54.91 | 238 to 377 | |
| 4 | 3 | 374.3 | 42.48 | 309 to 393 | 1 | 425.0 | | | 4 | 366.7 | 52.07 | 309 to 425 | |
| 5 | 12 | 378.2 | 22.73 | 318 to 402 | 4 | 390.7 | 17.93 | 373 to 413 | 16 | 381.4 | 21.78 | 318 to 413 | 1.125 |
| 6 | 10 | 408.9 | 15.11 | 389 to 437 | 9 | 396.4 | 52.44 | 296 to 451 | 19 | 403.0 | 37.11 | 296 to 451 | 0.688 |
| 7 | 3 | 407.7 | 8.96 | 402 to 418 | 3 | 402.7 | 21.94 | 390 to 428 | 8 | 384.0 | 42.68 | 300 to 428 | 0.365 |
| 8 | 1 | 435.0 | | | 3 | 377.7 | 68.24 | 299 to 421 | 4 | 392.0 | 62.66 | 299 to 435 | |
| 9 | 3 | 424.0 | 26.91 | 394 to 446 | 0 | | | | 3 | 424.0 | 26.91 | 394 to 446 | |
| 10 | 1 | 450.0 | | | 1 | 428.0 | | | 2 | 439.0 | 15.56 | 428 to 450 | |
| 11 | 0 | | | | 0 | | | | 0 | | | | |
| 12 | 1 | 394.0 | | | 0 | | | | 1 | 394.0 | | | |
| 13 | 0 | | | | 0 | | | | 0 | | | | |
| Total | 36 | | | | 26 | | | | 67 | | | | |

Table 39. Age-weight (g) relationship for lake whitefish from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|--------|--------|--------------|---------|--------|--------|-------------|----------|--------|--------|--------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 1 | 30.0 | | | |
| 1 | ND | | | | ND | | | | 2 | 210.0 | 14.14 | 200 to 220 | |
| 2 | 1 | 470.0 | | | 1 | 240.0 | | | 2 | 355.0 | 162.63 | 240 to 470 | |
| 3 | 1 | 890.0 | | | 4 | 407.5 | 197.88 | 180 to 630 | 5 | 504.0 | 275.55 | 180 to 890 | |
| 4 | 3 | 666.7 | 229.55 | 420 to 1000 | 1 | 1190.0 | | | 4 | 797.5 | 358.18 | 420 to 1190 | |
| 5 | 12 | 879.2 | 140.22 | 550 to 1080 | 4 | 1070.0 | 237.63 | 860 to 1370 | 16 | 926.9 | 181.65 | 550 to 1370 | 1.520 |
| 6 | 10 | 1106.0 | 165.41 | 880 to 1410 | 9 | 1105.5 | 467.63 | 350 to 1670 | 19 | 1105.8 | 332.97 | 350 to 1670 | 0.003 |
| 7 | 3 | 1190.0 | 175.78 | 970 to 1300 | 3 | 1136.7 | 246.64 | 970 to 1420 | 8 | 956.3 | 343.47 | 400 to 1420 | 0.210 |
| 8 | 1 | 1130.0 | | | 3 | 930.0 | 493.25 | 370 to 1300 | 4 | 980.0 | 414.97 | 370 to 1300 | |
| 9 | 3 | 1296.7 | 222.34 | 1040 to 1430 | 0 | | | | 3 | 1296.7 | 222.34 | 1040 to 1430 | |
| 10 | 1 | 1370.0 | | | 1 | 1190.0 | | | 2 | 1280.0 | 127.28 | 1190 to 1370 | |
| 11 | 0 | | | | 0 | | | | 0 | | | | |
| 12 | 1 | 1000.0 | | | 0 | | | | 1 | 1000.0 | | | |
| 13 | 0 | | | | 0 | | | | 0 | | | | |
| Total | 36 | | | | 26 | | | | 67 | | | | |

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4.2.3.3 Sex and maturity. Age-specific sex ratios and maturity data for lake whitefish captured from the Mildred Lake and Delta study areas in 1977 are given in Tables 40 and 41, respectively. In both areas, males and females tended to occur in approximately equal numbers within each age class and in the overall sample the sex ratio did not differ significantly from unity.

While some lake whitefish of both sexes appear to mature at age 3, most do not spawn until age 4. Similar results were obtained in 1976 (Bond and Berry in prep.).

4.2.3.4 Spawning. No ripe lake whitefish were reported in the Delta study area during 1977. In the Mildred Lake area, no ripe males were taken. Ripe females were captured on 18 October but not thereafter. At that time water temperatures were near 4°C (Figure 2) and it was apparent that lake whitefish had not spawned in the Mildred Lake study area but had proceeded further upstream. Spent whitefish first appeared in the Mildred Lake study area on 24 October and were present in decreasing numbers until 2 November.

Although no lake whitefish spawning areas were discovered downstream of Fort McMurray in 1977, the area upstream of Fort McMurray was identified as a spawning area for this species. Jones et al. (1978) documented the presence of a large concentration of lake whitefish below Mountain Rapids, 15 km upstream of Fort McMurray, and a smaller concentration below Cascade Rapids, 25 km upstream of Fort McMurray (Figure 4). Spawning is reported to have occurred between 13 October and 26 October at water temperatures ranging from 6°C to 3°C. The above authors found large concentrations of eggs below Mountain Rapids and smaller numbers below Cascade Rapids on 27 and 28 October.

4.2.3.5 Fecundity. Gravimetric estimations were performed on 13 lake whitefish ranging in fork length from 382 to 473 mm. These fish were fully mature when captured in the Mildred Lake study area on 4 to 5 October. Fecundity estimates varied from 13 906 to 44 058 ova with a mean of 22 815 ova per female (Table 42). Length-relative fecundity

Table 40. Age-specific sex ratios and maturity for lake whitefish from the Mildred Lake study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Total | | χ^2 |
|-----------|---------|-------|----------|-------|-------|----------|-------|-------|----------|
| | N | % | % Mature | N | % | % Mature | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | |
| 2 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | |
| 3 | 1 | 50.0 | 100.0 | 1 | 50.0 | 100.0 | 2 | 1.6 | |
| 4 | 2 | 25.0 | 100.0 | 6 | 75.0 | 66.8 | 8 | 6.4 | 2.000 |
| 5 | 9 | 36.0 | 77.8 | 16 | 64.0 | 93.8 | 25 | 20.0 | 1.960 |
| 6 | 18 | 60.0 | 100.0 | 12 | 40.0 | 100.0 | 30 | 24.0 | 1.200 |
| 7 | 15 | 53.6 | 100.0 | 13 | 46.4 | 100.0 | 28 | 22.4 | 0.140 |
| 8 | 9 | 47.4 | 100.0 | 10 | 52.6 | 100.0 | 19 | 15.2 | 0.060 |
| 9 | 5 | 62.5 | 100.0 | 3 | 37.5 | 100.0 | 8 | 6.4 | 0.500 |
| 10 | 1 | 50.0 | 100.0 | 1 | 50.0 | 100.0 | 2 | 1.6 | |
| 11 | 2 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 2 | 1.6 | |
| 12 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | |
| 13 | 0 | 0.0 | 0.0 | 1 | 100.0 | 100.0 | 1 | 0.8 | |
| Totals | 62 | 49.6 | 96.8 | 63 | 50.4 | 95.2 | 125 | 100.0 | 0.400 |

Table 41. Age-specific sex ratios and maturity for lake whitefish from the Delta study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|-----------|---------|------|----------|-------|-------|----------|--------------|-------|-------|--------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1 | 1 | 1.5 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 2 | 2 | 3.0 | |
| 2 | 1 | 50.0 | 0.0 | 1 | 50.0 | 0.0 | 0 | 2 | 3.0 | |
| 3 | 4 | 80.0 | 0.0 | 1 | 20.0 | 100.0 | 0 | 5 | 7.5 | |
| 4 | 1 | 25.0 | 100.0 | 3 | 75.0 | 100.0 | 0 | 4 | 6.0 | |
| 5 | 4 | 25.0 | 100.0 | 12 | 75.0 | 100.0 | 0 | 16 | 23.9 | 4.000 ^a |
| 6 | 9 | 47.4 | 77.8 | 10 | 52.6 | 100.0 | 0 | 19 | 28.3 | 0.060 |
| 7 | 3 | 50.0 | 100.0 | 3 | 50.0 | 100.0 | 2 | 8 | 11.9 | |
| 8 | 3 | 75.0 | 66.7 | 1 | 25.0 | 100.0 | 0 | 4 | 6.0 | |
| 9 | 0 | 0.0 | 0.0 | 3 | 100.0 | 100.0 | 0 | 3 | 4.5 | |
| 10 | 1 | 50.0 | 100.0 | 1 | 50.0 | 100.0 | 0 | 2 | 3.0 | |
| 11 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 12 | 0 | 0.0 | 0.0 | 1 | 100.0 | 100.0 | 0 | 1 | 1.5 | |
| 13 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| Totals | 26 | 41.9 | 69.2 | 36 | 58.1 | 97.2 | 5 | 67 | 100.1 | 1.620 |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

Table 42. Fecundity estimates for lake whitefish from the Athabasca River, 4 to 5 October 1977.

| Fork Length (mm) | Weight (g) | Number of Eggs | | | Relative Fecundity ^a | |
|------------------|------------|----------------|-------------|--------|---------------------------------|--------|
| | | Left Ovary | Right Ovary | Total | Eggs/cm | Eggs/g |
| 382 | 840 | 7 900 | 6 933 | 14 833 | 388.3 | 17.1 |
| 383 | 880 | 7 965 | 5 941 | 13 906 | 363.1 | 15.8 |
| 385 | 1 020 | 6 049 | 11 798 | 17 847 | 463.6 | 17.5 |
| 386 | 920 | 8 532 | 9 731 | 18 263 | 473.1 | 19.9 |
| 394 | 1 130 | 11 841 | 9 559 | 21 400 | 543.1 | 18.9 |
| 397 | 1 040 | 10 640 | 9 897 | 20 537 | 517.3 | 19.7 |
| 411 | 1 310 | 12 264 | 10 638 | 22 902 | 557.2 | 17.5 |
| 415 | 1 160 | 9 887 | 8 678 | 18 565 | 447.3 | 16.0 |
| 423 | 1 270 | 14 568 | 13 234 | 27 802 | 657.3 | 21.9 |
| 434 | 1 210 | 8 677 | 12 063 | 20 740 | 477.9 | 17.1 |
| 436 | 1 400 | 13 201 | 15 159 | 28 360 | 650.5 | 20.3 |
| 451 | 1 400 | 13 646 | 13 734 | 27 380 | 607.1 | 19.6 |
| 473 | 1 920 | 18 327 | 25 731 | 44 058 | 931.5 | 22.9 |

^a Number of eggs per cm of fork length and per g of body weight.

ranged from 363.1 to 931.5 eggs per cm of fork length while weight-relative fecundity varied from 15.8 to 22.9 eggs per g of body weight.

4.2.3.6 Migrations and movements. A large lake whitefish spawning migration occurred in the Athabasca River during 1977. The peak of this migration passed through the Delta study area on 6 September (Tables 6 and 8) at which time water temperatures in the Athabasca River were near 14°C (Figure 3). This migration reached the Mildred Lake study area between 20 September and 5 October (Tables 5 and 7) by which time water temperatures were between 11° and 6°C (Figure 2). Jones et al. (1978) reported that concentrations of whitefish entered their study area upstream of Fort McMurray during the first two weeks of October and that spawning occurred below Mountain Rapids (predominantly) and below Cascade Rapids (to a lesser extent) between 13 and 25 October. These authors captured no lake whitefish upstream of Cascade Rapids and reported finding no ripe whitefish in the Clearwater River. By 20 October, whitefish had begun to leave the spawning grounds and none was captured after 26 October. Spent lake whitefish of both sexes were captured in the Mildred Lake study area between 24 October and 2 November as whitefish began their post-spawning, downstream movement. Recaptures of tagged whitefish in the lower Athabasca River, Lake Athabasca, and Mamawi Lake within weeks of tagging in the Mildred Lake study area (Bond and Berry in prep.; Appendix 6.4) indicate a rapid downstream movement by some lake whitefish shortly after spawning.

While some lake whitefish return to Lake Athabasca and the Peace-Athabasca Delta after spawning, others may remain in the Mildred Lake area of the Athabasca River to overwinter. This is suggested by the presence there of considerable numbers of lake whitefish in late April and early May 1977, as reflected in standard gang and large mesh seine catch results (Tables 5 and 7). Additional evidence that overwintering occurs in the Mildred Lake area derives from Machniak and Bond (1979) who reported upstream movement of 39 lake whitefish in the Steepbank River in May 1977. Small numbers of lake whitefish also moved up the Muskeg River in May 1976 and May 1977 (Bond and

Machniak 1977, 1979). Large mesh beach seines and standard gill net gangs captured few lake whitefish in the Mildred Lake area or the Delta study area between the end of May and the beginning of the fall spawning run.

During the two years of the present study, 2389 lake whitefish were tagged and 65 were recaptured for a return rate of 2.7% (Table 13). Twenty-seven tagged lake whitefish have been recaptured from Lake Athabasca or the Peace-Athabasca Delta (Bond and Berry in prep.; Appendix 6.4), suggesting that some lake whitefish that spawn in or upstream of the Mildred Lake study area are part of the Lake Athabasca population and return to the lake or delta to overwinter. In some cases, the post-spawning movement back to the lake may be very rapid as three whitefish, tagged between 28 September and 7 October 1977, were recaptured at Quatre Fourches (Figure 4) on 23 October 1977, having travelled approximately 295 km in from 16 to 25 days. Maximum movement observed for a lake whitefish during the study was 338 km. This fish was recaptured on the north shore of Lake Athabasca near the Alberta-Saskatchewan border, having been at large for 122 days (Bond and Berry in prep.).

4.2.4 Northern Pike

4.2.4.1 Distribution and relative abundance. Northern pike occurred throughout both the Mildred Lake and Delta study areas but were not captured in large numbers either in standard gangs (Tables 5 and 6) or large mesh seines (Tables 7 and 8).

In the Mildred Lake study area, northern pike accounted for 5.7% of all fish taken in standard gangs and 5.2% of those taken in large mesh seines. They were captured in 52% of all standard gangs and in 25% of all large mesh seine hauls. Catch-per-unit-effort values were high in the Mildred Lake area in late April and early May (Table 5) at which time pike were abundant around tributary mouths. Spring movements of northern pike into tributaries of the Athabasca River have been documented by Bond and Machniak (1977, 1979); Machniak and Bond (1979); and Machniak et al. (in prep.). These movements may

be of a spawning or post-spawning nature. Throughout the summer, catch-per-unit-effort values for pike remained at a low level in the Mildred Lake study area. They tended to increase, however, in September and October (Tables 5 and 7), perhaps indicating that pike had left the tributaries for overwintering areas in the Athabasca River.

In the Delta study area, northern pike occurred in 41% of all standard gangs and made up 14.0% of the total catch (Table 6). They comprised 12.4% of the catch in large mesh seines and were taken in 29% of all hauls (Table 8). As in the Mildred Lake study area, catch-per-unit-effort values for pike remained relatively constant in the Delta study area throughout the summer. They appeared to decrease in abundance, however, during September (Tables 6 and 8) probably as a result of movement to overwintering areas either upstream in the Athabasca River or in the lower delta and Lake Athabasca.

The majority of northern pike in the Mildred study area were captured at Sites 1 to 6, 7 to 17, 19 to 22, 24, 31, 33, 34, 37, 39, 41, and 43 and large numbers were angled 1 km up the Horseshoe Lake outlet (km 46.4) on 17 June 1977. In the Delta study area, most pike were captured at Sites 51 to 57, 59, 61 to 66, 68 to 72, 74, 76, 78, 82, 83, 85, and 86 and large numbers were captured by angling at Sites 68 and 78 (Figure 4, Appendix 6.1).

4.2.4.2 Age and growth. Northern pike captured from the Athabasca River in 1977 ranged in fork length from 19 to 1099 mm with young-of-the-year varying from 19 to 185 mm in fork length. Length-frequency distributions for larger pike taken in each gear type in the Mildred Lake and Delta study areas are shown in Tables 43 and 44, respectively. In both areas, the length-frequencies show the same multi-modal character as appeared in the 1976 sample (Bond and Berry in prep.). This results from the use of a small length interval (20 mm) and the fact that the various gear types tend to select pike of distinctly different modal lengths. The majority of pike captured (75%) were between 320 and 619 mm long (Tables 43 and 44).

Age determinations were performed on 144 northern pike captured from the Athabasca River in 1977. Scale ages ranged from 0+ to

Table 43. Length-frequency distribution for northern pike from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-----|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 100 to 119 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 120 to 139 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 140 to 159 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 160 to 179 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 180 to 199 | 0 | 0 | 1 | 0 | 0 | 1 | 0.3 |
| 200 to 219 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 220 to 239 | 2 | 0 | 6 | 3 | 0 | 11 | 3.0 |
| 240 to 259 | 0 | 0 | 5 | 1 | 0 | 6 | 1.7 |
| 260 to 279 | 1 | 0 | 6 | 1 | 0 | 7 | 1.9 |
| 280 to 299 | 0 | 0 | 5 | 0 | 1 | 6 | 1.7 |
| 300 to 319 | 0 | 0 | 5 | 0 | 0 | 5 | 1.4 |
| 320 to 339 | 0 | 0 | 8 | 5 | 1 | 14 | 3.9 |
| 340 to 359 | 1 | 0 | 9 | 1 | 0 | 11 | 3.0 |
| 360 to 379 | 1 | 1 | 9 | 3 | 4 | 18 | 5.0 |
| 380 to 399 | 0 | 0 | 10 | 1 | 1 | 12 | 3.3 |
| 400 to 419 | 1 | 3 | 6 | 2 | 0 | 12 | 3.3 |
| 420 to 439 | 2 | 0 | 15 | 0 | 0 | 17 | 4.7 |
| 440 to 459 | 2 | 3 | 18 | 2 | 0 | 25 | 6.9 |
| 460 to 479 | 4 | 4 | 15 | 1 | 3 | 27 | 7.4 |
| 480 to 499 | 1 | 2 | 10 | 1 | 4 | 18 | 5.0 |
| 500 to 519 | 3 | 3 | 10 | 0 | 3 | 19 | 5.2 |
| 520 to 539 | 4 | 3 | 15 | 2 | 4 | 28 | 7.7 |
| 540 to 559 | 6 | 5 | 3 | 1 | 2 | 17 | 4.7 |
| 560 to 579 | 3 | 6 | 8 | 1 | 2 | 20 | 5.5 |
| 580 to 599 | 7 | 8 | 7 | 1 | 3 | 26 | 7.2 |

continued ...

Table 43. Concluded.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 600 to 619 | 3 | 5 | 2 | 1 | 2 | 13 | 3.6 |
| 620 to 639 | 3 | 4 | 2 | 0 | 0 | 9 | 2.5 |
| 640 to 659 | 1 | 4 | 1 | 1 | 0 | 7 | 1.9 |
| 660 to 679 | 1 | 3 | 2 | 0 | 0 | 6 | 1.7 |
| 680 to 699 | 1 | 3 | 3 | 0 | 0 | 7 | 1.9 |
| 700 to 719 | 1 | 2 | 0 | 0 | 0 | 3 | 0.8 |
| 720 to 739 | 2 | 0 | 1 | 1 | 0 | 4 | 1.1 |
| 740 to 759 | 2 | 0 | 0 | 0 | 0 | 2 | 0.6 |
| 760 to 779 | 0 | 1 | 0 | 0 | 0 | 1 | 0.3 |
| 780 to 799 | 1 | 1 | 0 | 0 | 0 | 2 | 0.6 |
| 800 to 819 | 0 | 2 | 0 | 0 | 0 | 2 | 0.6 |
| 820 to 839 | 0 | 2 | 2 | 0 | 0 | 4 | 1.1 |
| 840 to 859 | 0 | 0 | 1 | 0 | 0 | 1 | 0.3 |
| 860 to 879 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 880 to 899 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 900 to 919 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 920 to 939 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 940 to 959 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 960 to 979 | 0 | 0 | 1 | 0 | 0 | 1 | 0.3 |
| 980 to 990 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Totals | 53 | 65 | 186 | 29 | 30 | 363 | 100.1 |

Table 44. Length-frequency distribution by gear type for northern pike from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-----|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 180 to 199 | 0 | 0 | 2 | 0 | 0 | 2 | 0.4 |
| 200 to 219 | 0 | 0 | 2 | 2 | 0 | 4 | 0.9 |
| 220 to 239 | 1 | 0 | 5 | 0 | 0 | 6 | 1.3 |
| 240 to 259 | 0 | 0 | 4 | 0 | 0 | 4 | 0.9 |
| 260 to 279 | 0 | 0 | 5 | 1 | 1 | 7 | 1.5 |
| 280 to 299 | 2 | 0 | 6 | 0 | 0 | 8 | 1.7 |
| 300 to 319 | 0 | 0 | 3 | 1 | 0 | 4 | 0.9 |
| 320 to 339 | 1 | 0 | 4 | 0 | 1 | 6 | 1.3 |
| 340 to 359 | 2 | 0 | 10 | 1 | 3 | 16 | 3.5 |
| 360 to 379 | 2 | 0 | 2 | 0 | 3 | 7 | 1.5 |
| 380 to 399 | 4 | 1 | 4 | 0 | 2 | 11 | 2.4 |
| 400 to 419 | 4 | 1 | 4 | 0 | 4 | 13 | 2.8 |
| 420 to 439 | 5 | 4 | 6 | 0 | 12 | 27 | 5.8 |
| 440 to 459 | 6 | 5 | 8 | 1 | 14 | 34 | 7.4 |
| 460 to 479 | 9 | 10 | 6 | 0 | 17 | 42 | 9.1 |
| 480 to 499 | 7 | 7 | 5 | 4 | 19 | 42 | 9.1 |
| 500 to 519 | 3 | 14 | 7 | 0 | 18 | 42 | 9.1 |
| 520 to 539 | 6 | 6 | 5 | 3 | 7 | 27 | 5.8 |
| 540 to 559 | 5 | 5 | 6 | 0 | 11 | 27 | 5.8 |
| 560 to 579 | 3 | 6 | 2 | 0 | 5 | 16 | 3.5 |
| 580 to 599 | 4 | 3 | 1 | 0 | 11 | 19 | 4.1 |
| 600 to 619 | 0 | 4 | 5 | 0 | 7 | 16 | 3.5 |
| 620 to 639 | 1 | 1 | 2 | 0 | 4 | 8 | 1.7 |
| 640 to 659 | 0 | 1 | 0 | 0 | 4 | 5 | 1.1 |
| 660 to 679 | 0 | 5 | 0 | 0 | 4 | 9 | 1.9 |

continued ...

Table 44. Concluded.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 680 to 699 | 0 | 6 | 1 | 0 | 8 | 15 | 3.2 |
| 700 to 719 | 0 | 1 | 1 | 0 | 1 | 3 | 0.6 |
| 720 to 739 | 0 | 3 | 0 | 0 | 4 | 7 | 1.5 |
| 740 to 759 | 0 | 1 | 0 | 0 | 3 | 4 | 0.9 |
| 760 to 779 | 0 | 6 | 3 | 0 | 2 | 11 | 2.4 |
| 780 to 799 | 0 | 2 | 0 | 0 | 0 | 2 | 0.4 |
| 800 to 819 | 0 | 3 | 0 | 0 | 2 | 5 | 1.1 |
| 820 to 839 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| 840 to 859 | 0 | 2 | 0 | 0 | 0 | 2 | 0.4 |
| 860 to 879 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 880 to 899 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 900 to 919 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| 920 to 939 | 0 | 2 | 0 | 0 | 0 | 2 | 0.4 |
| 940 to 959 | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |
| 960 to 979 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 980 to 999 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| 1000 to 1019 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 1020 to 1039 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| 1040 to 1059 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| 1060 to 1079 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 1080 to 1099 | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |
| Totals | 65 | 104 | 111 | 13 | 169 | 462 | 99.7 |

7 years and, excluding young-of-the-year, the majority of pike (66%) belonged to age groups 3 and 4. Age-length and age-weight data are summarized in Tables 45 and 46, respectively, for pike taken in the Mildred Lake study area while the corresponding information for the Delta study area is presented in Tables 47 and 48. Age and growth data from 1977 compare favourably with those collected in 1976 (Bond and Berry in prep.) although the length and weight values for age 0+ fish given in the latter report appear to be questionable (108 to 307 mm; 10 to 200 g). Young-of-the-year pike collected at Site 22 (Figure 4) on 16 to 18 June 1977 (N = 11) had a mean fork length of 27.9 mm (range 19 to 36 mm) while six fish captured 28 June at Site 37 had a mean fork length of 40.8 mm (range 39 to 44 mm). In the Delta study area, nine young-of-the-year pike taken between 14 and 28 July ranged in fork length from 93 to 119 mm with a mean length of 105.8 mm and a mean weight of 9.0 g. The largest young-of-the-year pike observed in 1977 was 185 mm in fork length and weighed 41.6 g. It was captured in the Mildred Lake study area on 18 October.

Growth data for northern pike taken from the Athabasca River over two years appear to indicate a more rapid growth rate than has been reported for pike captured in the Muskeg River (Bond and Machniak 1979), the Steepbank River (Machniak and Bond 1979), and the MacKay River (Machniak et al. in prep). This apparent difference in mean length and weight for fish of a given scale age is probably due in part to the fact that most pike in the tributaries were captured in the early spring before they had added much new growth whereas the fish from the Athabasca River were taken over the course of the summer. An age 4 fish captured in August would be expected to have increased considerably in length and weight since May, thus increasing the means for its age group.

Table 30 presents the results of the length-weight analysis for male and female northern pike captured in the Mildred Lake and Delta study areas in 1977. No significant difference was found between the slopes of the regression for males and females within either area.

Table 45. Age-length (mm) relationship for northern pike from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|------------|---------|-------|--------|------------|----------|-------|--------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 19 | 40.9 | ND | 19 to 185 | |
| 1 | 2 | 249.0 | 26.87 | 230 to 268 | 0 | | | | 2 | 249.0 | 26.87 | 230 to 268 | |
| 2 | 2 | 312.5 | 53.03 | 275 to 350 | 1 | 423.0 | | | 4 | 317.0 | 88.50 | 220 to 423 | |
| 3 | 2 | 539.5 | 28.99 | 519 to 560 | 2 | 464.5 | 123.74 | 377 to 552 | 4 | 502.0 | 85.20 | 377 to 560 | 0.835 |
| 4 | 4 | 515.2 | 43.21 | 455 to 549 | 8 | 601.2 | 83.80 | 489 to 730 | 12 | 572.5 | 83.25 | 455 to 730 | 2.342 ^a |
| 5 | 7 | 537.7 | 44.70 | 470 to 593 | 14 | 569.9 | 99.11 | 400 to 728 | 21 | 559.1 | 85.00 | 400 to 728 | 1.023 |
| 6 | 1 | 501.0 | | | 6 | 669.8 | 103.33 | 559 to 790 | 7 | 645.7 | 113.88 | 501 to 790 | |
| 7 | 1 | 684.0 | | | 1 | 652.0 | | | 2 | 668.0 | 22.63 | 652 to 684 | |
| Total | 19 | | | | 32 | | | | 71 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 46. Age-weight (g) relationship for northern pike from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|--------|--------|--------------|---------|--------|---------|--------------|----------|--------|---------|--------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 19 | ND | | | |
| 1 | 2 | 110.0 | 28.28 | 90 to 130 | 0 | | | | 2 | 110.0 | 28.28 | 90 to 130 | |
| 2 | 2 | 215.0 | 77.78 | 160 to 270 | 1 | 490.0 | | | 4 | 252.5 | 174.81 | 90 to 490 | |
| 3 | 2 | 1180.0 | 28.28 | 1160 to 1200 | 2 | 835.0 | 657.61 | 370 to 1300 | 4 | 1007.5 | 429.06 | 370 to 1300 | 0.741 |
| 4 | 4 | 1035.0 | 271.60 | 690 to 1310 | 8 | 1726.2 | 832.71 | 700 to 2870 | 12 | 1495.8 | 759.74 | 690 to 2870 | 2.132 |
| 5 | 7 | 1132.9 | 237.75 | 760 to 1340 | 14 | 1471.4 | 727.18 | 550 to 3110 | 21 | 1358.6 | 622.43 | 550 to 3110 | 1.581 |
| 6 | 1 | 1050.0 | | | 6 | 2548.3 | 1377.70 | 1260 to 4260 | 7 | 2334.3 | 1379.28 | 1050 to 4260 | |
| 7 | 1 | 2500.0 | | | 1 | 2480.0 | | | 2 | 2490.0 | 14.14 | 2480 to 2500 | |
| Total | 19 | | | | 32 | | | | 71 | | | | |

Table 47. Age-length (mm) relationship for northern pike from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|--------------|-------|-------|-------|------------|---------|-------|--------|------------|----------|-------|-------|------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 9 | 105.8 | ND | 93 to 119 | |
| 1 | 0 | | | | 0 | | | | 2 | 259.5 | 53.00 | 222 to 297 | |
| 2 | 6 | 371.5 | 33.34 | 328 to 410 | 2 | 416.0 | 53.74 | 378 to 454 | 10 | 369.4 | 46.57 | 293 to 454 | 1.102 |
| 3 | 7 | 461.0 | 64.72 | 380 to 573 | 13 | 480.8 | 44.46 | 416 to 566 | 23 | 474.5 | 49.09 | 380 to 573 | 0.724 |
| 4 | 8 | 490.6 | 51.47 | 431 to 580 | 11 | 506.3 | 59.55 | 416 to 596 | 21 | 499.4 | 44.07 | 416 to 596 | 0.612 |
| 5 | 4 | 504.0 | 40.72 | 463 to 540 | 4 | 549.0 | 105.31 | 395 to 632 | 8 | 526.5 | 77.73 | 395 to 632 | 0.797 |
| 6 | 0 | | | | 0 | | | | 0 | | | | |
| Total | 25 | | | | 30 | | | | 73 | | | | |

Table 48. Age-weight (g) relationship for northern pike from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|--------|-------------|---------|--------|--------|-------------|----------|--------|--------|-------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 9 | 9.0 | ND | ND | |
| 1 | 0 | | | | 0 | | | | 2 | 130.0 | 70.71 | 80 to 180 | |
| 2 | 6 | 375.0 | 83.13 | 280 to 460 | 2 | 600.0 | 169.70 | 480 to 720 | 10 | 394.0 | 149.38 | 190 to 720 | 1.804 |
| 3 | 7 | 682.9 | 265.50 | 380 to 1060 | 13 | 783.1 | 230.92 | 420 to 1210 | 23 | 748.7 | 229.07 | 380 to 1210 | 0.842 |
| 4 | 8 | 905.0 | 345.9 | 570 to 1320 | 11 | 925.4 | 265.68 | 560 to 1500 | 21 | 911.4 | 238.67 | 560 to 1500 | 0.177 |
| 5 | 4 | 902.5 | 178.39 | 730 to 1110 | 4 | 1270.0 | 603.66 | 460 to 1920 | 8 | 1086.2 | 456.51 | 460 to 1920 | 1.168 |
| 6 | 0 | | | | 0 | | | | 0 | | | | |
| Total | 25 | | | | 30 | | | | 73 | | | | |

4.2.4.3 Sex and maturity. Age-specific sex ratios and maturity data for northern pike are shown in Tables 49 and 50 for the Mildred Lake and Delta study areas, respectively. The male to female ratio did not differ significantly from unity either within age groups or in the overall sample.

Maturity results for this study were similar to those found in 1976 (Bond and Berry in prep.) and agree with those reported by other studies in the AOSERP study area (Bond and Machniak 1979; Machniak and Bond 1979; Machniak et al. in prep.). A few pike may spawn as early as age 2; however, most do not mature sexually until age 3 or 4.

4.2.4.4 Spawning. Northern pike generally spawn in April and early May, immediately after the ice melts, at water temperatures of 4.4^o to 11.1^oC (Scott and Crossman 1973). Although pike may spawn in a variety of habitats, the presence of vegetation appears to be a requirement of the spawning site (Machniak 1975b). Marshes or marsh-like conditions along small streams seem to be preferred areas. Such sites are available at several locations in the AOSERP study area (Bond and Berry in prep.).

Spawning of northern pike was not observed in 1977 in either the Mildred Lake or Delta study area. Ripe pike, however, were captured in the former area between 27 April and 9 May 1977 and young-of-the-year (19 to 36 mm) were taken on 16 to 18 June. Spent fish were captured in the Mildred Lake study area between 7 May and 29 June. No ripe pike were found in the Delta study area since sampling did not begin there until 14 May, but spent fish were taken between 2 and 28 June and a young-of-the-year (25 mm) was captured on 19 June.

4.2.4.5 Fecundity. For five mature female northern pike (554 to 657 mm FL) captured in the Mildred Lake area between 1 and 8 May, estimated fecundity varied from 17 764 to 42 962 eggs with a mean of 28 896 ova per female (Table 51). Length-relative fecundity varied from 321.0 to 658.9 eggs per cm of fork length and weight-relative fecundity ranged from 10.2 to 19.4 eggs per g of body weight.

Table 49. Age-specific sex ratios and maturity for northern pike from the Mildred Lake study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|-----------|---------|------|----------|-------|-------|----------|--------------|-------|-------|----------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 2 | 100.0 | 0.0 | 0 | 2 | 3.8 | |
| 1 | 1 | 33.3 | 100.0 | 2 | 66.7 | 50.0 | 1 | 4 | 7.7 | |
| 2 | 2 | 50.0 | 50.0 | 2 | 50.0 | 100.0 | 0 | 4 | 7.7 | |
| 3 | 8 | 66.7 | 100.0 | 4 | 33.3 | 75.0 | 0 | 12 | 23.1 | 1.333 |
| 4 | 14 | 66.7 | 92.9 | 7 | 33.3 | 85.7 | 0 | 21 | 40.4 | 2.333 |
| 5 | 6 | 85.7 | 100.0 | 1 | 14.3 | 100.0 | 0 | 7 | 13.5 | |
| 6 | 1 | 50.0 | 100.0 | 1 | 50.0 | 100.0 | 0 | 2 | 3.8 | |
| 7 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| Totals | 32 | 62.7 | 93.8 | 19 | 37.3 | 73.7 | 1 | 52 | 100.0 | 3.314 |

Table 50. Age-specific sex ratios and maturity for northern pike from the Delta study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|-----------|---------|------|----------|-------|------|----------|--------------|-------|------|----------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 2 | 2 | 3.1 | |
| 2 | 2 | 25.0 | 50.0 | 6 | 75.0 | 50.0 | 2 | 10 | 15.6 | 2.000 |
| 3 | 13 | 65.0 | 92.3 | 7 | 35.0 | 85.7 | 3 | 23 | 35.9 | 1.800 |
| 4 | 11 | 57.9 | 90.9 | 8 | 42.1 | 75.0 | 2 | 21 | 32.8 | 0.474 |
| 5 | 4 | 50.0 | 100.0 | 4 | 50.0 | 75.0 | 0 | 8 | 12.5 | |
| 6 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| Totals | 30 | 54.5 | 90.0 | 25 | 45.5 | 72.0 | 9 | 64 | 99.9 | 0.455 |

Table 51. Fecundity estimates for northern pike from the Athabasca River, 1 to 8 May 1977.

| Fork Length (mm) | Weight (g) | Estimated Number of Eggs | Relative Fecundity ^a | |
|---------------------|---------------|-----------------------------|---------------------------------|--------|
| | | | Eggs/cm | Eggs/g |
| 554 | 1 210 | 17 764 | 321.0 | 14.7 |
| 608 | 1 570 | 25 400 | 417.8 | 16.2 |
| 609 | 2 010 | 20 764 | 341.0 | 10.3 |
| 652 | 2 480 | 42 962 | 658.9 | 17.3 |
| 657 | 1 940 | 37 592 | 572.2 | 19.4 |

^a Number of eggs per cm of fork length and per g of body weight.

4.2.4.6 Migrations and movements. Northern pike of the AOSERP study area enter some tributaries in early spring. These movements may be related to spawning or feeding and substantial runs were monitored in the Muskeg River (Bond and Machniak 1979) and the Steepbank River (Machniak and Bond 1979) during late April and early May 1977. High catch-per-unit-effort values in standard gangs had indicated the presence of pike concentrations near the mouths of tributary streams in the Mildred Lake study area between late April and early May. After spawning, some pike remain in the tributaries throughout the summer while others move back down to the Athabasca River where they tend to frequent tributary mouths. A slight increase in catch-per-unit-effort for pike in September and October in the Mildred Lake study area (Table 7) may indicate a movement out of the tributaries and back into the Athabasca River at that time. Apart from these spring and fall movements, pike generally tend to move around very little. Of 96 tagged pike that were recaptured during the study, 72 (77.4%) were taken within 10 km of the original tagging site (Bond and Berry in prep.; Appendix 6.4). A few individuals, however, move considerable distances. One pike, for example, tagged at km 247.0 of the Athabasca River on 2 September 1977, was recaptured on 15 May 1978 in the Poplar River, having travelled 220 km. Another pike, tagged at km 215.4 on 22 June 1977 had travelled approximately 113 km when recaptured near Fort Chipewyan on 17 June 1979. Within the tributaries, pike often move up- and downstream throughout the summer and a given fish may be recaptured a number of times during that period.

4.2.5 Longnose Sucker

4.2.5.1 Distribution and relative abundance. Suckers (2 species) accounted for 22.6% of all fish captured from the Athabasca River in 1977 (Table 2). The vast majority, however, were young-of-the-year that could not be identified to species. Longnose suckers made up 7.6% of all fish taken by standard gangs in the Mildred Lake study area (Table 5) while comprising 20.4% of the catch produced by large mesh seines (Table 7). In the Delta study area, longnose suckers

accounted for 5.6% of the catch from standard gangs (Table 6) and 1.2% of that from large mesh beach seines (Table 8).

Longnose suckers were abundant in the Mildred Lake study area by late April 1977 (Tables 5 and 7). This abundance is known to be associated with movements onto spawning grounds in tributary streams such as the Muskeg River (Bond and Machniak 1977, 1979) and the Steepbank River (Machniak and Bond 1979) and in the Athabasca River upstream of Fort McMurray (Tripp and McCart in prep.). After leaving the spawning grounds, longnose suckers quickly left the Mildred Lake study area and few were captured during the summer (Tables 5 and 7). In the Delta study area, as well, few longnose suckers were captured during the summer (Tables 6 and 8).

Bond and Machniak (1977, 1979) and Machniak and Bond (1979) suggested that, while most longnose suckers leave the spawning streams shortly after spawning, a gradual return to the Athabasca River occurs during the summer and some fish remain in the tributaries until just prior to freeze-up. An increase in catch-per-unit-effort in the Mildred Lake study area during September and October (Tables 5 and 7) seems to confirm that suggestion. Tagging nets also indicated an increased abundance of longnose suckers in the Delta study area in the autumn. Of 111 longnose suckers captured in tagging nets in the Delta study area during 1977, 101 were taken in September and October.

In the Mildred Lake study area, the majority of longnose suckers were caught at Sites 1 to 6, 7 to 17, 19 to 25, 27 to 34, 36, 37, and 41 to 44, while most longnose suckers captured in the Delta study area were taken at Sites 51 to 54, 56, 62, 67, 71, 74 to 80, and 82 to 85 (Figure 4, Appendix 6.1).

4.2.5.2 Age and growth. Longnose suckers captured from the Athabasca River in 1977 ranged in fork length from 180 to 549 mm (excluding young-of-the-year) with the largest percentage (89%) lying in the 350 to 469 mm range. Length-frequency distributions by gear type for longnose suckers taken in the Mildred Lake and Delta study areas are presented in Tables 52 and 53, respectively. Overall length-frequencies were similar between the two study areas.

Table 52. Length-frequency distribution by gear type for longnose suckers from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 190 to 199 | 0 | 0 | 1 | 0 | 0 | 1 | 0.1 |
| 200 to 209 | 0 | 0 | 2 | 0 | 0 | 2 | 0.2 |
| 210 to 219 | 1 | 0 | 0 | 0 | 0 | 1 | 0.1 |
| 220 to 229 | 0 | 0 | 0 | 1 | 0 | 1 | 0.1 |
| 230 to 239 | 0 | 1 | 0 | 0 | 0 | 1 | 0.1 |
| 240 to 249 | 0 | 0 | 2 | 0 | 0 | 2 | 0.2 |
| 250 to 259 | 0 | 0 | 2 | 0 | 0 | 2 | 0.2 |
| 280 to 289 | 1 | 0 | 1 | 0 | 0 | 2 | 0.2 |
| 290 to 299 | 0 | 0 | 2 | 1 | 0 | 3 | 0.3 |
| 300 to 309 | 1 | 0 | 1 | 0 | 0 | 2 | 0.2 |
| 310 to 319 | 1 | 0 | 0 | 0 | 0 | 1 | 0.1 |
| 320 to 329 | 1 | 0 | 4 | 0 | 0 | 5 | 0.4 |
| 330 to 339 | 2 | 0 | 4 | 0 | 0 | 6 | 0.5 |
| 340 to 349 | 1 | 0 | 11 | 0 | 0 | 12 | 1.1 |
| 350 to 359 | 7 | 3 | 21 | 0 | 0 | 31 | 2.8 |
| 360 to 369 | 5 | 3 | 43 | 0 | 0 | 51 | 4.5 |
| 370 to 379 | 5 | 5 | 64 | 0 | 0 | 74 | 6.6 |
| 380 to 389 | 9 | 13 | 87 | 0 | 0 | 109 | 9.7 |
| 390 to 399 | 7 | 26 | 99 | 0 | 0 | 132 | 11.7 |
| 400 to 409 | 11 | 32 | 72 | 0 | 0 | 115 | 10.2 |
| 410 to 419 | 4 | 36 | 73 | 0 | 1 | 114 | 10.1 |
| 420 to 429 | 8 | 38 | 64 | 0 | 0 | 110 | 9.8 |
| 430 to 439 | 4 | 38 | 69 | 0 | 0 | 111 | 9.9 |
| 440 to 449 | 3 | 28 | 48 | 0 | 0 | 79 | 7.0 |
| 450 to 459 | 3 | 15 | 32 | 0 | 0 | 50 | 4.4 |

continued ...

Table 52. Concluded.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 460 to 469 | 0 | 19 | 15 | 0 | 0 | 34 | 3.0 |
| 470 to 479 | 0 | 8 | 18 | 0 | 0 | 26 | 2.3 |
| 480 to 489 | 0 | 9 | 9 | 0 | 0 | 18 | 1.6 |
| 490 to 499 | 0 | 5 | 11 | 0 | 0 | 16 | 1.4 |
| 500 to 510 | 0 | 0 | 5 | 0 | 0 | 5 | 0.4 |
| 510 to 519 | 1 | 0 | 2 | 0 | 0 | 3 | 0.3 |
| 520 to 529 | 0 | 0 | 2 | 0 | 0 | 2 | 0.2 |
| 530 to 539 | 0 | 1 | 1 | 0 | 0 | 2 | 0.2 |
| 540 to 549 | 0 | 0 | 1 | 0 | 0 | 1 | 0.1 |
| Totals | 75 | 280 | 766 | 2 | 1 | 1124 | 100.0 |

Table 53. Length-frequency distribution by gear type for long-nose suckers from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | Total | |
|---------------------|-------------------|----------------------|----------------------|-------|------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | N | % |
| 180 to 189 | 0 | 0 | 1 | 1 | 0.7 |
| 220 to 229 | 0 | 1 | 0 | 1 | 0.7 |
| 230 to 239 | 1 | 0 | 0 | 1 | 0.7 |
| 240 to 249 | 0 | 0 | 1 | 1 | 0.7 |
| 250 to 259 | 0 | 1 | 0 | 1 | 0.7 |
| 270 to 279 | 0 | 0 | 1 | 1 | 0.7 |
| 280 to 289 | 0 | 0 | 1 | 1 | 0.7 |
| 350 to 359 | 0 | 1 | 0 | 1 | 0.7 |
| 360 to 369 | 0 | 0 | 0 | 0 | 0.0 |
| 370 to 379 | 4 | 4 | 0 | 8 | 5.5 |
| 380 to 389 | 1 | 4 | 1 | 6 | 4.1 |
| 390 to 399 | 1 | 6 | 0 | 7 | 4.8 |
| 400 to 409 | 4 | 10 | 1 | 15 | 10.3 |
| 410 to 419 | 1 | 13 | 1 | 15 | 10.3 |
| 420 to 429 | 3 | 13 | 1 | 17 | 11.7 |
| 430 to 439 | 2 | 16 | 0 | 18 | 12.4 |
| 440 to 449 | 2 | 13 | 0 | 15 | 10.3 |
| 450 to 459 | 1 | 4 | 1 | 6 | 4.1 |
| 460 to 469 | 2 | 11 | 0 | 13 | 9.0 |
| 470 to 479 | 0 | 7 | 1 | 8 | 5.5 |
| 480 to 489 | 0 | 3 | 1 | 4 | 2.8 |
| 490 to 499 | 0 | 4 | 0 | 4 | 2.8 |
| 500 to 529 | 1 | 0 | 0 | 1 | 0.7 |
| Totals | 23 | 111 | 11 | 145 | 99.9 |

The majority of longnose suckers aged in 1977 (78%) were 6 to 11 years old inclusive. The maximum age recorded was 19 years, but few fish exceeded 13 years of age. Age and growth summaries for longnose suckers from the two study areas are presented in Tables 54, 55, 56, and 57.

Longnose suckers are approximately 8 mm long at hatching. By 17 to 20 June, young-of-the-year suckers (2 species) captured in the Athabasca River had a mean length of 21.3 mm (range 18 to 26 mm). Young-of-the-year longnose suckers had a mean fork length of 43.7 mm (range 25 to 72 mm) on 26 to 28 July and averaged 62.0 mm (range 25 to 88 mm) in mid-September. Twelve age 1 longnose suckers captured during April and May showed a mean length of 60.6 mm (range 31 to 97 mm) and a mean weight of 3.2 g.

Length-weight relationships for longnose suckers are presented in Table 30. No significant differences were found between the slopes of the regressions for males and females although the slope values from the Delta study area appear to be out of line. The small sample size in this case is likely to blame for this discrepancy.

4.2.5.3 Sex and maturity. Age and sex were determined for 59 longnose suckers from the Mildred Lake area and 22 from the Delta study area (Tables 58 and 59). All males were mature from age 5 on while all females were mature at age 6. Bond and Machniak (1977) reported both male and female longnose suckers mature at age 7 in the Muskeg River. In the Steepbank River, Machniak and Bond (1979) report the youngest mature male and female longnose suckers to be age 6 and 7, respectively.

The sex ratio for longnose suckers did not differ significantly from unity either within individual age classes or in the overall sample (Tables 58 and 59) in those fish for which sex was determined by gonadal examination. Of 1043 suckers in the Mildred Lake area whose sex was determined only by the presence or absence of tubercles, 45% were males, 16% females, and 39% unsexed. It is likely that most of the fish listed as unsexed were females while a small number were immature males.

Table 54. Age-length (mm) relationship for longnose sucker from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (include unsexed fish.)

| Fin Ray Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|--------|------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 0 | | | | 1 | 331.0 | | | 1 | 331.0 | | | |
| 4 | 0 | | | | 1 | 315.0 | | | 3 | 271.3 | 49.22 | 218 to 315 | |
| 5 | 1 | 342.0 | | | 1 | 357.0 | | | 2 | 349.5 | 285.56 | 342 to 357 | |
| 6 | 3 | 365.7 | 37.00 | 329 to 403 | 2 | 370.5 | 3.53 | 368 to 373 | 6 | 357.7 | 164.52 | 308 to 403 | 0.255 |
| 7 | 7 | 388.7 | 28.32 | 350 to 441 | 6 | 392.7 | 21.89 | 356 to 421 | 13 | 390.5 | 25.88 | 350 to 441 | 0.266 |
| 8 | 4 | 377.7 | 32.44 | 352 to 422 | 7 | 408.0 | 27.25 | 381 to 458 | 11 | 397.0 | 31.53 | 352 to 458 | 1.574 |
| 9 | 4 | 406.5 | 15.80 | 390 to 428 | 3 | 377.3 | 21.01 | 356 to 398 | 7 | 394.0 | 22.69 | 356 to 428 | 2.015 |
| 10 | 0 | | | | 4 | 403.5 | 32.36 | 375 to 450 | 4 | 403.5 | 32.36 | 375 to 450 | |
| 11 | 3 | 416.3 | 9.29 | 410 to 427 | 4 | 418.5 | 24.96 | 398 to 452 | 7 | 417.6 | 18.48 | 398 to 452 | 0.160 |
| 12 | 1 | 437.0 | | | 1 | 420.0 | | | 2 | 428.5 | 12.02 | 420 to 437 | |
| 13 | 3 | 428.7 | 21.50 | 405 to 477 | 1 | 514.0 | | | 4 | 450.0 | 46.14 | 405 to 514 | 1.003 |
| 14 | 0 | | | | 0 | | | | 0 | | | | |
| 15 | 2 | 428.5 | 7.78 | 423 to 434 | 0 | | | | 2 | 428.5 | 7.78 | 423 to 439 | |
| Total | 28 | | | | 31 | | | | 62 | | | | |

Table 55. Age-weight (g) relationship for longnose sucker from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Fin Ray Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------------|-------|--------|--------|-------------|---------|--------|--------|-------------|----------|--------|--------|-------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 0 | | | | 1 | 470.0 | | | 1 | 470.0 | | | |
| 4 | 0 | | | | 1 | 350.0 | | | 3 | 236.7 | 115.04 | 120 to 350 | |
| 5 | 1 | 580.0 | | | 1 | 570.0 | | | 2 | 575.0 | 7.07 | 570 to 580 | |
| 6 | 3 | 673.3 | 170.09 | 500 to 840 | 2 | 720.0 | 28.28 | 700 to 740 | 6 | 636.7 | 175.00 | 500 to 840 | 0.466 |
| 7 | 7 | 745.0 | 123.25 | 550 to 950 | 6 | 805.0 | 148.02 | 580 to 1020 | 13 | 772.7 | 133.02 | 550 to 1020 | 0.786 |
| 8 | 4 | 702.5 | 223.51 | 550 to 1030 | 7 | 851.4 | 169.94 | 670 to 1060 | 11 | 797.3 | 194.84 | 550 to 1060 | 1.155 |
| 9 | 4 | 870.0 | 94.87 | 750 to 980 | 3 | 730.0 | 115.32 | 600 to 820 | 7 | 810.0 | 120.55 | 600 to 980 | 1.713 |
| 10 | 0 | | | | 4 | 817.5 | 182.28 | 660 to 1080 | 4 | 817.5 | 182.28 | 660 to 1080 | |
| 11 | 3 | 866.7 | 68.07 | 810 to 940 | 4 | 902.5 | 183.91 | 730 to 1160 | 7 | 895.7 | 136.12 | 730 to 1160 | 0.158 |
| 12 | 1 | 1070.0 | | | 1 | 920.0 | | | 2 | 995.0 | 106.07 | 920 to 1070 | |
| 13 | 3 | 1006.7 | 161.66 | 860 to 1180 | 1 | 1640.0 | | | 4 | 1165.0 | | 860 to 1640 | |
| 14 | 0 | | | | 0 | | | | 0 | | | | |
| 15 | 2 | 1000.0 | 84.85 | 940 to 1060 | 0 | | | | 2 | 1000.0 | | 940 to 1060 | |
| Total | 28 | | | | 31 | | | | 62 | | | | |

Table 56. Age-length (mm) relationship for longnose sucker from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Fin Ray Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 0 | | | | 0 | | | | 0 | | | | |
| 4 | 0 | | | | 0 | | | | 1 | 239.0 | | | |
| 5 | 0 | | | | 0 | | | | 0 | | | | |
| 6 | 0 | | | | 0 | | | | 0 | | | | |
| 7 | 0 | | | | 1 | 377.0 | | | 1 | 377.0 | | | |
| 8 | 4 | 383.7 | 13.89 | 371 to 503 | 2 | 401.5 | 33.23 | 378 to 425 | 6 | 389.7 | 20.50 | 371 to 425 | 0.724 |
| 9 | 3 | 406.7 | 12.58 | 395 to 420 | 2 | 442.5 | 12.02 | 434 to 451 | 6 | 420.3 | 20.08 | 395 to 451 | 3.204 |
| 10 | 1 | 440.0 | | | 2 | 400.0 | | 400 to 440 | 4 | 410.0 | 20.00 | 400 to 440 | |
| 11 | 1 | 425.0 | | | 2 | 454.0 | 11.31 | 446 to 462 | 3 | 444.3 | 18.56 | 425 to 462 | |
| 12 | 0 | | | | 0 | | | | 0 | | | | |
| 13 | 0 | | | | 2 | 459.0 | 36.77 | 433 to 485 | 2 | 459.0 | 36.77 | 433 to 485 | |
| 14 | 0 | | | | 0 | | | | 0 | | | | |
| 15 | 0 | | | | 1 | 464.0 | | | 1 | 464.0 | | | |
| 16 | 0 | | | | 0 | | | | 0 | | | | |
| 17 | 0 | | | | 0 | | | | 0 | | | | |
| 18 | 0 | | | | 0 | | | | 0 | | | | |
| 19 | 0 | | | | 1 | 522.0 | | | 1 | 522.0 | | | |
| Total | 9 | | | | 13 | | | | 25 | | | | |

Table 57. Age-weight (g) relationship for longnose sucker from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Fin Ray Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|--------|-------|------------|---------|--------|--------|--------------|----------|--------|--------|--------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 0 | | | | 0 | | | | 0 | | | | |
| 1 | 0 | | | | 0 | | | | 0 | | | | |
| 2 | 0 | | | | 0 | | | | 0 | | | | |
| 3 | 0 | | | | 0 | | | | 0 | | | | |
| 4 | 0 | | | | 0 | | | | 1 | 160.0 | | | |
| 5 | 0 | | | | 0 | | | | 0 | | | | |
| 6 | 0 | | | | 0 | | | | 0 | | | | |
| 7 | 0 | | | | 1 | 780.0 | | | 1 | 780.0 | | | |
| 8 | 4 | 812.5 | 60.76 | 740 to 880 | 2 | 875.0 | 247.49 | 700 to 1050 | 6 | 833.3 | 124.52 | 700 to 1050 | 0.352 |
| 9 | 3 | 866.7 | 70.24 | 800 to 940 | 2 | 1150.0 | 311.13 | 930 to 1370 | 6 | 965.0 | 204.82 | 800 to 1370 | 1.267 |
| 10 | 1 | 1150.0 | | | 2 | 855.0 | 21.21 | 840 to 870 | 4 | 882.5 | 198.89 | 670 to 1150 | |
| 11 | 1 | 960.0 | | | 2 | 1125.0 | 120.21 | 1040 to 1210 | 3 | 1070.0 | 127.67 | 960 to 1210 | |
| 12 | 0 | | | | 0 | | | | 0 | | | | |
| 13 | 0 | | | | 2 | 1195.0 | 233.34 | 1030 to 1360 | 2 | 1195.0 | 233.34 | 1030 to 1360 | |
| 14 | 0 | | | | 0 | | | | 0 | | | | |
| 15 | 0 | | | | 1 | 1180.0 | | | 1 | 1180.0 | | | |
| 16 | 0 | | | | 0 | | | | 0 | | | | |
| 17 | 0 | | | | 0 | | | | 0 | | | | |
| 18 | 0 | | | | 0 | | | | 0 | | | | |
| 19 | 0 | | | | 1 | 1810.0 | | | 1 | 1810.0 | | | |
| Total | 9 | | | | 13 | | | | 25 | | | | |

Table 58. Age-specific sex ratios and maturity for longnose sucker from the Mildred Lake Study Area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Fin Ray Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|-------------------|---------|-------|----------|-------|-------|----------|-----------------|-------|------|----------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 2 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 3 | 1 | 100.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 1 | 1.6 | |
| 4 | 1 | 100.0 | 0.0 | 0 | 0.0 | 0.0 | 2 | 3 | 4.8 | |
| 5 | 1 | 50.0 | 0.0 | 1 | 50.0 | 100.0 | 0 | 2 | 3.2 | |
| 6 | 2 | 40.0 | 100.0 | 3 | 60.0 | 100.0 | 1 | 6 | 9.7 | |
| 7 | 6 | 46.2 | 100.0 | 7 | 53.8 | 100.0 | 0 | 13 | 20.9 | 0.080 |
| 8 | 7 | 63.6 | 100.0 | 4 | 36.4 | 100.0 | 0 | 11 | 17.7 | 0.818 |
| 9 | 3 | 42.9 | 100.0 | 4 | 57.1 | 100.0 | 0 | 7 | 11.3 | 0.142 |
| 10 | 4 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 4 | 6.5 | |
| 11 | 4 | 57.1 | 100.0 | 3 | 42.9 | 100.0 | 0 | 7 | 11.3 | 0.142 |
| 12 | 1 | 50.0 | 100.0 | 1 | 50.0 | 100.0 | 0 | 2 | 3.2 | |
| 13 | 1 | 25.0 | 100.0 | 3 | 75.0 | 100.0 | 0 | 4 | 6.5 | |
| 14 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 15 | 0 | 0.0 | 0.0 | 2 | 100.0 | 100.0 | 0 | 2 | 3.2 | |
| 16 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 17 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 18 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 19 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 20 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| Totals | 31 | 52.5 | 90.3 | 28 | 47.5 | 100.0 | 3 | 62 | 99.9 | 0.152 |

Table 59. Age-specific sex ratios and maturity for longnose sucker from the Delta Study Area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Fin Ray Age | Females | | | Males | | | Unsexed Fish | Total | | χ ² |
|-------------------|---------|-------|----------|-------|------|----------|-----------------|-------|-------|----------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 2 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 3 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 4 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1 | 1 | 4.0 | |
| 5 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 6 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 7 | 1 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 1 | 4.0 | |
| 8 | 2 | 33.3 | 100.0 | 4 | 66.7 | 100.0 | 0 | 6 | 24.0 | 0.660 |
| 9 | 2 | 40.0 | 100.0 | 3 | 60.0 | 100.0 | 1 | 6 | 24.0 | 0.200 |
| 10 | 2 | 66.7 | 100.0 | 1 | 33.3 | 100.0 | 1 | 4 | 16.0 | |
| 11 | 2 | 66.7 | 100.0 | 1 | 33.3 | 100.0 | 0 | 3 | 12.0 | |
| 12 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 13 | 2 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 2 | 8.0 | |
| 14 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 15 | 1 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 1 | 4.0 | |
| 16 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 17 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 18 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| 19 | 1 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 1 | 4.0 | |
| 20 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | |
| Totals | 13 | 59.1 | 100.0 | 9 | 40.9 | 100.0 | 3 | 25 | 100.0 | 1.540 |

4.2.5.4 Spawning. Longnose suckers were abundant in tributary mouths within the Mildred Lake study area in late April and early May 1977. A reduction in catch-per-unit-effort in standard gillnet gangs and large mesh seines (Tables 5 and 7) in early May marked the movement of longnose suckers onto spawning grounds in tributary streams or in the Athabasca River upstream of the Mildred Lake study area. Both the Muskeg River (Bond and Machniak 1979) and the Steepbank River (Machniak and Bond 1979) are known to have had longnose sucker runs in 1977. Spawning was not observed in the Mildred Lake study area portion of the Athabasca River and is not believed to have occurred there. Tripp and McCart (in prep.), however, indicated that longnose suckers did spawn in the Athabasca River upstream from Fort McMurray in May 1978. Spawning occurred below Cascade and Mountain rapids (Figure 4) in areas used for spawning by lake whitefish in the autumn (Jones et al. 1978). Spent longnose suckers appeared in the Athabasca River by 2 June 1977 in both the Mildred Lake and Delta study areas.

Young-of-the-year suckers (2 species) first appeared in the Mildred Lake portion of the Athabasca River in mid-June (Table 9) and, although their abundance in the main river diminished after the end of June, they remained common. Large numbers of young-of-the-year suckers are known to remain in the tributaries throughout their first summer to rear (Bond and Machniak 1977, 1979; Machniak and Bond 1979). Young-of-the-year suckers first showed up in the Delta study area on 17 to 20 June and appeared to be abundant through 9 to 10 August (Table 10). Few young-of-the-year suckers were captured in the Delta study area after 10 August perhaps indicating that the fry had drifted past the Delta and down to Lake Athabasca.

4.2.5.5 Fecundity. Fecundity estimates were performed on 12 mature female longnose suckers captured from the Mildred Lake study area on 1 to 5 May 1977. These fish ranged in fork length from 387 to 491 mm and the estimated fecundity varied from 19 408 to 44 402 ova with a mean of 29 203 eggs per female. Length-relative fecundity ranged from 464.7 to 940.7 eggs per cm of fork length while weight-relative

fecundity ranged from 17.8 to 29.6 eggs per g of body weight (Table 60).

4.2.5.6 Migrations and movements. As mentioned previously, a large longnose sucker migration was in progress in the Mildred Lake study area when sampling began in late April 1977. During late April and early May, many longnose suckers left the Athabasca River and entered tributaries such as the Muskeg River (Bond and Machniak 1979) and the Steepbank River (Machniak and Bond 1979). Others may have continued upstream through the Mildred Lake study area to spawning grounds in the Athabasca or Clearwater rivers, upstream from Fort McMurray (Tripp and McCart in prep.). After spawning, most longnose suckers left the spawning streams and returned downstream, although some fish remained in the tributaries throughout the summer, leaving just prior to freeze-up (Bond and Machniak 1977; Machniak and Bond 1979).

Tag return evidence from this and other studies (Bond and Machniak 1979; Machniak and Bond 1979; Machniak et al. in prep.) suggests that longnose suckers that spawn in the tributaries of the Mildred Lake study area belong to the Lake Athabasca population and return to the lake to overwinter. During the two years of the present study, Floy tags were applied to 1267 longnose suckers of which 34 have been recaptured for a return rate of 2.7% (Table 13, Appendix 6.4). Twelve longnose suckers were recaptured at the Muskeg River counting fence between 2 May and 5 June 1977, while six fish, tagged in 1977, were recaptured at the MacKay River counting fence between 30 April and 5 May 1978. Ten tagged longnose suckers were recovered in Lake Athabasca or the Peace-Athabasca Delta. Three of these fish were recaptured in Lake Athabasca after 38, 52, and 53 days, indicating that some longnose suckers return to the lake quite rapidly after spawning.

Large numbers of young-of-the-year suckers (2 species) drifted out of the Mildred Lake study area in mid-June (Table 9) and had passed the Delta study area by mid-August (Table 10) on their way to rearing areas in the lower delta or Lake Athabasca.

Table 60. Fecundity estimates for longnose sucker from the Athabasca River, 1 to 5 May 1977.

| Fork Length (mm) | Weight (g) | Estimated Number of Eggs | Relative Fecundity ^a | |
|---------------------|---------------|-----------------------------|---------------------------------|--------|
| | | | Eggs/cm | Eggs/g |
| 387 | 740 | 19 408 | 501.5 | 26.2 |
| 416 | 990 | 22 339 | 537.0 | 22.6 |
| 422 | 850 | 22 000 | 521.3 | 25.9 |
| 428 | 1 150 | 29 477 | 688.7 | 25.6 |
| 429 | 1 130 | 25 103 | 585.2 | 22.2 |
| 435 | 1 150 | 26 623 | 612.0 | 23.2 |
| 439 | 1 140 | 20 399 | 464.7 | 17.8 |
| 452 | 1 160 | 30 547 | 675.8 | 26.4 |
| 467 | 1 370 | 35 914 | 769.0 | 26.2 |
| 471 | 1 460 | 36 145 | 767.4 | 24.8 |
| 472 | 1 500 | 44 402 | 940.7 | 29.6 |
| 491 | 1 680 | 38 079 | 775.5 | 22.7 |

^a Number of eggs per cm of fork length and per g of body weight.

4.2.6 White Sucker

4.2.6.1 Distribution and relative abundance. Suckers (2 species) accounted for 22.6% of all fish captured from the Athabasca River in 1977 (Table 2). The vast majority, however, were young-of-the-year that could not be identified to species. Only six white suckers were captured in standard gangs in the Mildred Lake study area (Table 5) and none was taken by this gear in the Delta study area. Many of the white suckers migrating in the Athabasca River were large, mature fish and it is felt that they were not susceptible to the standard gangs because of their large heads and the fact that much of the gang consisted of small mesh net. Large mesh seines also produced few white suckers in the Delta study area (Table 8), but in the Mildred Lake study area, white suckers occurred in 22% of all large mesh seine hauls and accounted for 12.6% of the total catch (Table 7).

Catch-per-unit-effort values of from 6.8 to 7.2 fish per large mesh seine haul (Table 7) indicated the presence of large numbers of white suckers in the Mildred Lake study area in late April and early May. This abundance is known to be associated with movements onto spawning grounds in tributary streams such as the Muskeg River (Bond and Machniak 1977, 1979) and the Steepbank River (Machniak and Bond 1979). Between 15 May and 22 September only four white suckers were captured in large mesh seines in the Mildred Lake study area. An increase in catch-per-unit-effort was observed in late September and early October (Table 7), however, which is thought to indicate the return to the Athabasca River of white suckers that spent the summer in tributary streams. Machniak and Bond (1979) recorded a downstream movement of white suckers in the Steepbank River just prior to freeze-up.

In the Mildred Lake study area, most white suckers were captured at Sites 1 to 3, 5, 8 to 16, 19 to 25, 27 to 34, 36, and 37, while in the Delta study area, white suckers were taken at Sites 59, 61, 62, 64, 74 to 80, and 82 to 85 (Figure 4, Appendix 6.1).

4.2.6.2 Age and growth. Excluding young-of-the-year, white suckers ranged in fork length from 150 to 579 mm with 82.9% of the sample being in the 350 to 559 mm range (Table 61).

Table 61. Length-frequency distribution by gear type for white sucker from the Mildred Lake and Delta^a study areas, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|-----|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 150 to 159 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 160 to 169 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 170 to 179 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 180 to 189 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 190 to 199 | 0 | 0 | 3 | 0 | 0 | 3 | 0.6 |
| 200 to 209 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 210 to 219 | 0 | 0 | 3 | 0 | 0 | 3 | 0.6 |
| 220 to 229 | 0 | 0 | 2 | 0 | 0 | 2 | 0.4 |
| 230 to 239 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 240 to 249 | 0 | 0 | 4 | 0 | 0 | 4 | 0.8 |
| 250 to 259 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| 260 to 269 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 270 to 279 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 280 to 289 | 0 | 0 | 2 | 0 | 0 | 2 | 0.4 |
| 290 to 299 | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| 300 to 309 | 2 | 0 | 5 | 0 | 0 | 7 | 1.3 |
| 310 to 319 | 0 | 0 | 4 | 0 | 0 | 4 | 0.8 |
| 320 to 329 | 0 | 0 | 6 | 1 | 0 | 7 | 1.3 |
| 330 to 339 | 0 | 0 | 5 | 0 | 0 | 5 | 0.9 |
| 340 to 349 | 0 | 0 | 8 | 0 | 0 | 8 | 1.5 |
| 350 to 359 | 1 | 1 | 11 | 0 | 0 | 13 | 2.4 |
| 360 to 369 | 0 | 0 | 24 | 0 | 0 | 24 | 4.5 |
| 370 to 379 | 1 | 2 | 20 | 0 | 0 | 23 | 4.3 |
| 380 to 389 | 0 | 5 | 19 | 0 | 0 | 24 | 4.5 |
| 390 to 399 | 0 | 9 | 18 | 0 | 0 | 27 | 5.1 |

continued ...

Table 61. Concluded.

| Fork Length (mm) | Number of Fish | | | | | Total | |
|---------------------|-------------------|----------------------|----------------------|----------------------|---------|-------|------|
| | Standard Gangs | Tagging Gill Nets | Large Mesh Seines | Small Mesh Seines | Angling | N | % |
| 400 to 409 | 0 | 8 | 19 | 0 | 0 | 27 | 5.1 |
| 410 to 419 | 0 | 6 | 17 | 0 | 0 | 23 | 4.3 |
| 420 to 429 | 0 | 8 | 13 | 0 | 0 | 21 | 4.0 |
| 430 to 439 | 0 | 2 | 17 | 0 | 0 | 19 | 3.6 |
| 440 to 449 | 0 | 2 | 16 | 0 | 0 | 18 | 3.4 |
| 450 to 459 | 0 | 4 | 19 | 0 | 0 | 23 | 4.3 |
| 460 to 469 | 0 | 7 | 25 | 0 | 0 | 32 | 6.0 |
| 470 to 479 | 0 | 0 | 42 | 0 | 0 | 42 | 7.9 |
| 480 to 489 | 0 | 1 | 30 | 0 | 0 | 31 | 5.8 |
| 490 to 499 | 0 | 0 | 22 | 0 | 0 | 22 | 4.1 |
| 500 to 509 | 0 | 2 | 25 | 0 | 0 | 27 | 5.1 |
| 510 to 519 | 0 | 0 | 20 | 0 | 0 | 20 | 3.8 |
| 520 to 529 | 0 | 0 | 19 | 0 | 0 | 19 | 3.6 |
| 530 to 539 | 0 | 0 | 16 | 0 | 0 | 16 | 3.0 |
| 540 to 549 | 0 | 0 | 11 | 0 | 0 | 12 | 2.3 |
| 550 to 559 | 0 | 0 | 12 | 0 | 0 | 12 | 2.3 |
| 560 to 569 | 0 | 0 | 5 | 0 | 0 | 5 | 0.9 |
| 570 to 579 | 0 | 0 | 1 | 0 | 0 | 1 | 0.2 |
| Totals | 5 | 57 | 467 | 1 | 1 | 531 | 99.9 |

^a Includes only 13 white suckers from the Delta study area.

Because of the small number of white suckers captured in standard gangs, no age-length or age-weight analysis was performed on this species. Information relative to this aspect of the life history of white suckers in the AOSERP area has been presented by Bond and Machniak (1977, 1979) and Machniak and Bond (1979).

White suckers are approximately 10 cm long at hatching. On 17 to 20 June, young-of-the-year suckers (2 species) captured in the Athabasca River had a mean length of 21.3 mm (range 18 to 26 mm). Young-of-the-year white suckers had a fork length of 39.7 mm (range 25 to 55 mm) and 47.2 mm (range 30 to 77 mm) on 26 to 28 July and 6 to 22 August, respectively. Most of the first year's growth appears to have been completed by late August as young-of-the-year captured in September and October had mean fork lengths of 43.3 mm (range 33 to 67 mm) and 46.8 mm (range 35 to 68), respectively. These fish had a mean weight of 1.0 g.

4.2.6.3 Sex and maturity. Most white suckers captured in 1977 were taken in late April and early May while on their way to the spawning grounds. However, since few suckers were captured in standard gangs, few were sacrificed, so the state of maturity of these fish is not known officially. White suckers in the AOSERP study area mature as early as age 3 or 4 but most do not spawn until they are 6 to 8 years old (Bond and Machniak 1977, 1979; Machniak and Bond 1979; Machniak et al. in prep.).

The presence of nuptial tubercles was used to identify male white suckers during the early part of the year. Of 518 suckers examined, 40.3% were males, 11.2% females, and 51.5% were left unsexed. As with longnose suckers, mature male white suckers were readily identified by the presence of tubercles. Most of the fish left unsexed were probably females with a small proportion being immature males.

4.2.6.4 Spawning and migrations. White suckers were abundant in the Mildred Lake study area in late April and early May. Ripe males were captured in the Athabasca River as early as 24 April and as late

as 13 May while ripe females were taken from 2 to 11 May. Spawning is known to take place in tributary streams such as the Muskeg River (Bond and Machniak 1977, 1979) and the Steepbank River (Machniak and Bond 1979) but Tripp and McCart (in prep.) report that there is no appreciable spawning in the Athabasca or Clearwater rivers just upstream of Fort McMurray. After spawning, most white suckers left the spawning streams and returned downstream although some fish remained in the tributaries throughout the summer, leaving just prior to freeze-up (Bond and Machniak 1977, 1979; Machniak and Bond 1979).

Tag return evidence from this and other studies (Shell Canada Ltd. 1975; Bond and Machniak 1977, 1979; Machniak and Bond 1979; Machniak et al in prep.) suggests that white suckers that spawn in the tributaries of the Mildred Lake study area belong to the Lake Athabasca population and return to the lake to overwinter. During the two years of the present study, Floy tags were applied to 583 white suckers of which 48 have been recaptured for a return rate of 8.2% (Table 13, Appendix 6.4). Six white suckers, tagged in the Athabasca River in 1976, were recaptured at the Muskeg River counting fence in 1977. Also recaptured at the Muskeg River fence were nine white suckers that had been tagged in the Athabasca River between 23 April and 4 May 1977. Nineteen white suckers, tagged in the Athabasca River in 1977, were taken at the counting fence on the MacKay River between 1 and 14 May 1978. A total of nine white suckers were recaptured in Lake Athabasca or the Peace-Athabasca Delta with one fish having travelled approximately 300 km when recaptured at Quatre Fourches (Figure 4). Four fish, tagged in the Mildred Lake study area between 24 April and 13 May, were recaptured in the lake and delta after from 23 to 67 days, indicating that some white suckers return to the lake quite rapidly after spawning.

Young-of-the-year suckers (2 species) had begun to appear in the tributaries by 29 May and large numbers were taken in the Mildred Lake study area in mid-June (Table 9). The downstream fry migration had passed the Delta study area by mid-August (Table 10) as the fry moved to nursery areas in the lower delta or Lake Athabasca.

4.2.6.5 Fecundity. Fecundity data for 11 white suckers, fork length 370 to 565 mm, are presented in Table 62. Estimated fecundity ranged from 31 566 to 85 461 eggs with a mean of 54 766.1 ova per female. Length-relative fecundity ranged from 853.1 to 1512.6 eggs per cm of fork length while weight-relative fecundity varied from 21.8 to 36.7 ova per g of body weight.

4.2.7 Trout-perch

4.2.7.1 Distribution and relative abundance. Trout-perch were abundant and widely distributed throughout both the Mildred Lake and Delta study areas in 1977. In the Mildred Lake study area, trout-perch made up 26.6% of the total catch from small mesh seines, occurred in 62% of all seine hauls, and had an average catch-per-unit-effort of 11.7 fish per haul (Table 9). In the Delta, trout-perch were taken in 76% of all small mesh seine hauls, comprising 9.6% of the total catch from this gear with an average catch-per-unit-effort of 14.8 fish per haul (Table 10). This species was captured at Sites 21 to 33, 25, 27 to 28, 30, 31, 33 to 37, 39, and 41 to 44 in the Mildred Lake area and at Sites 73 to 79 and 81 to 87 in the Delta (Figure 4, Appendix 6.1).

An examination of Tables 9 and 10 reveals that trout-perch displayed similar trends in abundance through the summer in both study areas. In general, the catch-per-unit-effort was low in April and May but peaked in mid- to late June as a result of the appearance of young-of-the-year. Through the remainder of the sampling period the catch-per-unit-effort experienced fluctuations; however, the trend was toward a gradual reduction in abundance as the summer progressed, indicating a dispersal of young-of-the-year and the probable mortality of older fish.

4.2.7.2 Age and growth. Trout-perch captured in the Athabasca River in 1977 ranged in fork length from 12 to 89 mm, with those in the 25 to 49 mm range accounting for 68.5% of the total. Similar length-frequency distributions were obtained in both study areas (Tables 63

Table 62. Fecundity estimates for white sucker from the Athabasca River, 1 to 4 May 1977.

| Fork Length (mm) | Weight (g) | Estimated Number of Eggs | Relative Fecundity ^a | |
|---------------------|---------------|-----------------------------|---------------------------------|--------|
| | | | Eggs/cm... | Eggs/g |
| 370 | 860 | 31 566 | 853.1 | 36.7 |
| 448 | 1 440 | 43 935 | 980.7 | 30.5 |
| 451 | 1 550 | 50 436 | 1 118.3 | 32.5 |
| 458 | 1 580 | 37 112 | 810.3 | 23.5 |
| 465 | 1 710 | 42 131 | 906.0 | 24.6 |
| 487 | 1 860 | 51 785 | 1 063.3 | 27.8 |
| 505 | 2 210 | 65 067 | 1 288.5 | 29.4 |
| 533 | 2 110 | 67 333 | 1 263.3 | 31.9 |
| 542 | 2 730 | 70 189 | 1 295.0 | 25.7 |
| 551 | 2 630 | 57 412 | 1 042.0 | 21.8 |
| 565 | 3 220 | 85 461 | 1 512.6 | 26.5 |

^a Number of eggs per cm of fork length and per g of body weight.

Table 63. Length-frequency distribution for trout-perch from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | | Total | |
|---------------------|----------------|------|------|------|-------|-----|-------|------|
| | May | June | July | Aug. | Sept. | Oct | N | % |
| 0 to 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 5 to 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 10 to 14 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0.8 |
| 15 to 19 | 0 | 19 | 2 | 1 | 0 | 1 | 23 | 3.8 |
| 20 to 24 | 0 | 4 | 11 | 10 | 4 | 13 | 42 | 7.0 |
| 25 to 29 | 0 | 0 | 29 | 22 | 11 | 28 | 90 | 14.9 |
| 30 to 34 | 5 | 1 | 16 | 18 | 14 | 28 | 82 | 13.6 |
| 35 to 39 | 11 | 6 | 2 | 20 | 20 | 23 | 82 | 13.6 |
| 40 to 44 | 23 | 9 | 0 | 4 | 23 | 34 | 93 | 15.4 |
| 45 to 49 | 16 | 16 | 1 | 1 | 1 | 30 | 65 | 10.8 |
| 50 to 54 | 7 | 11 | 9 | 0 | 2 | 9 | 38 | 6.3 |
| 55 to 59 | 3 | 4 | 8 | 6 | 1 | 6 | 28 | 4.6 |
| 60 to 64 | 3 | 1 | 5 | 2 | 1 | 9 | 21 | 3.5 |
| 65 to 69 | 3 | 0 | 0 | 1 | 3 | 6 | 13 | 2.2 |
| 70 to 74 | 9 | 0 | 1 | 0 | 2 | 2 | 14 | 2.3 |
| 75 to 79 | 1 | 1 | 1 | 1 | 1 | 0 | 5 | 0.8 |
| 80 to 84 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0.3 |
| 85 to 89 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Totals | 82 | 77 | 85 | 87 | 83 | 189 | 603 | 99.9 |

and 64). The May samples are believed to consist largely of age 1 fish with small numbers of older individuals. Young-of-the-year first appeared in June resulting in a bi-modal distribution. This age class became increasingly dominant throughout the summer as age 1 and older fish became less abundant.

Age-length and age-weight relationships for trout-perch taken from the Mildred Lake and Delta study areas in 1977 are summarized in Tables 65 and 66 and Tables 67 and 68, respectively. Trout-perch had a maximum age of three years but the majority were young-of-the-year (62.7%) and age 1 (33.3%) fish (Table 69). All age 3 fish and most age 2 individuals were captured in May.

Length-weight relationships for male and female trout-perch from both the Mildred Lake and Delta study areas are presented in Table 70. For the Mildred Lake sample, a significant difference was found between the slopes of the regressions for males and females ($t = 4.992$, $P < 0.05$). No such difference occurred, however, in the Delta sample ($t = 1.331$, $P < 0.05$).

4.2.7.3 Sex and maturity. Age-specific sex ratios and maturity data for trout-perch from both study areas are summarized in Table 69. Of 637 trout-perch for which sex was determined, 396 (62%) were females, producing an overall sex ratio that was significantly different from unity. Females out-numbered males in all age groups with significant differences occurring at age 0+ in the Delta sample and age 1 in both study areas.

Trout-perch in the Athabasca River first achieve sexual maturity at age 1. The data indicate that 4% of females and 17% of males were mature at age 1 while at age 2 the corresponding figures were 65% and 86% (Table 69).

4.2.7.4 Spawning. Spawning was not observed for trout-perch during the present study but ripe male and female trout-perch were collected from the Athabasca River in the Mildred Lake study area during late April and early May. Ripe trout-perch were captured near the Steepbank River fence site during May and young-of-the-year were taken

Table 64. Length-frequency distribution for trout-perch from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | | Total | |
|---------------------|----------------|------|------|------|-------|------|-------|-------|
| | May | June | July | Aug. | Sept. | Oct. | N | % |
| 0 to 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 5 to 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 10 to 14 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| 15 to 19 | 0 | 8 | 0 | 3 | 0 | 0 | 11 | 2.4 |
| 20 to 24 | 0 | 13 | 6 | 6 | 10 | 0 | 35 | 7.6 |
| 25 to 29 | 0 | 0 | 33 | 6 | 22 | 6 | 67 | 14.6 |
| 30 to 34 | 1 | 0 | 28 | 14 | 20 | 25 | 88 | 19.1 |
| 35 to 39 | 7 | 6 | 3 | 23 | 10 | 17 | 66 | 14.4 |
| 40 to 44 | 9 | 8 | 0 | 8 | 9 | 4 | 38 | 8.3 |
| 45 to 49 | 18 | 26 | 1 | 2 | 5 | 5 | 57 | 12.4 |
| 50 to 54 | 10 | 17 | 3 | 1 | 2 | 1 | 34 | 7.4 |
| 55 to 59 | 13 | 17 | 3 | 4 | 0 | 0 | 37 | 8.0 |
| 60 to 64 | 5 | 4 | 0 | 3 | 0 | 0 | 12 | 2.6 |
| 65 to 69 | 1 | 0 | 3 | 1 | 0 | 0 | 5 | 1.1 |
| 70 to 74 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0.7 |
| 75 to 79 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0.4 |
| 80 to 84 | 1 | 1 | 0 | 1 | 0 | 0 | 3 | 0.7 |
| 85 to 89 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0.2 |
| Totals | 69 | 101 | 81 | 72 | 79 | 58 | 460 | 100.1 |

Table 65. Age-length (mm) relationship for trout-perch from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|----------|---------|------|------|----------|----------|------|------|----------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 51 | 39.6 | 7.27 | 25 to 58 | 58 | 36.2 | 6.29 | 25 to 50 | 150 | 35.0 | 8.87 | 13 to 58 | 2.58 ^a |
| 1 | 50 | 49.9 | 7.79 | 35 to 67 | 96 | 49.7 | 9.01 | 31 to 73 | 159 | 48.9 | 8.87 | 31 to 73 | 0.15 |
| 2 | 11 | 62.6 | 9.41 | 43 to 76 | 16 | 71.9 | 4.92 | 62 to 82 | 27 | 68.1 | 8.38 | 43 to 82 | 3.03 ^a |
| 3 | 2 | 76.0 | 8.49 | 70 to 82 | 3 | 78.3 | 9.45 | 71 to 89 | 5 | 77.4 | 8.02 | 70 to 89 | 0.29 |
| Total | 114 | | | | 173 | | | | 341 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 66. Age-weight relationship for trout-perch from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|--------------|---------|------|------|--------------|----------|------|------|--------------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 51 | 0.73 | 0.41 | 0.20 to 2.10 | 58 | 0.58 | 0.31 | 0.16 to 1.48 | 150 | 0.56 | 0.38 | 0.02 to 2.10 | 2.56 ^a |
| 1 | 50 | 1.48 | 0.78 | 0.36 to 3.62 | 96 | 1.51 | 0.90 | 0.25 to 4.48 | 159 | 1.43 | 0.86 | 0.25 to 4.48 | 0.21 |
| 2 | 11 | 2.95 | 1.23 | 0.71 to 4.69 | 16 | 4.39 | 0.97 | 2.97 to 6.56 | 27 | 3.80 | 1.28 | 0.71 to 6.56 | 3.25 ^a |
| 3 | 2 | 4.73 | 0.63 | 4.29 to 5.18 | 3 | 5.73 | 2.26 | 3.82 to 8.23 | 5 | 5.40 | 1.72 | 3.82 to 8.23 | 0.72 |
| Total | 114 | | | | 173 | | | | 341 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 67. Age-length (mm) relationship for trout-perch from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|----------|---------|------|------|----------|----------|------|------|----------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 34 | 35.9 | 7.01 | 26 to 53 | 38 | 33.5 | 5.42 | 24 to 48 | 109 | 31.6 | 7.24 | 16 to 53 | 1.56 |
| 1 | 57 | 50.7 | 7.79 | 35 to 66 | 53 | 50.6 | 9.02 | 35 to 80 | 110 | 50.6 | 8.36 | 35 to 80 | 0.02 |
| 2 | 3 | 73.0 | 2.65 | 71 to 76 | 4 | 77.8 | 9.84 | 69 to 89 | 7 | 75.7 | 7.63 | 69 to 89 | 0.92 |
| Total | 94 | | | | 95 | | | | 226 | | | | |

Table 68. Age-weight (g) relationship for trout-perch from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|--------------|---------|------|------|--------------|----------|------|------|--------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | 34 | 0.54 | 0.34 | 0.21 to 1.56 | 38 | 0.43 | 0.21 | 0.11 to 1.13 | 109 | 0.39 | 0.27 | 0.06 to 1.56 | 1.61 |
| 1 | 57 | 1.60 | 0.70 | 0.42 to 3.68 | 53 | 1.72 | 1.07 | 0.50 to 6.38 | 110 | 1.66 | 0.90 | 0.42 to 6.38 | 0.69 |
| 2 | 3 | 4.49 | 0.24 | 4.22 to 4.69 | 4 | 5.78 | 2.06 | 4.02 to 8.14 | 7 | 5.23 | 1.62 | 4.02 to 8.14 | 1.24 |
| Total | 94 | | | | 95 | | | | 226 | | | | |

Table 69. Age-specific sex ratios and maturity for trout-perch from the Mildred Lake, Delta, and combined study areas, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Otolith Age | Females | | | Males | | | Unsexed Fish | Total | | X ² |
|--------------------------|---------|------|----------|-------|------|----------|--------------|-------|-------|--------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| <u>Mildred Lake Area</u> | | | | | | | | | | |
| 0+ | 58 | 53.2 | 0.0 | 51 | 46.8 | 0.0 | 206 | 315 | 62.3 | 0.44 |
| 1 | 96 | 65.8 | 2.1 | 50 | 34.2 | 8.0 | 13 | 159 | 31.4 | 14.48 ^a |
| 2 | 16 | 59.3 | 62.5 | 11 | 40.7 | 81.8 | 0 | 27 | 5.3 | 0.92 |
| 3 | 3 | 60.0 | 100.0 | 2 | 40.0 | 100.0 | 0 | 5 | 1.0 | 0.20 |
| Totals | 173 | 60.3 | 8.7 | 114 | 39.7 | 13.2 | 219 | 506 | 100.0 | 12.12 ^a |
| <u>Delta Area</u> | | | | | | | | | | |
| 0+ | 114 | 63.0 | 0.0 | 67 | 37.0 | 0.0 | 109 | 290 | 63.2 | 12.20 ^a |
| 1 | 105 | 64.8 | 6.7 | 57 | 35.2 | 26.3 | 0 | 162 | 35.3 | 14.22 ^a |
| 2 | 4 | 57.1 | 75.0 | 3 | 42.9 | 100.0 | 0 | 7 | 1.5 | 0.14 |
| Totals | 223 | 63.7 | 4.5 | 127 | 36.3 | 14.2 | 109 | 459 | 100.0 | 26.34 ^a |
| <u>Combined Areas</u> | | | | | | | | | | |
| 0+ | 172 | 59.3 | 0.0 | 118 | 40.7 | 0.0 | 315 | 605 | 62.7 | 10.06 ^a |
| 1 | 201 | 65.3 | 4.0 | 107 | 34.7 | 16.8 | 13 | 321 | 33.3 | 28.68 ^a |
| 2 | 20 | 58.8 | 65.0 | 14 | 41.2 | 85.7 | 0 | 34 | 3.5 | 1.06 |
| 3 | 3 | 60.0 | 100.0 | 2 | 40.0 | 100.0 | 0 | 5 | 0.5 | 0.20 |
| Totals | 396 | 62.9 | 6.3 | 241 | 37.1 | 13.7 | 328 | 965 | 100.0 | 37.27 ^a |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

Table 70. Length-weight relationships for trout-perch, flathead chub, lake chub, emerald shiner, and spottail shiner from the Mildred Lake and Delta study areas, Athabasca River, 1977.

| Species | Sex | Number of Fish | Range in Fork Length (mm) | Slope (b) | Intercept (a) | sb | Correlation Coefficient (r) |
|--------------------------|--------|----------------|---------------------------|-----------|---------------|-------|-----------------------------|
| <u>Mildred Lake Area</u> | | | | | | | |
| Trout-perch | Male | 114 | 25 to 82 | 3.057 | -5.061 | 0.003 | 0.983 |
| | Female | 173 | 25 to 89 | 2.153 | -3.539 | 0.013 | 0.822 |
| Flathead chub | Male | 44 | 80 to 261 | 2.905 | -4.714 | 0.009 | 0.978 |
| | Female | 103 | 121 to 299 | 3.112 | -4.862 | 0.005 | 0.970 |
| Lake chub | Male | 47 | 32 to 94 | 3.154 | -5.213 | 0.005 | 0.992 |
| | Female | 68 | 30 to 79 | 3.095 | -5.110 | 0.003 | 0.989 |
| Emerald shiners | Male | 47 | 69 to 88 | 2.512 | -4.127 | 0.039 | 0.884 |
| | Female | 57 | 46 to 100 | 3.088 | -5.189 | 0.016 | 0.953 |
| Spottail shiners | Male | 26 | 36 to 78 | 2.902 | -4.788 | 0.028 | 0.989 |
| | Female | 44 | 35 to 89 | 3.168 | -5.245 | 0.003 | 0.990 |
| <u>Delta Area</u> | | | | | | | |
| Trout-perch | Male | 94 | 26 to 76 | 3.070 | -5.067 | 0.002 | 0.992 |
| | Female | 95 | 24 to 89 | 3.151 | -5.189 | 0.002 | 0.991 |
| Flathead chub | Male | 8 | 99 to 209 | 2.984 | -4.882 | 0.015 | 0.976 |
| | Female | 21 | 90 to 320 | 3.018 | -4.942 | 0.007 | 0.993 |
| Emerald shiners | Male | 119 | 44 to 87 | 2.924 | -4.922 | 0.008 | 0.988 |
| | Female | 96 | 36 to 98 | 3.127 | -5.271 | 0.002 | 0.993 |
| Spottail shiners | Male | 45 | 50 to 83 | 2.802 | -4.560 | 0.008 | 0.984 |
| | Female | 74 | 35 to 95 | 3.038 | -5.018 | 0.002 | 0.994 |

as far upstream as the North Steepbank River in August (Machniak and Bond 1979). W. A. Bond captured ripe males and a 10 mm long fry in the Ells River at a point 5 km upstream from the mouth on 8 June 1977. Whether or not trout-perch spawn in the Athabasca River itself, it seems apparent that at least some tributaries are utilized for this purpose with late May or early June being the time of spawning in 1977. Young-of-the-year trout-perch (12 to 22 mm in length) first appeared in the Athabasca River in early June in both the Mildred Lake and Delta study areas.

4.2.7.5 Fecundity. Total egg counts were performed on 12 mature trout-perch captured in the Mildred Lake study area on 3 to 7 May 1977. For these fish, which ranged from 58 to 89 mm in fork length, egg counts varied between 192 and 421 with a mean of 274.8 (Table 71).

4.2.7.6 Food habits. The stomach contents of 70 trout-perch were examined for food and the overall results described in terms of percentage frequency of occurrence (Table 72). Diptera larvae (mostly Chironomidae) were the most common food item, occurring in 77.1% of the Mildred Lake samples and in 68.6% of the Delta samples. Ephemeroptera nymphs (22.8 and 8.6%), Copepoda (22.8 and 5.7%), Ostracoda (22.8 and 2.8%), and Cladocera (8.6 and 5.7%) were also found commonly in the food. Trichoptera larvae (5.7%) and Plecoptera nymphs (8.6%) were found only in the stomachs of trout-perch from the Mildred Lake study area.

4.2.8 Flathead Chub

4.2.8.1 Distribution and relative abundance. Although common throughout the study area, flathead chub were not taken in large numbers either in standard gangs or large mesh beach seines. Flathead chub of a size that was susceptible to capture by standard gangs and large mesh seines (over 150 mm fork length) appeared to be more abundant within the Mildred Lake study area than in the Delta. Flathead chub made up 9.6% of the total catch in standard gangs in the

Table 71. Fecundity of trout-perch from the Athabasca River, 3 to 7 May 1977.

| Fork Length (mm) | Weight (g) | Otolith Age (yrs) | Number of Eggs (Total Counts) |
|---------------------|---------------|----------------------|----------------------------------|
| 58 | 2.35 | 1 | 235 |
| 62 | 2.97 | 2 | 249 |
| 68 | 3.05 | 2 | 200 |
| 70 | 4.04 | 2 | 264 |
| 71 | 3.82 | 3 | 283 |
| 71 | 5.01 | 2 | 236 |
| 71 | 4.05 | 2 | 214 |
| 71 | 4.34 | 2 | 288 |
| 74 | 4.28 | 2 | 192 |
| 75 | 5.15 | 3 | 311 |
| 77 | 6.56 | 2 | 405 |
| 89 | 8.23 | 3 | 421 |

Table 72. Food habits of trout-perch from the Athabasca River, 1977.

| Food Item | Percentage Frequency of Occurrence ^a | |
|------------------------|---|------------------------|
| | Mildred Lake Area (N = 35) | Delta Area (N = 35) |
| Trichoptera | 5.7 | 0.0 |
| Ephemeroptera | 22.8 | 8.6 |
| Plecoptera | 8.6 | 0.0 |
| Diptera | 77.1 | 68.6 |
| Unidentifiable Insects | 0.0 | 22.8 |
| Nematoda | 8.6 | 2.8 |
| Cladocera | 8.6 | 5.7 |
| Copepoda | 22.8 | 5.7 |
| Ostracoda | 22.8 | 2.8 |
| Debris | 2.8 | 2.8 |
| Empty | 8.6 | 14.3 |

^a Expressed as a percentage of the number of stomachs examined (N).

Mildred Lake study area and had an average catch-per-unit-effort of 0.115. They were most numerous from early May to early June at which time catch-per-unit-effort varied from 0.571 to 0.451 fish per gang per hour (Table 5). This species was taken in 15% of all large mesh seine hauls, accounted for 3.8% of the total catch, and had an average catch-per-unit-effort of 0.3 fish per haul. Large mesh seines showed flathead chub to be most numerous in the Mildred Lake area from mid-May to mid-June (Table 7). In the Delta study area, flathead chub was the least abundant species taken in standard gangs, making up only 2.7% of the catch and having an average catch-per-unit effort of 0.016 fish per gang per hour (Table 6). In large mesh, seines flathead chub was the fifth most abundant species taken in the Delta, making up 6.2% of the catch while occurring in 12% of all seine hauls with average catch-per-unit-effort of 0.2 fish per haul (Table 8).

Small mesh beach seines produced much larger catches in the Delta (Table 10) than in the Mildred Lake study area (Table 9). Fish taken in this gear were primarily young-of-the-year and age 1 individuals. In the Delta, flathead chub occurred in 63% of all small mesh seine hauls, comprised 5.3% of the total catch, and produced an average catch-per-unit-effort of 8.1 fish per haul (Table 10). Abundance peaks occurred in mid-June, mid-July, and mid-September at which times the catch-per-unit-effort values were 12.0, 14.7 and 22.4, respectively. In the Mildred Lake study area, flathead chub occurred in only 16% of small mesh seine hauls, making up 2.6% of the total catch, and showed an average catch-per-unit-effort of 1.1 fish per haul (Table 9). On 18 to 19 October, however, flathead chub made up 52.4% of the total catch produced by 21 small mesh seine hauls in the Mildred Lake study area although occurring in only three of those hauls (Table 9).

In the Mildred Lake study area, flathead chub were captured at Sites 9, 22 to 25, 28, 29, 31 to 36, 38, and 41 to 44 while in the Delta study area they were taken at Sites 52, 62, 71, 73, 75 to 77, 80, 81, 83, and 84 (Figure 4, Appendix 6.1) and also at km 250.6L, 258.9L, 264.8L, 265.6R, 202.7LI, 216.0R, 241.6R, and 223.4R.

4.2.8.2 Age and growth. Flathead chub ranged in fork length from 12 to 322 mm with the vast majority (70.4%) being less than 100 mm (Tables 73 and 74). The gap in length-frequency distribution that existed between 90 and 150 mm in the 1976 results (Bond and Berry in prep.) was partially filled, largely by the inclusion of age 2 chub for the Delta study area.

Age-length and age-weight data for flathead chub from the Mildred Lake and Delta study areas are summarized in Tables 75 and 76 and Tables 77 and 78, respectively.

Scale ages for flathead chub ranged from 0+ to 8 years in both study areas. Females tended to live longer than males (the oldest male was age 6) and to exceed them both in length and weight at a given age. In the Mildred Lake sample, females were significantly longer ($P < 0.05$) than males at age 4 and 5 and significantly heavier in age groups 4, 5, and 6.

The length-weight relationships for male and female flathead chub from the Mildred Lake and Delta study areas are given in Table 70. No significant difference ($P > 0.05$) was found between the slopes of the regressions for males and females in either the Mildred Lake ($t = 0.481$) or Delta ($t = 0.127$) study areas.

4.2.8.3 Sex and maturity. Age-specific sex ratios and maturity data for flathead chub from both study areas are summarized in Tables 79 and 80. Of 183 flathead chub for which age and sex were determined, 126 (86.8%) were females, giving an overall sex ratio that differed significantly ($P < 0.05$) from unity.

Flathead chub in the Athabasca River may mature as early as age 3 but most do not spawn until age 4. In 1977, 63.3% of the females and 64.7% of the males examined were sexually mature at age 4. Bond and Berry (in prep.) reported that both sexes mature at four years of age. The smallest mature female was 179 mm in fork length while the smallest mature male measured 168 mm.

Only seven mature flathead chub were captured in the Delta study area, none of which was a male. The flathead chub population in this study area appears to consist largely of immature fish (88.1%

Table 73. Length-frequency distribution by gear type for flathead chub from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | Total | |
|---------------------|----------------------|----------------------|-----------|-------|-------|
| | Small Mesh Seines | Large Mesh Seines | Gill Nets | N | % |
| 10 to 19 | 6 | 0 | 0 | 6 | 2.2 |
| 20 to 29 | 13 | 0 | 0 | 13 | 4.7 |
| 30 to 39 | 12 | 0 | 0 | 12 | 4.4 |
| 40 to 49 | 8 | 0 | 0 | 8 | 2.9 |
| 50 to 59 | 2 | 0 | 0 | 2 | 0.7 |
| 60 to 69 | 0 | 0 | 0 | 0 | 0.0 |
| 70 to 79 | 0 | 0 | 0 | 0 | 0.0 |
| 80 to 89 | 1 | 0 | 0 | 1 | 0.4 |
| 90 to 99 | 0 | 0 | 0 | 0 | 0.0 |
| 100 to 109 | 0 | 0 | 0 | 0 | 0.0 |
| 110 to 119 | 1 | 0 | 0 | 1 | 0.4 |
| 120 to 129 | 3 | 0 | 0 | 3 | 1.1 |
| 130 to 139 | 1 | 0 | 0 | 1 | 0.4 |
| 140 to 149 | 5 | 4 | 0 | 9 | 3.3 |
| 150 to 159 | 1 | 9 | 0 | 10 | 3.6 |
| 160 to 169 | 5 | 19 | 2 | 26 | 9.4 |
| 170 to 179 | 3 | 21 | 4 | 28 | 10.1 |
| 180 to 189 | 0 | 16 | 10 | 26 | 9.4 |
| 190 to 199 | 4 | 9 | 6 | 19 | 6.9 |
| 200 to 209 | 1 | 3 | 5 | 9 | 3.3 |
| 210 to 219 | 0 | 4 | 5 | 9 | 3.3 |
| 220 to 229 | 0 | 2 | 9 | 11 | 4.0 |
| 230 to 239 | 1 | 4 | 3 | 8 | 2.9 |
| 240 to 249 | 0 | 5 | 8 | 13 | 4.7 |
| 250 to 259 | 0 | 3 | 9 | 12 | 4.4 |
| 260 to 269 | 0 | 3 | 18 | 21 | 7.6 |
| 270 to 279 | 2 | 4 | 6 | 12 | 4.4 |
| 280 to 289 | 0 | 1 | 9 | 10 | 3.6 |
| 290 to 299 | 0 | 0 | 4 | 4 | 1.5 |
| 300 to 309 | 0 | 1 | 1 | 2 | 0.7 |
| 310 to 319 | 0 | 0 | 0 | 0 | 0.0 |
| 320 to 329 | 0 | 0 | 0 | 0 | 0.0 |
| Totals | 69 | 108 | 99 | 276 | 100.3 |

Table 74. Length-frequency distribution by gear type for flathead chub from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | Total | |
|---------------------|----------------------|----------------------|-----------|----------------|-------|
| | Small Mesh Seines | Large Mesh Seines | Gill Nets | N | % |
| 10 to 19 | 82 | 0 | 0 | 82 | 10.0 |
| 20 to 29 | 313 | 0 | 0 | 313 | 38.1 |
| 30 to 39 | 92 | 0 | 0 | 92 | 11.2 |
| 40 to 49 | 80 | 0 | 0 | 80 | 9.7 |
| 50 to 59 | 77 | 0 | 0 | 77 | 9.4 |
| 60 to 69 | 50 | 1 | 0 | 51 | 6.2 |
| 70 to 79 | 23 | 0 | 0 | 23 | 2.8 |
| 80 to 89 | 8 | 0 | 0 | 8 | 1.0 |
| 90 to 99 | 5 | 0 | 0 | 5 | 0.6 |
| 100 to 109 | 11 | 0 | 0 | 11 | 1.3 |
| 110 to 119 | 6 | 0 | 0 | 6 | 0.7 |
| 120 to 129 | 1 | 0 | 0 | 1 | 0.1 |
| 130 to 139 | 0 | 0 | 0 | 0 | 0.0 |
| 140 to 149 | 0 | 4 | 0 | 4 | 0.5 |
| 150 to 159 | 2 | 10 | 0 | 12 | 1.5 |
| 160 to 169 | 1 | 11 | 1 | 13 | 1.6 |
| 170 to 179 | 1 | 11 | 0 | 12 | 1.5 |
| 180 to 189 | 0 | 2 | 0 | 2 | 0.2 |
| 190 to 199 | 0 | 4 | 0 | 4 | 0.5 |
| 200 to 209 | 0 | 1 | 2 | 3 | 0.4 |
| 210 to 219 | 0 | 2 | 0 | 2 | 0.2 |
| 220 to 229 | 0 | 0 | 0 | 0 | 0.0 |
| 230 to 239 | 0 | 0 | 2 | 2 | 0.2 |
| 240 to 249 | 0 | 1 | 1 | 2 | 0.2 |
| 250 to 259 | 0 | 2 | 1 | 3 | 0.4 |
| 260 to 269 | 0 | 2 | 3 | 5 | 0.6 |
| 270 to 279 | 0 | 1 | 3 | 4 | 0.5 |
| 280 to 289 | 0 | 0 | 1 | 1 | 0.1 |
| 290 to 299 | 0 | 0 | 1 | 1 | 0.1 |
| 300 to 309 | 0 | 0 | 0 | 0 | 0.0 |
| 210 to 319 | 0 | 0 | 0 | 0 | 0.0 |
| 320 to 329 | 0 | 0 | 2 | 3 ^a | 0.4 |
| Totals | 752 | 52 | 17 | 822 | 100.0 |

^a Includes one fish caught by angling.

Table 75. Age-length (mm) relationship for flathead chub from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 41 | 31.7 | 9.61 | 16 to 54 | |
| 1 | 2 | 96.0 | 22.63 | 80 to 112 | 1 | 121.0 | | | 3 | 104.3 | 21.55 | 80 to 121 | |
| 2 | 9 | 155.6 | 19.55 | 121 to 191 | 14 | 158.9 | 15.28 | 143 to 192 | 39 | 161.4 | 14.60 | 121 to 192 | 0.43 |
| 3 | 17 | 172.4 | 12.39 | 143 to 204 | 24 | 179.9 | 18.23 | 133 to 222 | 59 | 178.3 | 15.41 | 133 to 222 | 1.58 |
| 4 | 16 | 196.3 | 20.98 | 155 to 225 | 15 | 223.4 | 26.23 | 185 to 291 | 35 | 207.8 | 25.86 | 155 to 291 | 3.17 ^a |
| 5 | 3 | 229.3 | 5.77 | 226 to 236 | 17 | 255.2 | 11.55 | 235 to 277 | 30 | 247.3 | 18.30 | 200 to 277 | 5.95 ^a |
| 6 | 2 | 247.5 | 19.09 | 234 to 261 | 20 | 268.4 | 13.23 | 250 to 297 | 29 | 263.5 | 16.48 | 233 to 297 | 1.51 |
| 7 | 0 | | | | 11 | 280.0 | 10.56 | 266 to 299 | 14 | 281.3 | 11.58 | 266 to 305 | |
| 8 | 0 | | | | 3 | 283.7 | 1.53 | 282 to 285 | 3 | 283.7 | 1.53 | 282 to 285 | |
| Total | 49 | | | | 105 | | | | 253 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 76. Age-weight (g) relationship for flathead chub from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 41 | 0.3 | 0.27 | 0.1 to 1.0 | |
| 1 | 2 | 10.9 | 7.58 | | 1 | 21.0 | | | 3 | 14.3 | 7.90 | 6 to 21 | |
| 2 | 9 | 48.2 | 17.89 | 25 to 86 | 14 | 45.9 | 11.70 | 25 to 70 | 31 | 48.0 | 13.13 | 25 to 86 | 0.35 |
| 3 | 15 | 61.8 | 11.99 | 37 to 90 | 24 | 68.2 | 18.13 | 34 to 120 | 45 | 64.7 | 15.61 | 34 to 120 | 1.32 |
| 4 | 14 | 91.0 | 27.20 | 45 to 140 | 15 | 129.4 | 32.17 | 73 to 180 | 29 | 110.9 | 35.25 | 45 to 180 | 3.48 ^a |
| 5 | 2 | 140.0 | | | 16 | 208.1 | 23.73 | 80 to 250 | 21 | 188.1 | 43.66 | 80 to 250 | 11.48 ^a |
| 6 | 2 | 195.0 | 21.21 | 180 to 210 | 20 | 237.0 | 41.43 | 180 to 320 | 23 | 229.1 | 45.02 | 140 to 320 | 2.38 ^a |
| 7 | 0 | | | | 10 | 268.0 | 37.06 | 220 to 320 | 10 | 268.0 | 37.06 | 220 to 320 | |
| 8 | 0 | | | | 3 | 286.7 | 41.63 | 240 to 320 | 3 | 286.7 | 41.63 | 240 to 320 | |
| Total | 44 | | | | 103 | | | | 206 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 77. Age-length (mm) relationship for flathead chub from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|------------|---------|-------|-------|------------|----------|-------|-------|------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 50 | 27.4 | 12.27 | 14 to 67 | |
| 1 | ND | | | | ND | | | | 47 | 50.4 | 12.80 | 30 to 89 | |
| 2 | 5 | 117.2 | 20.34 | 99 to 152 | 7 | 104.9 | 9.08 | 90 to 119 | 29 | 123.4 | 22.41 | 90 to 158 | 1.27 |
| 3 | 2 | 157.5 | 3.53 | 155 to 160 | 3 | 162.3 | 9.07 | 154 to 172 | 33 | 168.4 | 9.52 | 154 to 191 | 0.83 |
| 4 | 1 | 207.0 | | | 0 | | | | 6 | 203.2 | 10.07 | 192 to 220 | |
| 5 | ND | | | | ND | | | | 5 | 235.0 | 17.04 | 215 to 251 | |
| 6 | ND | | | | 6 | 252.0 | 16.01 | 235 to 270 | 8 | 253.1 | 13.90 | 235 to 270 | |
| 7 | ND | | | | 3 | 271.3 | 10.32 | 261 to 281 | 6 | 274.8 | 12.79 | 261 to 295 | |
| 8 | ND | | | | 2 | 320.0 | | | 3 | 320.7 | 1.15 | 320 to 322 | |
| Total | 8 | | | | 21 | | | | 187 | | | | |

Table 78. Age-weight (g) relationship for flathead chub from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Scale Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-----------|-------|-------|-------|----------|---------|-------|-------|------------|----------|-------|-------|------------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 404 | 0.1 | | | |
| 1 | ND | | | | ND | | | | 47 | 1.7 | 1.4 | 0.3 to 7.3 | |
| 2 | 5 | 21.2 | 11.65 | 12 to 40 | 7 | 16.0 | 8.25 | 8 to 30 | 29 | 24.8 | 13.30 | 8 to 50 | 0.86 |
| 3 | 2 | 43.5 | 2.12 | 42 to 45 | 3 | 50.0 | | | 33 | 56.3 | 12.00 | 40 to 90 | 4.33 ^a |
| 4 | 1 | 120.0 | | | ND | | | | 6 | 105.2 | 20.68 | 80 to 130 | |
| 5 | ND | | | | ND | | | | 5 | 168.0 | 32.71 | 120 to 210 | |
| 6 | ND | | | | 6 | 210.0 | 41.47 | 160 to 250 | 8 | 205.0 | 39.64 | 160 to 250 | |
| 7 | ND | | | | 3 | 250.0 | 10.00 | 240 to 260 | 6 | 251.7 | 30.60 | 200 to 290 | |
| 8 | ND | | | | 2 | 395.0 | 35.35 | 370 to 420 | 3 | 423.3 | 55.07 | 370 to 480 | |
| Total | 8 | | | | 21 | | | | 541 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 79. Age-specific sex ratios and maturity for flathead chub from the Mildred Lake study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | | χ ² |
|-----------|---------|-------|----------|-------|------|----------|--------------|-------|-------|--------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 96 | 96 | 31.2 | |
| 1 | 1 | 33.3 | 0.0 | 2 | 66.7 | 0.0 | 0 | 3 | 1.0 | |
| 2 | 14 | 60.9 | 0.0 | 9 | 39.1 | 0.0 | 16 | 39 | 12.7 | 1.08 |
| 3 | 24 | 58.5 | 8.3 | 17 | 41.5 | 17.6 | 18 | 59 | 19.2 | 1.20 |
| 4 | 15 | 48.4 | 53.3 | 16 | 51.6 | 62.5 | 4 | 35 | 11.4 | 0.04 |
| 5 | 17 | 85.0 | 94.1 | 3 | 15.0 | 66.7 | 10 | 30 | 9.7 | 9.80 ^a |
| 6 | 20 | 90.9 | 95.0 | 2 | 9.1 | 100.0 | 7 | 29 | 9.4 | 14.72 ^a |
| 7 | 11 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 3 | 14 | 4.6 | 11.00 ^a |
| 8 | 3 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 3 | 1.0 | |
| Totals | 105 | 68.2 | 56.2 | 49 | 31.8 | 34.7 | 154 | 308 | 100.2 | 20.36 ^a |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

Table 80. Age-specific sex ratios and maturity for flathead chub from the Delta study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Scale Age | Females | | | Males | | | Unsexed Fish | Total | |
|-----------|---------|-------|----------|-------|-------|----------|--------------|-------|-------|
| | N | % | % Mature | N | % | % Mature | | N | % |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 433 | 433 | 57.2 |
| 1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 234 | 234 | 30.9 |
| 2 | 7 | 58.3 | 0.0 | 5 | 41.7 | 0.0 | 17 | 29 | 3.8 |
| 3 | 3 | 60.0 | 0.0 | 2 | 40.0 | 0.0 | 28 | 33 | 4.4 |
| 4 | 0 | 0.0 | 0.0 | 1 | 100.0 | 0.0 | 5 | 6 | 0.8 |
| 5 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 5 | 5 | 0.7 |
| 6 | 6 | 100.0 | 66.7 | 0 | 0.0 | 0.0 | 2 | 8 | 1.1 |
| 7 | 3 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 3 | 6 | 0.8 |
| 8 | 2 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 1 | 3 | 0.4 |
| Totals | 21 | 72.4 | 42.8 | 8 | 27.6 | 0.0 | 728 | 757 | 100.1 |

were age 0+ or age 1) suggesting that the Delta may represent an important rearing area for the flathead chub population that inhabits more upstream portions of the river.

4.2.8.4 Spawning. Spawning of flathead chub was not observed in 1977 but it seems certain that spawning did occur in the Mildred Lake study area of the Athabasca River. Both ripe and spent individuals were captured in this area from early June to mid-August, indicating an extended spawning period. However, it is believed that most spawning occurred during June. Of 53 flathead chub taken in standard gangs between 1 and 16 June, 34% were sexually mature and would have spawned that year, 58% were ripe, and 8% were spent. Young-of-the-year were first captured in July, at which time they ranged in fork length from 16 to 31 mm, but this age group was not found in abundance in the Mildred Lake study area during the summer. It is not known whether flathead chub spawned in the Delta study area but on the basis of our results this seems unlikely. Few ripe or spent chub were taken in this area and any spawning that does occur here is probably minor. It would appear that the significance of the Delta to the flathead chub population of the lower Athabasca is as a rearing area for juvenile fish.

4.2.8.5 Movements. During 1976 and 1977, Floy tags were applied to 78 flathead chub (Table 13). Two of these tags were recaptured; one after 28 days and one after 245 days at large. Both fish were recaptured at their original tagging sites.

4.2.8.6 Fecundity. Fecundity was estimated gravimetrically for 11 flathead chub in spawning condition. The estimated total number of eggs per female (size range 235 to 297 mm) ranged from 7000 to 15 170 (Table 81) with an average of 10 564 eggs per female. Length-relative fecundity ranged from 260.2 to 619.2 ova per cm of fork length while weight-relative fecundity varied from 30.4 to 84.3 eggs per g of body weight.

Table 81. Fecundity estimates for flathead chub from the Athabasca River, 2 June 1977.

| Fork Length (mm) | Weight (g) | Estimated Number of Eggs | Relative Fecundity ^a | |
|---------------------|---------------|-----------------------------|---------------------------------|--------|
| | | | Eggs/cm | Eggs/g |
| 235 | 180 | 10 241 | 435.8 | 56.9 |
| 245 | 180 | 10 905 | 445.1 | 60.6 |
| 245 | 180 | 15 170 | 619.2 | 84.3 |
| 260 | 180 | 8 346 | 321.0 | 46.4 |
| 261 | 200 | 12 508 | 479.2 | 62.5 |
| 263 | 220 | 9 774 | 371.6 | 44.4 |
| 263 | 230 | 9 944 | 378.1 | 43.2 |
| 264 | 250 | 12 186 | 461.6 | 48.7 |
| 269 | 230 | 7 000 | 260.2 | 30.4 |
| 277 | 240 | 8 000 | 288.8 | 33.3 |
| 297 | 320 | 12 132 | 408.5 | 37.9 |

^a Number of eggs per cm of fork length and per g of body weight.

4.2.8.7 Food habits. Examination of stomachs of flathead chub revealed an extremely varied diet consisting largely of aquatic insects (Table 82). Diptera larvae was the most common food item in the stomach contents of chub captured in the Mildred Lake study area, occurring in 61.8% of all stomachs examined. Adult Coleoptera (26.5%), Hemiptera (23.5%), and Hymenoptera (26.5%), larval Trichoptera (26.5%), and nymphal Ephemeroptera (23.5%) and Plecoptera (20.6%) were also common in the food of flathead chub taken in this area. The same pattern of results occurred in the sample from the Delta study area but here fewer fish stomachs contained food, resulting in lower percentage frequency of occurrence values.

4.2.9 Lake Chub

4.2.9.1 Distribution and relative abundance. Only five lake chub were captured in the Delta study area, thus the following results were obtained from the Mildred Lake study area only. Lake chub was the 4th most abundant species taken in small mesh beach seines, occurring in 29% of all seine hauls and accounting for 5.2% of the total catch. The catch-per-unit-effort values, which averaged 2.3 fish per haul, exhibited no real trends although a high value of 14.3 fish per haul was recorded on 25 to 27 July (Table 9). Lake chub were captured at Sites 3, 15, 21 to 23, 27 to 29, 30, 31, 33, 36 to 39, and 41 to 44, many of which are tributary-associated sites (Figure 4 and Appendix 6.1).

4.2.9.2 Age and growth. Lake chub ranged from 17 to 94 mm in fork length with the majority (63.3%) being in the 25 to 39 mm range (Table 83).

Age-length and age-weight relationships for lake chub are presented in Tables 84 and 85. Otolith ages ranged from 0+ to 3 years although the majority were 0+ (45.5%) and age 1 (50.6%) (Table 86). The largest chub taken was a mature age 3 male. This fish was captured in mid-April and was 94 mm in fork length with a weight of 10 g. Five years appears to be the maximum age attained by lake chub in the AOSERP study area (Bond and Machniak 1977; Machniak and Bond

Table 82. Food habits of flathead chub from the Athabasca River, 1977.

| Food Item | Percentage Frequency of Occurrence ^a | |
|------------------------|---|------------------------|
| | Mildred Lake Area (N = 34) | Delta Area (N = 32) |
| Trichoptera | 26.5 | 9.4 |
| Ephemeroptera | 23.5 | 9.4 |
| Plecoptera | 20.6 | 3.1 |
| Diptera | 61.8 | 31.2 |
| Hymenoptera | 26.5 | 12.5 |
| Hemiptera | 23.5 | 3.1 |
| Coleoptera | 26.5 | 9.4 |
| Lepidoptera | 5.9 | 0.0 |
| Odonata | 2.9 | 0.0 |
| Unidentifiable Insects | 38.2 | 56.2 |
| Arachnida | 8.8 | 6.2 |
| Cladocera | 0.0 | 3.1 |
| Ostracoda | 0.0 | 6.2 |
| Nematoda | 14.7 | 0.0 |
| Gastropoda | 5.9 | 3.1 |
| Fish Remains | 5.9 | 6.2 |
| Shrew Remains | 2.9 | 0.0 |
| Plant Material | 17.6 | 12.5 |
| Detritus | 20.6 | 34.4 |

^a Expressed as a percentage of the number of stomachs examined (N).

Table 83. Length-frequency distribution for lake chub from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | | | Total | |
|---------------------|----------------|-----|------|------|------|-------|------|-------|-------|
| | April | May | June | July | Aug. | Sept. | Oct. | N | % |
| 15 to 19 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 0.7 |
| 20 to 24 | 0 | 3 | 7 | 7 | 7 | 1 | 2 | 27 | 8.8 |
| 25 to 29 | 2 | 19 | 1 | 15 | 6 | 2 | 1 | 46 | 14.9 |
| 30 to 34 | 3 | 27 | 8 | 32 | 19 | 6 | 2 | 97 | 31.5 |
| 35 to 39 | 4 | 17 | 12 | 6 | 8 | 4 | 1 | 52 | 16.9 |
| 40 to 44 | 0 | 8 | 14 | 2 | 2 | 3 | 0 | 29 | 9.4 |
| 45 to 49 | 1 | 0 | 22 | 3 | 0 | 2 | 0 | 28 | 9.1 |
| 50 to 54 | 3 | 0 | 5 | 2 | 1 | 1 | 0 | 12 | 3.9 |
| 55 to 59 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 3 | 1.0 |
| 60 to 64 | 1 | 0 | 1 | 0 | 3 | 1 | 0 | 6 | 2.0 |
| 65 to 69 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0.3 |
| 70 to 74 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.3 |
| 75 to 79 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0.7 |
| 80 to 84 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.3 |
| 85 to 89 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 90 to 94 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.3 |
| 95 to 99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Totals | 18 | 73 | 74 | 69 | 48 | 20 | 6 | 308 | 100.1 |

Table 84. Age-length (mm) relationship for lake chub from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|----------|---------|------|------|----------|----------|------|------|----------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 47 | 30.5 | 5.96 | 20 to 45 | |
| 1 | 42 | 41.4 | 6.64 | 32 to 61 | 61 | 41.7 | 7.45 | 30 to 62 | 156 | 38.5 | 8.33 | 23 to 62 | 0.17 |
| 2 | 3 | 65.0 | 9.17 | 57 to 75 | 6 | 61.7 | 7.74 | 52 to 73 | 9 | 62.8 | 7.82 | 52 to 75 | 0.54 |
| 3 | 2 | 89.0 | 7.07 | 84 to 94 | 1 | 79.0 | | | 3 | 85.7 | | 79 to 84 | |
| Total | 47 | | | | 68 | | | | 215 | | | | |

Table 85. Age-weight (g) relationship for lake chub from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|---------------|---------|------|------|--------------|----------|------|------|---------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 47 | 0.35 | 0.23 | 0.08 to 1.12 | |
| 1 | 42 | 0.85 | 0.48 | 0.29 to 2.74 | 61 | 0.90 | 0.54 | 0.27 to 2.65 | 156 | 0.71 | 0.51 | 0.10 to 2.74 | 0.49 |
| 2 | 3 | 3.22 | 1.17 | 2.09 to 4.43 | 6 | 2.63 | 0.97 | 1.40 to 3.95 | 9 | 2.83 | 1.01 | 1.40 to 4.43 | 0.75 |
| 3 | 2 | 8.50 | 2.12 | 7.00 to 10.00 | 1 | 5.86 | | | 3 | 7.62 | | 5.86 to 10.00 | |
| Total | 47 | | | | 68 | | | | 215 | | | | |

1979). During April, May, and June, the lake chub catch in the Mildred Lake study area was dominated by one-year-old fish; however, young-of-the-year were the dominant age class from July on.

The relationship between fork length and body weight for lake chub captured in the Mildred Lake study area in 1977 is given in Table 70 for males and females. No significant difference was found to exist between the slopes of the regressions for male and female chub ($t = 0.703$, $P > 0.05$).

4.2.9.3 Sex and maturity. Of 115 lake chub age 1 or older, 59% were females (Table 86). Only 1 female (age 3, 79 mm) and 2 males (age 3, 84 and 94 mm) were sexually mature. Bond and Machniak (1977) report that lake chub of both sexes spawn at age 3 in the Muskeg River.

4.2.9.4 Spawning. No observations of spawning were made and it seems likely that this event does not occur in the Athabasca River. This species seems to be more typical of the tributary streams of the area, being known to occur in the Muskeg River (Bond and Machniak 1977), the Steepbank River (Machniak and Bond 1979), and numerous other tributaries (Griffiths 1973). W. A. Bond captured lake chub from the Pierre River, the Tar River, the Ells River, and Unnamed Creek at km 116.8L on 6 to 8 June 1977. It is possible that the lake chub population of the Athabasca River, consisting largely of immature fish, results from downstream drift within the tributaries and that many of these fish eventually find their way out of the main river and back into tributaries.

4.2.9.5 Food habits. Lake chub had fed predominantly on aquatic insects of the orders Diptera, Ephemeroptera, and Hymenoptera (Table 87).

Table 86. Age-specific sex ratios and maturity for lake chub from the Mildred Lake study area, Athabasca River, 1977^a. Sex ratios were based only on fish for which sex was determined.

| Otolith Age | Females | | | Males | | | Unsexed Fish | Total | | X ² |
|-------------|---------|------|----------|-------|------|----------|--------------|-------|-------|-------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 140 | 140 | 45.5 | |
| 1 | 61 | 59.2 | 0.0 | 42 | 40.8 | 0.0 | 53 | 156 | 50.6 | 3.50 |
| 2 | 6 | 66.7 | 0.0 | 3 | 33.3 | 0.0 | 0 | 9 | 2.9 | |
| 3 | 1 | 33.3 | 100.0 | 2 | 66.7 | 100.0 | 0 | 3 | 1.0 | |
| Totals | 68 | 59.1 | 1.5 | 47 | 40.9 | 4.3 | 193 | 308 | 100.0 | 3.84 ^b |

^a Only 5 lake chub were examined from the Delta study area; four were unsexed, age 0+ and one was a two-year-old immature male.

^b Significant difference ($P < 0.05$) between the numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

Table 87. Food habits of lake chub from the Athabasca River, 1977.

| Food Item | Percentage Frequency of Occurrence ^a | |
|------------------------|---|-----------------------|
| | Mildred Lake Area (N = 30) | Delta Area (N = 5) |
| Trichoptera | 0.0 | 20.0 |
| Ephemeroptera | 43.3 | 0.0 |
| Plecoptera | 3.3 | 0.0 |
| Diptera | 60.0 | 100.0 |
| Hemiptera | 10.0 | 20.0 |
| Hymenoptera | 16.7 | 0.0 |
| Coleoptera | 10.0 | 0.0 |
| Unidentifiable Insects | 13.3 | 0.0 |
| Hydracarina | 0.0 | 20.0 |
| Fish Remains | 3.3 | 0.0 |
| Debris | 26.7 | 0.0 |

^a Expressed as a percentage of the number of stomachs examined (N).

4.2.10 Emerald Shiner

4.2.10.1 Distribution and relative abundance. Emerald shiner was the third most abundant species captured in small mesh seines in the Mildred Lake study area during 1977 (Table 9). This species occurred in 31% of all seine hauls accounting for 6.0% of the total catch. During most of the summer, the catch-per-unit-effort was relatively low, the highest values occurring in July (3.7 fish per haul on 11 to 13 July). However, the catch-per-unit-effort rose sharply during September (Table 9) as the result of the appearance of large numbers of fish in the 13 to 27 mm size range. In the Mildred Lake study area, emerald shiners were captured at Sites 15, 21, 22, 25, 27, 28, 31, 33 to 37, and 41 to 44 (Figure 4, Appendix 6.1).

In the Delta study area, emerald shiner was by far the most abundant of species captured in small mesh seines comprising 74.8% of the total catch (Table 10). Emerald shiner occurred in 61% of all seine hauls made in this area and had an average catch-per-unit-effort of 115.0 fish per haul. On 6 September, an estimated 10 000 shiners were captured in a single seine haul. Catch-per-unit-effort fluctuated drastically through the summer in this area (Table 10) with abundance peaks occurring on 17 to 20 June, 14 to 15 July, and 6 to 7 September, on which dates the catch-per-unit-effort was 23.5, 45.8, and 987.8 fish per seine haul, respectively. Most emerald shiners taken in the Delta study area were captured at Sites 53, 62, 74, 76, and 80 to 86 (Figure 4, Appendix 6.1) and at km 196.5LI, 202.6LI, 210.7R, 216.3R, 216.3LI, 216.0R, 216.8RI, 222.4L, 247.0R, 256.0R, 262.1L, 264.8L, and 265.6R.

4.2.10.2 Age and growth. Emerald shiners ranged in fork length from 13 to 100 mm but the length frequency distributions varied considerably between the two study area (Tables 88 and 89). In the Mildred Lake study area, two strong modes occurred in the overall length-frequency distribution. From May to August, most fish captured in the Mildred Lake study area were found to be in the 75 to 79 mm length interval. The abundance of fish of this size, however, decreased markedly at the

Table 88. Length-frequency distribution for emerald shiner from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | | Total | |
|---------------------|----------------|------|------|------|-------|-----|-------|-------|
| | May | June | July | Aug. | Sept. | Oct | N | % |
| 10 to 14 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0.4 |
| 15 to 19 | 0 | 0 | 0 | 0 | 33 | 43 | 76 | 15.7 |
| 20 to 24 | 0 | 0 | 0 | 0 | 87 | 57 | 144 | 29.8 |
| 25 to 29 | 0 | 3 | 0 | 0 | 20 | 11 | 34 | 7.0 |
| 30 to 34 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0.4 |
| 35 to 39 | 0 | 1 | 6 | 0 | 0 | 0 | 7 | 1.5 |
| 40 to 44 | 1 | 0 | 3 | 0 | 0 | 0 | 4 | 0.8 |
| 45 to 49 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0.2 |
| 50 to 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 55 to 59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 60 to 64 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.2 |
| 65 to 69 | 0 | 4 | 3 | 0 | 0 | 0 | 7 | 1.5 |
| 70 to 74 | 1 | 10 | 18 | 3 | 0 | 3 | 35 | 7.2 |
| 75 to 79 | 4 | 37 | 32 | 5 | 3 | 5 | 86 | 17.8 |
| 80 to 84 | 1 | 27 | 27 | 4 | 2 | 1 | 62 | 12.8 |
| 85 to 89 | 0 | 8 | 7 | 0 | 1 | 4 | 20 | 4.1 |
| 90 to 94 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 0.4 |
| 95 to 99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 100 to 104 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| 105 to 109 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.0 |
| Totals | 7 | 92 | 96 | 12 | 149 | 128 | 484 | 100.0 |

Table 89. Length-frequency distribution for emerald shiner from the Delta study area, Athabasca River, 1977.

| Fork Length (mm) | Number of Fish | | | | | | Total | |
|---------------------|----------------|------|------|------|-------|------|-------|-------|
| | May | June | July | Aug. | Sept. | Oct. | N | % |
| 10 to 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 15 to 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 20 to 24 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0.5 |
| 25 to 29 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0.7 |
| 30 to 34 | 3 | 1 | 0 | 0 | 0 | 0 | 4 | 0.9 |
| 35 to 39 | 1 | 4 | 2 | 0 | 0 | 0 | 7 | 1.6 |
| 40 to 44 | 0 | 11 | 31 | 0 | 0 | 0 | 42 | 9.6 |
| 45 to 49 | 0 | 8 | 51 | 1 | 4 | 0 | 64 | 14.6 |
| 50 to 54 | 0 | 10 | 23 | 7 | 16 | 2 | 58 | 13.2 |
| 55 to 59 | 0 | 5 | 10 | 22 | 35 | 7 | 79 | 18.0 |
| 60 to 64 | 0 | 3 | 5 | 15 | 33 | 4 | 60 | 13.7 |
| 65 to 69 | 3 | 8 | 1 | 5 | 6 | 0 | 23 | 5.3 |
| 70 to 74 | 3 | 13 | 4 | 5 | 1 | 0 | 26 | 5.9 |
| 75 to 79 | 6 | 15 | 4 | 8 | 4 | 0 | 37 | 8.5 |
| 80 to 84 | 4 | 15 | 1 | 3 | 0 | 0 | 23 | 5.3 |
| 85 to 89 | 5 | 3 | 0 | 1 | 0 | 0 | 9 | 2.1 |
| 90 to 94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 95 to 99 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| 100 to 104 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 105 to 109 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| Totals | 28 | 97 | 132 | 67 | 99 | 15 | 438 | 100.0 |

end of July. Most fish taken in September and October, on the other hand, were in the 15 to 24 mm size range. Fish in the 30 to 64 mm size range made up only 3.1% of the total sample. This situation is identical to that reported in 1976 (Bond and Berry in prep.) and is believed to indicate an absence of age 1 shiners in the Mildred Lake study area.

In the Delta study area, a strong mode occurred at the 55 to 59 mm length interval with a smaller mode appearing in the 75 to 79 mm range. In this sample, 71.7% of the total measured sample fell in the 30 to 64 mm range. It must also be noted that, of the estimated 10 000 emerald shiners taken in one seine haul on 6 September, the vast majority, although not measured, fell within this fork length range.

Otolith ages were determined for 167 emerald shiners from the Mildred Lake study area and 253 from the Delta study area. Age-length and age-weight relationships for shiners from the Mildred Lake study area are presented in Tables 90 and 91, respectively. The age and growth features for the Delta sample are summarized in Tables 92 and 93.

Emerald shiners hatch at a length of about 4 mm (Fuchs 1967). No young-of-the-year were captured in either sampling area until September and October 1977 when large numbers began to appear in the Mildred Lake study area. These fish had a mean fork length of 21.5 mm (range 13 to 27 mm). Only two young-of-the-year were caught in the Delta.

The Mildred Lake sample contained few age 1 emerald shiners, accounting for the large gap between the two modes in the length-frequency distribution for that area. Very large numbers of age 1 shiners were found in the Delta study area throughout the summer. These fish ranged in fork length from 29 to 73 mm (mean 51.7 mm). Age 1 fish captured in the Delta in May (N = 7) had a mean fork length of 31.0 mm (range 28 to 36 mm). By mid-June this age class had a mean length of 44.3 mm (range 33 to 55 mm) while 13 shiners captured on 6 October ranged from 54 to 61 mm with a mean fork length of 57.6 mm.

Table 90. Age-length (mm) relationship for emerald shiner from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|----------|---------|-------|-------|----------|----------|-------|------|----------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 48 | 21.5 | 2.70 | 13 to 29 | |
| 1 | ND | | | | 2 | 54.0 | 11.31 | 46 to 62 | 17 | 38.8 | | 28 to 62 | |
| 2 | 47 | 78.0 | 3.69 | 69 to 88 | 54 | 78.4 | 4.60 | 68 to 91 | 101 | 78.3 | 4.19 | 68 to 91 | 0.48 |
| 3 | 0 | | | | 1 | 100.0 | | | 1 | 100.0 | | | |
| Total | 47 | | | | 57 | | | | 167 | | | | |

Table 91. Age-weight (g) relationship for emerald shiner from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|--------------|---------|------|------|--------------|----------|------|------|--------------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 48 | 0.28 | | | |
| 1 | ND | | | | 2 | 1.59 | 0.93 | 0.93 to 2.25 | 17 | 0.57 | | 0.16 to 2.25 | |
| 2 | 47 | 4.25 | 0.57 | 3.25 to 5.61 | 54 | 4.56 | 1.02 | 2.95 to 7.44 | 101 | 4.42 | 0.86 | 2.95 to 7.44 | 1.91 |
| 3 | 0 | | | | 1 | 9.78 | | | 1 | 9.78 | | | |
| Total | 47 | | | | 57 | | | | 167 | | | | |

Table 92. Age-length (mm) relationship for emerald shiner from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|----------|---------|------|------|----------|----------|------|------|----------|--------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 2 | 23.0 | 1.41 | 22 to 24 | |
| 1 | 51 | 55.7 | 5.35 | 44 to 65 | 54 | 53.5 | 7.17 | 36 to 73 | 141 | 51.7 | 8.05 | 29 to 73 | 1.77 |
| 2 | 68 | 75.1 | 5.77 | 62 to 87 | 41 | 77.3 | 5.98 | 62 to 88 | 109 | 75.9 | 5.92 | 62 to 88 | 1.91 |
| 3 | 0 | | | | 1 | 98.0 | | | 1 | 98.0 | | | |
| Total | 119 | | | | 96 | | | | 253 | | | | |

Table 93. Age-weight (g) relationship for emerald shiner from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|--------------|---------|-------|------|--------------|----------|-------|------|--------------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 2 | 0.11 | 0.03 | 0.09 to 0.13 | |
| 1 | 51 | 1.57 | 0.43 | 0.75 to 2.37 | 54 | 1.45 | 0.58 | 0.42 to 3.57 | 141 | 1.31 | 0.58 | 0.13 to 3.57 | 1.20 |
| 2 | 68 | 3.72 | 0.81 | 2.01 to 5.45 | 41 | 4.40 | 1.20 | 1.95 to 7.26 | 109 | 3.98 | 1.03 | 1.95 to 7.26 | 3.21 ^a |
| 3 | 0 | | | | 1 | 10.16 | | | 1 | 10.16 | | | |
| Total | 119 | | | | 96 | | | | 253 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Age 2 emerald shiners were quite abundant in the Delta study area during May and June. Their numbers dropped off quickly, however, in July, and after 10 August, only 8 emerald shiners were captured belonging to this age group. In the Mildred Lake area, age 2 fish were scarce during May but abundant during June and July. In this area too, numbers of age 2 emerald shiners declined in August. At age 2, emerald shiners had a mean fork length of 78.3 mm (range 68 to 91 mm) in the Mildred Lake area and 75.9 mm (range 62 to 88 mm) in the Delta.

Only two age 3 emerald shiners were captured during the study indicating that few shiners live beyond age 2 in this area. These fish, both females, had fork lengths of 98 and 100 mm.

Male and female emerald shiners increased in fork length at the same rate, although among age 2 fish, females tended to be heavier than males of the same age, significantly so in the Delta sample (Table 93).

Length-weight relationships for male and female emerald shiners from the Mildred Lake and Delta study areas are presented in Table 70. In both cases, a significant difference existed between the slopes of the regressions for males and females.

4.2.10.3 Sex and maturity. Age-specific sex and maturity data for emerald shiners from the two study areas are summarized in Table 94. Females made up 54% of the overall total but the sex ratio did not differ significantly from unity ($X^2 = 3.34$, $P > 0.05$). Age 1 fish were captured in quantity only in the Delta sample and in this group, males predominated, comprising 58% of the total. Both male and female emerald shiners reached sexual maturity at age 2. The smallest mature fish were in the 65 to 69 mm fork length range for both sexes.

Among 2 year old fish, 48% of the females and 73% of the males were mature. However, this situation differed between the two study areas (Table 94) and through the summer (Table 95). Table 95 brings out two main points. It is apparent that age 2 shiners were abundant in the Athabasca River during the early part of 1977 but became scarce near the end of July. More than 82% of all 2 year old

Table 94. Age-specific sex ratios and maturity for emerald shiner from the Mildred Lake, Delta, and combined study area, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Otolith Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|--------------------------|---------|-------|----------|-------|------|----------|--------------|-------|-------|--------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| <u>Mildred Lake Area</u> | | | | | | | | | | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 256 | 256 | 52.8 | |
| 1 | 2 | 100.0 | 0.0 | 0 | 0.0 | 0.0 | 15 | 17 | 3.5 | |
| 2 | 160 | 75.8 | 42.5 | 51 | 24.2 | 54.9 | 0 | 211 | 43.5 | 56.30 ^a |
| 3 | 1 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.2 | |
| Totals | 163 | 76.2 | 42.3 | 51 | 23.8 | 54.9 | 271 | 485 | 100.0 | 58.62 ^a |
| <u>Delta Area</u> | | | | | | | | | | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 2 | 2 | 0.5 | |
| 1 | 107 | 41.8 | 0.0 | 149 | 58.2 | 0.0 | 71 | 327 | 74.5 | 6.90 ^a |
| 2 | 41 | 37.6 | 70.7 | 68 | 62.4 | 86.7 | 0 | 109 | 24.8 | 6.68 ^a |
| 3 | 1 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.2 | |
| Totals | 149 | 40.7 | 20.1 | 217 | 59.3 | 27.2 | 73 | 439 | 100.0 | 12.64 ^a |
| <u>Combined Areas</u> | | | | | | | | | | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 258 | 258 | 28.0 | |
| 1 | 109 | 42.2 | 0.0 | 149 | 57.8 | 0.0 | 86 | 344 | 37.4 | 6.20 ^a |
| 2 | 201 | 62.8 | 48.3 | 119 | 37.2 | 73.1 | 0 | 316 | 34.4 | 21.00 ^a |
| 3 | 2 | 100.0 | 100.0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.2 | |
| Totals | 312 | 53.8 | 31.7 | 268 | 46.2 | 32.4 | 344 | 920 | 100.0 | 3.34 ^a |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

Table 95. Seasonal changes in sexual maturity for age 2 emerald shiner captured in the Mildred Lake and Delta study areas, Athabasca River, 1977.

| Date | Mildred Lake Area | | | | | Delta Area | | | | |
|-------------------|-------------------|----------|-----------------|----------|---------|------------|----------|----------------|----------|---------|
| | Males | | Females | | % Males | Males | | Females | | % Males |
| | N | % Mature | N | % Mature | | N | % Mature | N | % Mature | |
| May | 3 | 100 | 3 | 100 | 50 | 12 | 92 | 9 | 100 | 57 |
| 07 to 20 June | 21 | 100 | 35 | 91 | 38 | 31 | 100 | 10 | 100 | 76 |
| 28 June to 2 July | 1 | 0 | 25 | 32 | 4 | 9 | 100 | 8 | 100 | 53 |
| 11 to 15 July | 12 | 33 | 31 | 29 | 28 | 1 | 100 | 0 | 0 | 100 |
| 25 to 28 July | 7 | 0 | 37 ^a | 24 | 16 | 8 | 88 | 1 ^a | 100 | 89 |
| 09 to 11 August | 1 | 0 | 11 ^a | 27 | 8 | 3 | 0 | 9 ^a | 11 | 25 |
| 23 August | No Sample | | | | | 1 | 0 | 2 | 0 | 33 |
| September | 6 | 0 | 4 | 33 | 60 | 3 | 0 | 2 | 0 | 60 |
| October | 0 | 0 | 14 | 14 | 0 | No Sample | | | | |
| Totals | 51 | 55 | 160 | 42 | 24 | 68 | 87 | 41 | 71 | 62 |

^a Spent fish were present in the sample (A total of 12 spent females were captured in the Mildred Lake study area, and two were taken in the Delta).

fish captured were taken prior to this date. Secondly, the data indicate a dramatic shift in maturity occurring about mid-June in the Mildred Lake area and at the end of July in the Delta. Prior to this shift, virtually all emerald shiners of both sexes were sexually mature. After the shift, however, the age 2 population consisted of a few spent females and fish (mostly females) that would not spawn in 1977. No spent males were recorded. It seems likely that this reduction in age 2 emerald shiners in mid-summer reflects a post-spawning mortality among fish of this age class. A small percentage of this age class does survive, however, to spawn as 3 year old fish (two ripe 3 year old females were taken in 1977).

4.2.10.4 Spawning. Spawning of emerald shiners was not observed in 1977. However, it is believed to have occurred in the Athabasca River during June and July. Both male and female shiners were observed to be close to spawning condition between 8 June and 13 July in the Mildred Lake study area and spent females were taken between 25 July and 11 August. The greater abundance of age 2 fish and the earlier appearance of young-of-the-year in the Mildred Lake study area than in the Delta may indicate that the Mildred area or areas upstream of it are more important as spawning habitat for this species than are the lower reaches. The possibility that some spawning occurs below the Mildred Lake study area or in the Delta cannot be ruled out, however.

4.2.10.5 Movements. Although there is no direct evidence of emerald shiner migrations within the Athabasca River, the length frequency and age data available do suggest substantial movements and invite inferences with respect to the life history of this species. The following sequence of events is suggested.

The major spawning areas for emerald shiners in the lower Athabasca River are within or upstream of the Mildred Lake study area. Spawning occurs during late June and July, the spawning population consisting of age 2 fish plus a few 3 year old individuals. A severe post-spawning mortality occurs among age 2 fish. After emergence, young-of-the-year move downstream, eventually to the Delta where they

spend their next year of life. Age 1 shiners were found in abundance in the Delta throughout the 1977 sampling season. The Delta area appears to be critical as a rearing area for emerald shiners. After spending two winters in the Delta, emerald shiners migrate upstream out of the Delta onto the spawning grounds as 2 year old fish. Both spawners and non-spawners participate in this migration.

4.2.10.6 Fecundity. Total egg counts were made for 15 fully mature emerald shiner females captured between 8 and 19 June 1977 in the Mildred Lake study area. For these fish, which ranged from 73 to 100 mm in fork length, egg counts varied from 1124 to 2263 with a mean of 1464.6 eggs per female (Table 96).

4.2.10.7 Food habits. The food of emerald shiners consisted primarily of immature aquatic insects belonging to the orders Diptera, Plecoptera, Ephemeroptera, Hymenoptera, Coleoptera, and Trichoptera (Table 97). In the Mildred Lake study area, Ephemeroptera nymphs and Hymenoptera adults were the most common food items, occurring in 31.4 and 17.1%, respectively, of all stomachs. Diptera larvae occurred in 67.3% of the stomachs of emerald shiners captured in the Delta study area while Plecoptera (38.5%) and Ephemeroptera (13.5%) nymphs were also common. Hymenoptera and Hemiptera adults were identified from 13.5 and 15.4%, respectively, of the Delta fish.

4.2.11 Spottail Shiner

4.2.11.1 Distribution and relative abundance. Only 116 spottail shiners were captured in the Mildred Lake study area in 1977. In this area, spottails occurred in 15% of small mesh seine hauls accounting for 1.1% of the total catch. The average catch-per-unit-effort was 0.5 fish per haul with the highest values being 1.4 on 16 to 19 June and 1.9 on 6 to 10 October (Table 9). In the Mildred Lake study area, spottail shiners were captured at Sites 21, 22, 25 to 27, 29, 33, 36, 37, 41, and 43 (Figure 4 and Appendix 6.1). In the Delta study area, spottail shiners proved to be considerably more abundant during 1977,

Table 96. Fecundity of emerald shiner from the Mildred Lake study area, Athabasca River, 1977.

| Fork Length (mm) | Weight (g) | Otolith Age (yrs) | Number of Eggs (Total Counts) |
|---------------------|---------------|----------------------|----------------------------------|
| 73 | 4.21 | 2 | 1212 |
| 78 | 4.67 | 2 | 1653 |
| 79 | 4.98 | 2 | 1172 |
| 79 | 5.38 | 2 | 1213 |
| 79 | 5.02 | 2 | 1124 |
| 80 | 5.73 | 2 | 1422 |
| 80 | 5.72 | 2 | 1377 |
| 80 | 5.63 | 2 | 1245 |
| 81 | 5.58 | 2 | 1416 |
| 83 | 6.18 | 2 | 1609 |
| 83 | 5.66 | 2 | 1478 |
| 84 | 7.47 | 2 | 1692 |
| 84 | 5.85 | 2 | 1320 |
| 94 | 8.99 | 2 | 1773 |
| 100 | 9.78 | 3 | 2263 |

Table 97. Food habits of emerald shiner from the Athabasca River, 1977.

| Food Item | Percentage Frequency of Occurrence ^a | |
|------------------------|---|------------------------|
| | Mildred Lake Area (N = 30) | Delta Area (N = 52) |
| Trichoptera | 2.8 | 1.9 |
| Ephemeroptera | 31.4 | 13.5 |
| Plecoptera | 5.7 | 38.5 |
| Diptera | 2.8 | 67.3 |
| Hymenoptera | 17.1 | 13.5 |
| Coleoptera | 2.8 | 3.8 |
| Hemiptera | 0.0 | 15.4 |
| Odonata | 0.0 | 1.9 |
| Lepidoptera | 0.0 | 1.9 |
| Unidentifiable Insects | 45.7 | 3.8 |
| Cladocera | 11.4 | 3.8 |
| Arachnida | 0.0 | 7.7 |
| Gastropoda | 0.0 | 1.9 |
| Debris | 2.8 | 17.3 |
| Empty | 0.0 | 0.0 |

^a Expressed as a percentage of the number of stomachs examined (N).

occurring in 58% of all small mesh seine hauls and accounting for 3.8% of the total catch (Table 10). The catch-per-unit-effort, which averaged 5.8 fish per seine haul, was low during May and early June but rose to 7.0 on 17 to 20 June and to 15.8 on 14 to 15 July. At the end of July, the relative abundance dropped to 3.3 fish per haul and remained fairly constant through 7 October (Table 10). Sites in the Delta study area at which spottail shiners were captured were numbers 53, 61, 68, 73, 78 to 81, and 83 to 87 (Figure 4 and Appendix 6.1) plus km 250.6L, 264.8L, 265.6R, 214.3LI, 210.7R, 196.0LI, 200.8L, 204.5R, and 196.5LI.

4.2.11.2 Age and growth. Spottail shiners ranged in fork length from 16 to 97 mm with 98.2% falling within the 35 to 74 mm size range (Table 98). This is a considerable change from the situation observed in 1976 when 68.8% of the sample were young-of-the-year fish in the 20 to 39 mm range (Bond and Berry in prep.).

Otolith ages were determined for 306 spottail shiners. Age and growth characteristics for shiners captured in the Mildred Lake area are summarized in Tables 99 and 100 while those for fish from the Delta study area are presented in Tables 101 and 102. Spottail shiners appear to live to a maximum age of 3 years with most fish not living beyond age 2. Samples taken in June and early July were dominated by age 1 fish with 2 year olds also well represented. Young-of-the-year appeared in August and this age group dominated the catch during the latter part of the year.

Length-weight relationships for male and female spottail shiners from the Mildred Lake and Delta study areas are given in Table 70. In both cases, significant differences occurred between the slopes of the regressions for males and females.

4.2.11.3 Sex and maturity. Age-specific sex ratios and maturity data for spottail shiners collected during 1977 from each study area are presented in Table 103. Spottail shiners matured at two years of age, and in this age class 70% of females and 80% of males were found to be sexually mature. Females (62%) out-numbered males in the overall

Table 98. Length-frequency distribution for spottail shiner from the Mildred Lake and Delta study areas, Athabasca River, 1977.

| Fork Length (mm) | Mildred Lake | | Delta | | | | | | | Grand Total | |
|---------------------|--------------|-------|-------|------|------|------|-------|------|-------|-------------|-------|
| | June | Total | May | June | July | Aug. | Sept. | Oct. | Total | N | % |
| 15 to 19 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0.6 |
| 20 to 24 | 0 | 3 | 0 | 0 | 1 | 0 | 2 | 9 | 12 | 15 | 4.3 |
| 25 to 29 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 4 | 1.1 |
| 30 to 34 | 2 | 7 | 1 | 0 | 0 | 6 | 3 | 2 | 12 | 19 | 5.4 |
| 35 to 39 | 6 | 14 | 2 | 6 | 0 | 15 | 16 | 1 | 40 | 54 | 15.4 |
| 40 to 44 | 3 | 9 | 1 | 10 | 3 | 11 | 17 | 5 | 47 | 56 | 16.0 |
| 45 to 49 | 2 | 11 | 0 | 3 | 18 | 0 | 0 | 1 | 22 | 33 | 9.4 |
| 50 to 54 | 0 | 8 | 1 | 4 | 20 | 2 | 0 | 0 | 27 | 35 | 10.0 |
| 55 to 59 | 2 | 12 | 0 | 10 | 3 | 2 | 1 | 0 | 16 | 28 | 8.0 |
| 60 to 64 | 6 | 12 | 0 | 4 | 3 | 6 | 1 | 0 | 14 | 26 | 7.4 |
| 65 to 69 | 9 | 12 | 0 | 9 | 2 | 4 | 11 | 1 | 27 | 39 | 11.1 |
| 70 to 74 | 5 | 6 | 1 | 6 | 1 | 3 | 3 | 0 | 14 | 20 | 5.7 |
| 75 to 79 | 5 | 6 | 1 | 3 | 1 | 0 | 1 | 0 | 6 | 12 | 3.4 |
| 80 to 84 | 0 | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 5 | 5 | 1.4 |
| 85 to 89 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0.6 |
| 90 to 94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 95 to 99 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.3 |
| Totals | 41 | 104 | 13 | 55 | 52 | 49 | 58 | 20 | 247 | 351 | 100.1 |

Table 99. Age-length (mm) relationship for spottail shiner from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|----------------|-------|------|------|----------|---------|------|------|----------|----------|------|------|----------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 21 | 31.9 | 6.97 | 16 to 41 | |
| 1 | 14 | 54.4 | 9.38 | 36 to 66 | 21 | 50.1 | 6.24 | 35 to 64 | 49 | 48.5 | 8.99 | 31 to 66 | 1.50 |
| 2 | 12 | 63.6 | 6.10 | 55 to 78 | 23 | 70.2 | 7.45 | 56 to 89 | 35 | 67.9 | 7.62 | 55 to 89 | 2.83 ^a |
| Total | 26 | | | | 44 | | | | 105 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 100. Age-weight (g) relationship for spottail shiner from the Mildred Lake study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|--------------|---------|------|------|--------------|----------|------|------|--------------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 21 | 0.39 | 0.23 | 0.04 to 1.01 | |
| 1 | 14 | 1.90 | 0.83 | 0.51 to 3.02 | 21 | 1.43 | 0.55 | 0.50 to 2.89 | 49 | 1.37 | 0.74 | 0.27 to 3.02 | 1.86 |
| 2 | 12 | 2.85 | 0.86 | 1.70 to 4.89 | 23 | 4.21 | 1.34 | 1.81 to 7.09 | 35 | 3.75 | 1.35 | 1.70 to 7.09 | 3.64 ^a |
| Total | 26 | | | | 44 | | | | 105 | | | | |

^a Significant difference for means between males and females ($P < 0.05$).

Table 101. Age-length (mm) relationship for spottail shiner from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|----------|---------|------|------|----------|----------|------|------|----------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 46 | 36.3 | 6.85 | 19 to 45 | |
| 1 | 16 | 60.8 | 8.38 | 50 to 70 | 41 | 52.8 | 8.76 | 35 to 67 | 92 | 50.9 | 9.47 | 34 to 70 | 3.22 ^a |
| 2 | 28 | 68.4 | 7.77 | 55 to 83 | 30 | 64.3 | 7.44 | 52 to 78 | 59 | 66.1 | 7.85 | 52 to 83 | 2.03 ^a |
| 3 | 1 | 83.0 | | | 3 | 88.7 | 5.69 | 84 to 95 | 4 | 87.3 | | 83 to 95 | |
| Total | 45 | | | | 74 | | | | 201 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 102. Age-weight (g) relationship for spottail shiner from the Delta study area, Athabasca River, 1977. Sexes separate and combined (includes unsexed fish).

| Otolith Age | Males | | | | Females | | | | All Fish | | | | t-test |
|-------------|-------|------|------|--------------|---------|------|------|--------------|----------|------|------|--------------|-------------------|
| | N | Mean | S.D. | Range | N | Mean | S.D. | Range | N | Mean | S.D. | Range | |
| 0+ | ND | | | | ND | | | | 46 | 0.55 | 0.25 | 0.07 to 0.95 | |
| 1 | 16 | 2.58 | 0.91 | 1.30 to 3.67 | 41 | 1.78 | 0.85 | 0.41 to 3.70 | 92 | 1.61 | 0.91 | 0.33 to 3.70 | 3.20 ^a |
| 2 | 28 | 3.62 | 1.19 | 1.83 to 6.02 | 30 | 3.12 | 1.05 | 1.67 to 4.92 | 59 | 3.33 | 1.14 | 1.67 to 6.02 | 1.69 |
| 3 | 1 | 6.20 | | | 3 | 7.96 | 1.69 | 6.96 to 9.91 | 4 | 7.52 | | 6.20 to 9.91 | |
| Total | 45 | | | | 74 | | | | 201 | | | | |

^a Significant difference between means for males and females ($P < 0.05$).

Table 103. Age-specific sex ratios and maturity for spottail shiners from the Mildred Lake, Delta, and combined study areas, Athabasca River, 1977. Sex ratios were based only on fish for which sex was determined.

| Otolith Age | Females | | | Males | | | Unsexed Fish | Total | | χ^2 |
|--------------------------|---------|------|----------|-------|------|----------|--------------|-------|-------|--------------------|
| | N | % | % Mature | N | % | % Mature | | N | % | |
| <u>Mildred Lake Area</u> | | | | | | | | | | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 21 | 21 | 20.0 | |
| 1 | 21 | 60.0 | 0.0 | 14 | 40.0 | 0.0 | 14 | 49 | 46.7 | 1.40 |
| 2 | 23 | 65.7 | 78.3 | 12 | 34.3 | 91.6 | 0 | 35 | 33.3 | 3.46 |
| Totals | 44 | 62.9 | 40.9 | 26 | 38.1 | 42.3 | 35 | 105 | 100.0 | 4.62 ^a |
| <u>Delta Study Area</u> | | | | | | | | | | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 92 | 92 | 37.2 | |
| 1 | 41 | 71.9 | 0.0 | 16 | 28.1 | 0.0 | 35 | 92 | 37.2 | 10.96 ^a |
| 2 | 30 | 51.7 | 63.3 | 28 | 48.3 | 75.0 | 1 | 59 | 23.9 | 0.06 |
| 3 | 3 | 75.0 | 100.0 | 1 | 25.0 | 100.0 | 0 | 4 | 1.6 | 1.00 |
| Totals | 74 | 62.2 | 29.7 | 45 | 37.8 | 48.9 | 128 | 247 | 99.9 | 7.08 ^a |
| <u>Combined Areas</u> | | | | | | | | | | |
| 0+ | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 113 | 113 | 32.1 | |
| 1 | 62 | 67.4 | 0.0 | 30 | 32.6 | 0.0 | 49 | 141 | 40.1 | 11.14 ^a |
| 2 | 53 | 57.0 | 69.8 | 40 | 43.0 | 80.0 | 1 | 94 | 26.7 | 1.82 |
| 3 | 3 | 75.0 | 100.0 | 1 | 25.0 | 100.0 | 0 | 4 | 1.1 | 1.00 |
| Totals | 118 | 62.4 | 33.9 | 71 | 37.6 | 46.5 | 163 | 352 | 100.1 | 11.68 ^a |

^a Significant difference ($P < 0.05$) between numbers of males and females observed and expected for a sex ratio of unity (Chi-square test).

sample, the sex ratio being significantly different from unity. However, among 2 year old shiners, no significant difference from a 1:1 ratio existed between males and females ($\chi^2 = 1.83$, $P > 0.05$).

4.2.11.4 Spawning. Spawning of spottail shiners was not observed during the present study. Shiners captured in June were near ripe and spawning is believed to have occurred during late June or early July. Few age 2 fish were captured after 15 July. The first young-of-the-year spottail shiner (a single fish) appeared on 15 July in the Delta study area (21 mm in length) but this age class was not common in either area until mid-August by which time fork lengths ranged from 30 to 41 mm.

4.2.11.5 Fecundity. Total egg counts were made for 12 fully mature female spottail shiners captured from the Mildred Lake study area on 16 to 19 June 1977. These fish were all two years old and measured 65 to 89 mm in fork length. Egg counts (Table 104) varied from 746 to 1384 with a mean of 1088.0 ova per female.

4.2.11.6 Food habits. Spottail shiners had fed predominantly on aquatic insects (5 orders), Cladocera, Copepoda, and plant material (Table 105). Diptera larvae were the single most important food item occurring in 100.0 and 83.3% of stomachs for fish from the Mildred Lake and Delta study areas, respectively.

4.2.12 Other Species

During 1976 and 1977, 16 species of fish were captured that appear to be uncommon or rare in the Athabasca River downstream from Fort McMurray during the open-water period. Three of these species, pearl dace, Iowa darter, and brassy minnow, were taken only in 1976, while two, Dolly Varden and northern redbelly dace, were found only in 1977. All of these species were represented in collections made in the Mildred Lake study area while only 7 were found in the Delta study area.

Table 104. Fecundity of spottail shiners from the Mildred Lake study area, Athabasca River, 16 to 19 June 1977.

| Fork Length (mm) | Weight (g) | Otolith Age (yrs) | Number of Eggs (Total Counts) |
|---------------------|---------------|----------------------|----------------------------------|
| 65 | 3.50 | 2 | 918 |
| 66 | 3.36 | 2 | 873 |
| 69 | 3.77 | 2 | 746 |
| 71 | 4.78 | 2 | 1034 |
| 73 | 4.96 | 2 | 1250 |
| 73 | 5.01 | 2 | 973 |
| 73 | 4.69 | 2 | 1037 |
| 75 | 5.31 | 2 | 1248 |
| 76 | 5.75 | 2 | 1282 |
| 78 | 5.96 | 2 | 1181 |
| 79 | 5.51 | 2 | 1130 |
| 89 | 7.09 | 2 | 1384 |

Table 105. Food habits of spottail shiners from the Athabasca River, 1977.

| Food Item | Percentage Frequency of Occurrence ^a | |
|----------------|---|------------------------|
| | Mildred Lake Area (N = 10) | Delta Area (N = 30) |
| Trichoptera | 0.0 | 10.0 |
| Ephemeroptera | 30.0 | 6.7 |
| Plecoptera | 10.0 | 0.0 |
| Diptera | 100.0 | 83.3 |
| Lepidoptera | 10.0 | 0.0 |
| Hydracarina | 0.0 | 3.3 |
| Cladocera | 60.0 | 13.3 |
| Copepoda | 20.0 | 0.0 |
| Ostracoda | 10.0 | 6.7 |
| Turbellaria | 0.0 | 3.3 |
| Plant Material | 0.0 | 23.3 |

^a Expressed as a percentage of the number of stomachs examined (N).

Among the fish less frequently captured during the field program, eight species appear to be truly uncommon or rare within the AOSERP study area; i.e., Dolly Varden, finescale dace, northern red-belly dace, fathead minnow, ninespine stickleback, spoonhead sculpin, Iowa darter, and brassy minnow. Six species, although rarely captured in the Athabasca River downstream of Fort McMurray during the ice-free period, are common in tributaries of the AOSERP area at that time; i.e., brook stickleback, slimy sculpin, pearl dace, longnose dace, Arctic grayling, and mountain whitefish. The first four species appear to be typically tributary species while the latter two species utilize the tributary streams on a seasonal basis.

Yellow perch are common in tributaries and headwater lakes both within and upstream of the AOSERP study area and the young-of-the-year perch captured by our crews are thought to have originated in those areas.

Burbot are apparently more abundant than was indicated by results of 1976 work (Bond and Berry in prep.) although they appear to be common only during the early spring.

Because these species are represented by few specimens, or few age classes, no detailed analyses are possible. Age and growth data collected during 1977 for these species are summarized in Tables 106 and 107. Results of stomach analyses, expressed in terms of percentage frequency of occurrence, are presented in Tables 108 and 109.

4.2.12.1 Mountain whitefish. Few mountain whitefish are found in the Athabasca River during the open-water period. In 1977 only seven mountain whitefish were captured of which four were young-of-the-year (one captured in Delta study area). A mature male and a mature female, both age 6, were caught at the mouth of the Steepbank River (Site 10) (Figure 4) on 5 May while a four-year-old female was taken at Site 42 (Figure 4) in mid-June. Jones et al. (1978) reported capturing 17 mountain whitefish at Cascade Rapids upstream of Fort McMurray during September and October 1977.

Table 106. Age-length and age-weight relationships (derived from length and weight frequencies and otoliths), age-specific sex ratios, and maturity of less frequently captured species from the Mildred Lake study area of the Athabasca River, 1977.

| Species | Age | Females | | | Males | | | Unsexed Fish | Total | Fork Length (mm) ^a | | | Weight (g) | | |
|------------------------|--------|---------|----------|-----|-------|----------|-----|--------------|-------|-------------------------------|-------|------------|------------|-------|--------------|
| | | N | % Mature | | N | % Mature | | | | Mean | S.D. | Range | Mean | S.D. | Range |
| | | | | | | | | | | | | | | | |
| Mountain whitefish | 0+ | ND | | | ND | | | 3 | 3 | 44.3 | 6.51 | 38 to 51 | 0.85 | 0.18 | 0.67 to 1.02 |
| | 4 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 1 | 314.0 | | | 460.0 | | |
| | 6 | 1 | 50 | 100 | 1 | 50 | 100 | 0 | 2 | 395.0 | 1.41 | 394 to 396 | 900.0 | 28.28 | 880 to 920 |
| | Totals | 2 | 0 | 50 | 1 | 0 | 100 | 3 | 6 | | | | | | |
| Arctic grayling | 0+ | ND | | | ND | | | 4 | 4 | 20.8 | 2.75 | 18 to 24 | 0.08 | .039 | 0.04 to 0.12 |
| | 1 | ND | | | ND | | | 1 | 1 | 113.0 | | | 15.62 | | |
| | 2 | ND | | | ND | | | 4 | 4 | 197.3 | 15.36 | 175 to 215 | | | |
| | 3 | ND | | | ND | | | 7 | 7 | 263.0 | 31.96 | 243 to 331 | | | |
| | 4 | ND | | | ND | | | 4 | 4 | 328.0 | 22.01 | 300 to 353 | | | |
| | 5 | ND | | | ND | | | 2 | 2 | 339.0 | 22.18 | 325 to 353 | 460.0 | 84.85 | 400 to 520 |
| | 6 | ND | | | ND | | | 1 | 1 | 375.0 | | | 620.0 | | |
| | 8 | ND | | | ND | | | 1 | 1 | 375.0 | | | | | |
| | Unaged | ND | | | ND | | | 1 | 1 | 293.0 | | | 320.0 | | |
| | Totals | ND | | | ND | | | 25 | 25 | | | | | | |
| Dolly Varden | 4 | ND | | | ND | | | 1 | 1 | 178.0 | | | 58.9 | | |
| Totals | ND | | | ND | | | 1 | 1 | | | | | | | |
| Northern redbelly dace | 1 | 1 | 25 | 0 | 3 | 75 | 0 | 0 | 4 | 43.8 | 28.25 | 36 to 48 | 0.83 | 0.26 | 0.44 to 1.01 |
| | Totals | 1 | 25 | 0 | 3 | 75 | 0 | 0 | 4 | | | | | | |
| Finescale dace | 0+ | 2 | 100 | 0 | ND | | | 4 | 6 | 34.8 | 7.13 | 21 to 41 | 0.44 | 0.65 | 0.99 to 0.63 |
| | 1 | 2 | 18 | 0 | 9 | 82 | 0 | 0 | 11 | 41.2 | 6.10 | 37 to 58 | 0.77 | 0.40 | 0.54 to 1.90 |
| | 2 | 1 | 50 | 100 | 1 | 50 | 100 | 0 | 2 | 52.0 | 2.83 | 50 to 54 | 1.36 | 0.03 | 1.34 to 1.38 |
| | Totals | 5 | 33 | 20 | 10 | 67 | 10 | 4 | 19 | | | | | | |

continued ...

Table 106. Continued.

| Species | Age | Females | | | Males | | | Unsexed Fish | Total | Fork Length (mm) ^a | | | Weight | | |
|-----------------------|--------|---------|-----|--------|-------|-----|--------|------------------|------------------|-------------------------------|--------|------------|--------|------|----------------|
| | | N | % | Mature | N | % | Mature | | | Mean | S.D. | Range | Mean | S.D. | Range |
| Fathead minnow | 1 | 6 | 86 | 0 | 1 | 14 | 0 | 0 | 7 | 31.0 | 7.00 | 23 to 38 | 0.35 | 0.72 | 0.12 to 0.65 |
| | 2 | 4 | 67 | 100 | 2 | 33 | 100 | 0 | 6 | 43.2 | 4.02 | 39 to 48 | 0.96 | 0.31 | 0.63 to 1.32 |
| | Totals | 10 | 77 | 40 | 3 | 23 | 67 | 0 | 13 | | | | | | |
| Longnose dace | 0+ | ND | | | ND | | | 8 | 8 | 25.6 | 6.50 | 19 to 39 | 0.20 | 0.17 | 0.08 to 0.57 |
| | 1 | 11 | 61 | 0 | 7 | 39 | 0 | 0 | 18 | 48.6 | 4.83 | 41 to 57 | 1.16 | 0.40 | 0.58 to 2.00 |
| | Totals | 11 | 61 | 0 | 7 | 39 | 0 | 8 | 26 | | | | | | |
| Burbot | 0+ | ND | | | ND | | | 11 | 11 | 35.9 | 11.19 | 22 to 61 | 0.47 | 0.47 | 0.07 to 1.75 |
| | 1 | ND | | | ND | | | 2 | 2 | 97.0 | 1.41 | 96 to 98 | 5.23 | 0.37 | 4.97 to 5.49 |
| | 2 | ND | | | ND | | | 3 | 3 | 178.0 | 8.74 | 171 to 188 | 33.45 | 5.03 | 27.68 to 36.94 |
| | 5 | 1 | 100 | 100 | 0 | 0 | 0 | 0 | 1 | 536.0 | | | 930.0 | | |
| | 6 | 0 | 0 | 0 | 1 | 100 | 100 | 0 | 1 | 598.0 | | | 1130.0 | | |
| | Unaged | ND | | | ND | | | 34 | 34 | 501.2 | 123.70 | 220 to 750 | | | |
| Totals | 1 | 50 | 100 | 1 | 50 | 100 | 50 | 52 | | | | | | | |
| Brook stickleback | 0+ | ND | | | ND | | | 1 | 1 | 20.0 | | | 0.05 | | |
| | 1 | 2 | 50 | 50 | 2 | 50 | 50 | 0 | 4 | | | | | | |
| | 2 | 1 | 100 | 100 | 0 | 0 | 0 | 0 | 1 | 41.0 | | | 0.46 | | |
| Totals | 3 | 60 | 67 | 2 | 40 | 50 | 1 | 6 | | | | | | | |
| Ninespine stickleback | 3 | 0 | 0 | 0 | 2 | 100 | 100 | 0 | 2 | 52.5 | 0.71 | 52 to 53 | 0.82 | 0.03 | 0.79 to 0.84 |
| | Totals | 0 | 0 | 0 | 2 | 100 | 100 | 0 | 2 | | | | | | |
| Yellow perch | 0+ | ND | | | ND | | | 210 ^b | 210 ^b | 40.9 | 8.03 | 25 to 58 | 0.69 | 0.42 | 0.14 to 2.12 |
| | 1 | ND | | | ND | | | 1 | 1 | 75.0 | | | 4.39 | | |
| | Totals | ND | | | ND | | | 211 | 211 | | | | | | |

continued ...

Table 106. Concluded.

| Species | Age | Females | | | Males | | | Unsexed Fish | Total | Fork Length (mm) ^a | | | Weight (g) | | |
|-------------------|--------|---------|---|--------|-------|---|--------|--------------|-------|-------------------------------|------|----------|------------|------|--------------|
| | | N | % | Mature | N | % | Mature | | | Mean | S.D. | Range | Mean | S.D. | Range |
| Slimy sculpin | 0+ | ND | | | ND | | | 1 | 1 | 14.0 | | | 0.03 | | |
| | 1 | ND | | | ND | | | 4 | 4 | 44.0 | 7.61 | 38 to 55 | 0.89 | 0.32 | 0.51 to 1.65 |
| | Totals | ND | | | ND | | | 5 | 5 | | | | | | |
| Spoonhead sculpin | 0+ | ND | | | ND | | | 18 | 18 | 26.3 | 8.61 | 14 to 44 | 0.23 | 0.24 | 0.04 to 0.97 |
| | 1 | ND | | | ND | | | 5 | 5 | 53.6 | 4.61 | 47 to 60 | 1.61 | 0.35 | 1.06 to 2.02 |
| | Totals | ND | | | ND | | | 23 | 23 | | | | | | |

^a Total length used for burbot, stickleback, and sculpins.

^b Calculations based on 70 fish.

Table 107. Age-length and age-weight relationships (derived from length and weight frequencies and otoliths), age-specific sex ratios and maturity of less frequently captured fish species from the Delta study area of the Athabasca River, 1977.

| Species | Age | Females | | | Males | | | Unsexed Fish | Total | Fork Length (mm) ^a | | | Weight (g) | | |
|-----------------------|--------|---------|-----|----------|-------|---|----------|--------------|-------|-------------------------------|--------|------------|------------|------|--------------|
| | | N | % | % Mature | N | % | % Mature | | | Mean | S.D. | Range | Mean | S.D. | Range |
| Mountain whitefish | 0+ | ND | | | ND | | | 1 | 1 | 63.0 | | | 1.69 | | |
| | Total | ND | | | ND | | | 1 | 1 | | | | | | |
| Longnose dace | 1 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 1 | 43.0 | | | 0.83 | | |
| | Total | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 1 | | | | | | |
| Burbot | 0+ | ND | | | ND | | | 73 | 73 | 33.8 | 5.72 | 21 to 52 | 0.32 | 0.17 | 0.12 to 1.02 |
| | Unaged | ND | | | ND | | | 3 | 3 | 636.8 | 230.93 | 470 to 900 | | | |
| | Total | ND | | | ND | | | 76 | 76 | | | | | | |
| Brook stickleback | 0+ | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 1 | 28.0 | | | 0.15 | | |
| | Total | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 1 | | | | | | |
| Ninespine stickleback | 1 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 2 | 36.5 | 4.95 | 33 to 40 | 0.29 | 0.11 | 0.21 to 0.37 |
| | Total | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 2 | | | | | | |
| Yellow perch | 0+ | ND | | | ND | | | 24 | 24 | 36.1 | 9.27 | 19 to 63 | 0.65 | 0.63 | 0.05 to 3.00 |
| | Total | ND | | | ND | | | 24 | 24 | | | | | | |
| Spoonhead sculpin | 0+ | ND | | | ND | | | 13 | 13 | 20.4 | 5.71 | 14 to 36 | 0.11 | 0.14 | 0.03 to 0.53 |

^a Total length used for burbot, stickleback and sculpins.

Table 108. Percentage frequency of occurrence for food items found in the stomach contents of the less frequently captured fish species of the Mildred Lake study area of the Athabasca River, 1977. Sample size (N), Diptera (1), Ephemeroptera (2), Trichoptera (3), Hemiptera (4), Coleoptera (5), Hymenoptera (6), Plecoptera (7), Odonata (8), Insect Parts (9), Arachnida (10), Nematoda (11), Amphipoda (12), Copepoda (13), Cladocera (14), Ostracoda (15), Fish Remains (16), Detritus (17), and Empty (18).

| Species | N | Percentage Frequency of Occurrence ^a | | | | | | | | | | | | | | | | | |
|------------------------|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Mountain whitefish | 6 | 33 | 67 | 0 | 0 | 0 | 0 | 17 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| Arctic grayling | 6 | 67 | 17 | 0 | 33 | 17 | 0 | 33 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| Finescale dace | 10 | 90 | 0 | 0 | 10 | 10 | 10 | 30 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 0 |
| Northern redbelly dace | 4 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 0 | 0 | 50 | 25 |
| Fathead minnow | 10 | 100 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 |
| Longnose dace | 10 | 70 | 60 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 |
| Burbot | 10 | 10 | 30 | 10 | 0 | 0 | 0 | 20 | 30 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 20 |
| Brook stickleback | 4 | 100 | 0 | 25 | 0 | 50 | 0 | 25 | 0 | 25 | 25 | 0 | 0 | 75 | 25 | 0 | 0 | 0 | 0 |
| Ninespine stickleback | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| Yellow perch | 10 | 100 | 30 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 40 | 0 | 0 | 0 | 0 |
| Slimy sculpin | 5 | 100 | 80 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 20 | 0 | 80 | 0 |
| Spoonhead sculpin | 10 | 70 | 30 | 0 | 0 | 0 | 0 | 40 | 0 | 20 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

^a Expressed as a percentage of the total number of stomachs examined (N).

Table 109. Percentage frequency of occurrence for food items found in the stomach contents of the less frequently captured fish species of the Delta study area of the Athabasca River, 1977. Sample size (N), Diptera (1), Ephemeroptera (2), Trichoptera (3), Hemiptera (4), Coleoptera (5), Hymenoptera (6), Plecoptera (7), Odonata (8), Insect Parts (9), Arachnida (10), Nemotoda (11), Amphipoda (12), Copepoda (13), Cladocera (14), Ostracoda (15), Fish Remains (16), Detritus (17), and Empty (18).

| Species | N | Percentage Frequency of Occurrence ^a | | | | | | | | | | | | | | | | | |
|-----------------------|----|---|----|---|---|---|---|----|---|-----|----|----|----|----|----|----|----|----|-----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Mountain whitefish | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Longnose Dace | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Burbot | 12 | 25 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 42 | 0 | 0 | 0 | 25 |
| Brook stickleback | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| Ninespine stickleback | 2 | 50 | 0 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 50 | 50 | 0 | 0 | 0 | 0 |
| Yellow perch | 11 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 27 | 54 | 0 | 0 | 0 | 18 |
| Spoonhead sculpin | 10 | 90 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 80 | 0 |

^a Expressed as a percentage of the total number of stomachs examined (N).

The movements of mountain whitefish are known to be quite complex and it is clear from studies on the Muskeg River (Bond and Machniak 1977, 1979) and Steepbank River (Machniak and Bond 1979) that they are more abundant in the AOSERP area than previously supposed and that the Athabasca River is an important migration path for this species. During late April and early May 1976, Bond and Machniak (1977) documented a small migration of mountain whitefish into the Muskeg River and noted that these fish left the tributary in June, returning to the Athabasca River. In 1977, Machniak and Bond (1979) enumerated 504 mountain whitefish in a counting fence operation in the Steepbank River during late April and May. By 28 May, only 55 of these fish had left the tributary and these authors took only six mountain whitefish in their downstream trap between 12 September and 15 October. It is unknown whether these mountain whitefish remained in the Steepbank River beyond 15 October or left the tributary during the summer.

Spawning areas for this species are unknown but the presence of few young-of-the-year in the Muskeg (Bond and Machniak 1977, 1979) and Steepbank rivers (Machniak and Bond 1979) suggests that these tributaries are not utilized to any extent for this purpose. Griffiths (1973) believed that mountain whitefish spawned in the High Hill River, a tributary of the Clearwater River (Figure 4). Overwintering probably occurs in deeper areas of the Athabasca River upstream of the Mildred Lake study area.

4.2.12.2 Arctic grayling. No grayling were captured in the Delta study area in 1977 but 26 were taken in the Mildred Lake area. The majority of these fish were captured between 23 April and 13 May (N = 13) and between 6 and 20 October (N = 7). Jones et al. (1978) took 25 Arctic grayling during their study but none prior to mid-October.

In the AOSERP study area, Arctic grayling (excluding young-of-the-year) probably overwinter in the Athabasca River upstream of Fort McMurray although specific overwintering areas are unknown. In late April and early May, grayling leave the main river to migrate into

tributary streams where they spawn. The Muskeg River (Bond and Machniak 1977, 1979) and the Steepbank River (Machniak and Bond 1979) are known to be important in this respect. Grayling remain in these two tributary streams to feed following spawning. A counting fence operation on the Steepbank River (Machniak and Bond 1979) documented a downstream grayling migration between 6 and 8 October 1977, during which period minimum daily water temperature ranged from 3.3° to 0°C.

It is believed that most young-of-the-year grayling overwinter in these two streams, leaving the tributary for the first time at the end of their second summer (Machniak and Bond 1979).

Arctic grayling have also been reported to frequent other tributaries in the AOSERP area during the summer months (Griffiths 1973).

4.2.12.3 Dolly Varden. Dolly Varden are common in Alberta in the headwaters of the Peace, Athabasca, Red Deer, Bow, and Oldman drainages and in the North Saskatchewan River as far downstream as Edmonton (Paetz and Nelson 1970). This species was not captured in the Athabasca River during 1976 (Bond and Berry in prep.) but a single specimen was captured at Site 2 (Figure 4) on 6 June 1977. This fish was one of several strays reported in the AOSERP study area in 1977. Eight Dolly Varden were taken at the Steepbank River counting fence (Machniak and Bond 1979) while four were captured at the Muskeg River counting fence (Bond and Machniak 1979).

4.2.12.4 Finescale dace. Nineteen finescale dace were captured from the Athabasca River in 1977, most being taken at tributary-associated sites (Sites 21, 22, 27, and 34)(Figure 4). No finescale dace were captured in the Delta study area and in the Mildred Lake study area, none was taken downstream of the MacKay River (Figure 4).

4.2.12.5 Northern redbelly dace. The northern redbelly dace occurs in boggy lakes, creeks, and ponds (Scott and Crossman 1973). In Alberta it is known from scattered locations throughout much of the province (Paetz and Nelson 1970) and Griffiths (1973) reported finding

it in the Steepbank River within the AOSERP study area. This species was not taken from the Athabasca River in 1976 (Bond and Berry in prep.) but four specimens were captured from the Mildred Lake study area in 1977 (Sites 21, 22, and 31)(Figure 4). All were taken from tributary-associated sites and none was found downstream of the Muskeg River.

4.2.12.6 Fathead minnow. During 1977, 13 fathead minnows were captured, all being taken from the Mildred Lake study area (Sites 21, 22, 28, 31, 35, and 43)(Figure 4) between 6 May and 16 June.

4.2.12.7 Longnose dace. A single longnose dace (age 1) was found at Site 66 in the Delta study area (Figure 4) while 26 were captured in the Mildred Lake study area. Most of those occurring in the Mildred area were taken at tributary-associated sites (Sites 23, 27, 28, 33, 34, 36, 37, 42, 43, and 44)(Figure 4). Five were captured on 19 June at Site 34 while seven were taken in July at Site 36. Young-of-the-year longnose dace taken in the Athabasca River during July ranged in fork length from 19 to 39 mm (N = 8).

Longnose dace occur in many tributary streams in the AOSERP area (Griffiths 1973) and are more typical of the tributaries than of the Athabasca River. During 1977, this species accounted for 4.4% of the fish (excluding suckers) captured in small mesh seines in the Muskeg River (Bond and Machniak 1979). In the Steepbank River, (Machniak and Bond 1979) longnose dace made up 10.7% of the catch in small mesh seines (excluding suckers).

4.2.12.8 Burbot. A total of 53 burbot were captured in the Mildred Lake study area in 1977. Large burbot (220 to 750 mm total length) were common in the Mildred Lake study area between 17 April and 19 May 1977 and were taken at numerous sites (Sites 1, 3, 4, 6, 7, 10, 12, 13, 15 to 21, 31, 33, 37 to 39, and 41 to 43)(Figure 4). After 19 May few large burbot were captured. Young-of-the-year burbot taken in June (N = 10) ranged from 22 to 44 mm in total length. Two burbot

fry captured in a drift net near Site 37 on 6 June had total lengths of 16 and 26 mm.

In the Delta study area, 77 burbot were captured in 1977, of which 73 were young-of-the-year (21 to 55 mm TL) taken between 7 June and 2 July. Young-of-the-year burbot were taken in the Delta at Sites 79 (N = 39) and 82 to 85 and at km 202.6L1 (Figure 4).

Burbot usually spawn under ice in late winter and early spring. Although they usually spawn in lakes, river spawning is also known to occur (Scott and Crossman 1973). The presence of large burbot in the Mildred Lake study area in the early spring and appearance of young-of-the-year in early June suggests that burbot utilize the Mildred area of the Athabasca River or areas upstream of it for spawning purposes. The disappearance of large burbot after May was probably related to rising water temperatures. Optimum temperature for the species is 15.6° to 18.3°C (Scott and Crossman 1973). Maximum daily water temperature in the Mildred Lake study area exceeded 18.3°C from approximately mid-June to mid-July, causing these burbot to seek cooler water. It seems likely that many of these fish would return to Lake Athabasca although there is no direct evidence to support this suggestion. A small number of burbot are known to have entered the Steepbank River and to have remained in the tributary until fall when 43 were captured in the downstream trap (Machniak and Bond 1979).

4.2.12.9 Brook stickleback. Only one brook stickleback was captured in the Delta study area. This fish was a young-of-the-year taken 25 August near Site 75 (Figure 4). Eight brook stickleback were captured in the Mildred Lake area (Sites 21, 27, 29, and 33)(Figure 4). While not commonly found in the Athabasca River proper, brook stickleback are widely distributed in the tributary streams of the AOSERP area (Griffiths 1973). This species is known to be abundant in the upper reaches of the Muskeg River drainage (Bond and Machniak 1977, 1979) and in the Steepbank River (Machniak and Bond 1979).

4.2.12.10 Ninespine stickleback. Ninespine stickleback are rarely found either in the Athabasca River or in tributary streams of the AOSERP study area. During 1977, two ninespines were caught in the Delta study area, one at km 256.0R in August and the other at km 207.2L in October. Two ninespine stickleback were also taken by small mesh seine in the Mildred Lake area (Sites 36 and 42) (Figure 4). The latter were both mature males, aged three.

4.2.12.11 Yellow perch. Yellow perch are known to inhabit many lakes and streams of the Athabasca drainage including the Ellis and Christina rivers within the AOSERP study area (Paetz and Nelson 1970). Yellow perch captured from the Athabasca River in 1977 were all young-of-the-year (one age 1) that are thought to have originated upstream of the study area.

In the Mildred Lake study area, small mesh seines produced 213 yellow perch, of which 212 were young-of-the-year ranging in fork length from 25 to 58 mm. Perch first appeared in the samples on 28 to 29 June. Their abundance peaked on 9 to 10 August at which time they occurred in 53% of all small mesh seine hauls and accounted for 17.4% of the total catch in that gear (Table 9). Capture sites for yellow perch in the Mildred Lake study area were Sites 21, 22, 25 to 31, 33, 36, 37, and 41 to 43 (Figure 4). Machniak and Bond (1979) report capturing 101 young-of-the-year yellow perch in the lower Steepbank River in 1977. Small mesh seines produced 25 young-of-the-year yellow perch in the Delta study area between 29 June and 7 September. In the Delta, perch were captured at Sites 73, 75, 76, and 79 and at km 200.6LI, 294.5R, 210.7R, 211.5LI, and 256.2R (Figure 4).

4.2.12.12 Slimy sculpin. Only 13 slimy sculpins were captured in the Athabasca River in 1977, all of which were taken in the Mildred Lake study area where they occurred at Sites 27, 31, 36, 37, and 41 (Figure 4). Slimy sculpins are common in the lower reaches of the Muskeg River (Bond and Machniak 1977, 1979) and in the Steepbank River (Machniak and Bond 1979) and are known to frequent numerous other tributaries within the AOSERP study area (Griffiths 1973).

4.2.12.13 Spoonhead sculpin. A total of 39 spoonhead sculpins were captured from the Athabasca River during 1977. Thirteen spoonheads were taken in the Mildred Lake study area while 26 occurred in the Delta samples. Capture locations within the Mildred Lake study area were Sites 23, 25, 27, 31, 33, 35, 36, and 43 while in the Delta, spoonhead sculpins were taken at Sites 79, 81, 82, and 85 and at km 223.5R (Figure 4).

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6. APPENDIX

6.1 DESCRIPTIONS FOR SAMPLING SITES USED IN THE 1977 STUDY OF THE ATHABASCA RIVER

The locations described below refer to the standard gang, large mesh, and small mesh seine sites shown in Figure 4 of this report. Many of the sites became difficult to sample at high Athabasca River discharge rates ($> 1416 \text{ m}^3 \cdot \text{s}^{-1}$) and have been indicated as such. Discharge values given with the descriptions of tributary-associated sites refer to the 1976 mean annual discharge for the tributary (Water Survey of Canada 1977).

6.1.1 Mildred Lake Study Area

6.1.1.1 Standard gang sites. Site 1 (km 37.0) (Mile 23.1) Right bank. Eddy behind point of limestone bluff, diminishing with high discharges. Shallow, mud bottom sloping to gravels.

Site 2 (km 42.1) (Mile 26.3) Left bank. Large eddy behind point of limestone bluff, persisting through high discharge levels. Shallow along shore sloping to deep at mid-channel. Mud shore sloping to gravels.

Site 3 (km 59.5) (Mile 37.2) Right bank. Eddy behind point of limestone cliff, diminishing with high discharges. Mud shore sloping to sand and gravels, dropping off to deep at mid-channel.

Site 4 (km 81.8) (Mile 51.1) Right bank. Eddy created by large bank slumps, persists through high discharge. Vertical bank, sloping mud shore, gravel substrate. Fast drop off.

Site 5 (km 95.8) (Mile 59.9) Right bank. Medium to large size eddy, indentation in high clay bank near small tributary ($0.028 \text{ m}^3 \cdot \text{s}^{-1}$). Persists through high discharge levels. Mud shore sloping steeply to deep mid-channel area.

Site 6 (km 100.0) (Mile 62.5) Left bank. Mouth of Eymundson Creek ($0.42 \text{ m}^3 \cdot \text{s}^{-1}$). Tributary warm and usually highly turbid from silts. Flow often held back by high Athabasca discharge. Slack water hole and small eddy at stream mouth behind deflection point of oil sand bluff. Shallow in tributary mouth with bottom of

mud and sand. Fast drop off.

6.1.1.2 Large mesh seine sites. Site 7 (km 30.6)(Mile 19.1) Right bank. Slack water area and small eddy behind point of limestone cliff, diminishing with high discharge. Shallow with sloping shore of mud over sand and gravel.

Site 8 (km 37.0)(Mile 23.1) (see standard gang site 1).

Site 9 (km 39.8)(Mile 24.9) Left bank. Eddy created at low to medium discharge by gravel point bar. Mud shore, mud over gravel bottom, shallow.

Site 10 (km 40.0)(Mile 25.0) Right bank. Confluence of Steepbank River ($4.1 \text{ m}^3 \cdot \text{s}^{-1}$), a clear, warm, brown-water stream. Eddy formed by bitumen delta at low to medium discharge. Alternate site - Steepbank channel when flow held back by high Athabasca discharge.

Site 11 (km 40.5)(Mile 25.3) (see standard gang site 2).

Site 12 (km 55.5)(Mile 34.7) Right bank. Confluence of Muskeg River ($2.1 \text{ m}^3 \cdot \text{s}^{-1}$), a warm, clear, brown-water stream. Gravel substrate. Best at high Athabasca discharge when Muskeg River is backed up.

Site 13 (km 59.5)(Mile 37.2) Left bank. Slack water behind sand bar exposed at low discharge. Confluence of MacKay River ($14.7 \text{ m}^3 \cdot \text{s}^{-1}$), a warm, clear, brown-water stream. Gravel substrate. Flow held back at high Athabasca discharge.

Site 14 (km 59.5)(Mile 37.2) (see standard gang site 3).

Site 15 (km 70.6)(Mile 44.1) Right bank. Medium size eddy created by old barge docking site, best at medium discharge levels. Bitumen bank with fast drop off.

Site 16 (km 76.8)(Mile 48.0) Left bank. Slack water behind sand bar which is exposed at low discharge. Confluence with Ells River ($6.3 \text{ m}^3 \cdot \text{s}^{-1}$), a warm, brown-water stream. Often slight turbidity. Flow held back at high Athabasca discharge.

Site 17 (km 81.8)(Mile 51.1) (see standard gang site 4).

Site 18 (km 95.8)(Mile 59.9) (see standard gang site 5)
Willows on low bank make this site difficult to seine at high discharge levels.

Site 19 (km 100.0)(Mile 62.4) (see standard gang site 6)
Vertical banks make this site difficult to seine at high discharge levels.

Site 20 (km 110.0)(Mile 68.8) Right bank. Several small eddies created by gravel side bars. Dominant eddy varies with discharge level. Sloping gravel shore, shallow.

6.1.1.3 Small mesh seine sites. Site 21 (km 27.2)(Mile 17.0) Left bank, confluence of Poplar Creek ($1.1 \text{ m}^3 \cdot \text{s}^{-1}$), a clear, warm, brown-water stream, whose flow is held back at high Athabasca discharge (construction of weirs and diversion channel upstream).

Site 22 (km 29.6)(Mile 18.5) Right bank. Confluence Leggett Creek, a small, sluggish, clear, warm, brown-water stream. Deep side channel appearance. Emergent aquatic plants. Floods back at high Athabasca discharge.

Site 23 (km 30.6)(Mile 19.1) (see large mesh seine site 7).

Site 24 (km 34.9)(Mile 21.8) Left bank. Island-sand bar. Shallow, slack water site.

Site 25 (km 37.0)(Mile 23.1) (see standard gang site 1).

Site 26 (km 39.2)(Mile 24.5) Left bank. Small eddy behind rocky point, persisting at high discharge. Steep dropoff.

Site 27 (km 40.0)(Mile 25.0) (see large mesh seine site 10).

Site 28 (km 42.1)(Mile 26.3) (see standard gang site 2).

Site 29 (km 46.4)(Mile 29.0) Left bank. Slack water hole at outlet from Horseshoe Lake. Willows, snags, and mud make this site difficult to sample.

Site 30 (km 54.2)(Mile 33.9) Left bank. Confluence Beaver River ($0.7 \text{ m}^3 \cdot \text{s}^{-1}$). Mud bottom, warm, often turbid (dammed and diverted upstream).

Site 31 (km 55.5)(Mile 34.7) (see large mesh seine site 12).

Site 32 (km 57.6)(Mile 36.0) Mid-channel slack water site associated with sandbar. Inundated at higher discharge. Shallow, sloping sand shore and substrate.

Site 33 (km 59.5)(Mile 37.2) (see large mesh seine site 13).

Site 34 (km 59.5)(Mile 37.2) (See standard gang site 3).

Site 35 (km 74.9)(Mile 46.8) Left bank. Low current area downstream of mud bank, diminishing with medium to high discharge. Shallow sloping mud shore and bottom.

Site 36 (km 76.8)(Mile 48.0) (see large mesh seine site 16).

Site 37 (km 78.9)(Mile 49.3) Left bank. Confluence of Tar River ($0.9 \text{ m}^3 \cdot \text{s}^{-1}$), a warm, clear, brown-water stream. Shallow with mud-sand substrate. Flow held back at high Athabasca discharge.

Site 38 (km 81.8)(Mile 51.1) (see standard gang site 4).

Site 39 (km 89.0)(Mile 55.6) Left bank. Confluence Calumet River ($0.1 \text{ m}^3 \cdot \text{s}^{-1}$), a warm, clear, slightly brown-water stream. Shallow with mud-sand substrate.

Site 41 (km 94.1)(Mile 58.8) Left bank. Small eddy associated with Pierre River ($0.2 \text{ m}^3 \cdot \text{s}^{-1}$), a clear, slightly brown-water stream. Shallow with sloping mud shore.

Site 42 (km 95.8)(Mile 59.9) (see standard gang site 5).

Site 43 (km 99.8)(Mile 62.4) (see standard gang site 19).

Site 44 (km 110.1)(Mile 68.8) (see large mesh seine site 20).

6.1.2 Delta Study Area

6.1.2.1 Standard gang sites. Site 51 (km 212.8)(Mile 133.0) Slack water site at the tail of a large island with a current sweep on both sides. Shallow area, substrate of silt and sand.

Site 52 (Embarras River distributary) Left bank. Mouth of muskeg drainage channel, often flooded back by high Athabasca discharge. Small slack water hole with current sweep in main channel. Best at high discharge levels. Shallow, silt and sand substrate.

Site 53 (km 223.4)(Mile 139.6) Right bank. Large, deep, and turbulent eddy at the origin of an antropogenic channel, persisting through high discharge levels. Vertical sand bank extending to downstream sand bar. Sand substrate.

Site 54 (km 241.4)(Mile 150.9) Right bank. Small slack water eddy behind point bar, persisting at most discharge levels. Vertical to sloping sand banks. Silt over sand substrate. Shallow.

Site 55 (km 251.2)(Mile 157.0 - Devil's Elbow) Right bank. Small slack water eddy behind point bar, persisting at most discharge levels. Better at medium to high discharge. Shallow with sloping sand shore and bottom.

Site 56 (km 255.8)(Mile 159.9 - Ess Bend) Right bank. Large, deep, and turbulent eddy associated with the inside loop of a meander bend, persisting at high discharge.

6.1.2.2 Large mesh seine sites. Site 57 (km 196.0)(mile 122.5) Right bank. Slack water site behind a point bar, persisting at most discharge levels. Shallow with silt over sand substrate.

Site 58 (km 198.4)(Mile 124.0) Left bank. Slack water site behind point bar, not suitable at higher discharges when sand bar becomes inundated. Shallow with sloping sand substrate.

Site 59 (km 200.6)(Mile 125.4) Slack water site associated with mid-channel sand bar at the tail of a small island. Shallow, best at low to medium discharge.

Site 60 (km 202.4)(Mile 126.5) Slack water site associated with indentation of island shoreline. Sloping silt over sand substrate, shallow.

Site 61 (km 206.9)(Mile 129.3) Slack water site created by a side bar, persisting at most discharge levels. Sloping mud shore, drop-off to deeper area.

Site 62 (km 211.7)(Mile 132.3) Slack water site associated with a mid-channel sand bar at the tail of a small island, persisting at most discharge levels. Shallow with sand substrate.

Site 63 (km 215.7)(Mile 134.8) Right bank. Eddy behind sand point persisting at high discharge. Vertical banks with sand substrate sloping to moderately deep area.

Site 64 (km 216.5)(Mile 135.3) Right bank. Slack water site associated with bank indentation of island shoreline, best at medium to high discharge. Shallow with mud shoreline and bottom. Alternate site - mouth of delta back channel.

Site 65 (km 220.8)(Mile 138.0) Left bank. Slack water site behind point bar in an exit channel to the Embarras River distributary,

persisting at most discharge levels. Shallow with silt over sand substrate.

Site 66 (km 222.6)(Mile 139.1) Left bank. Small eddy behind sand point, best at medium discharge. Shallow with sloping mud shore and bottom

Site 67 (km 241.4)(Mile 150.9) (see standard gang site 54).

Site 68 (km 247.0)(Mile 154.4) Right bank. Slack water to reversed current site at confluence of Richardson River, a warm, clear, slightly brown-water stream. Frequent reversing of flow to Limon and Blanche Lake complexes.

Site 69 (km 251.2)(Mile 157.0) (see standard gang site 55).

Site 70 (km 255.7)(Mile 159.8) Left bank. Large turbulent eddy and back sweep shore current, persisting at high discharge levels. Mud shore with fast drop off.

Site 71 (km 255.8)(Mile 159.9) (see standard gang site 56).

Site 72 (km 260.5)(Mile 162.8) Left bank. Slack water site behind sand point at exit to Fletcher Channel distributary, best at medium discharge levels. Shallow with sloping sand shore and substrate.

6.1.2.3 Small mesh seine sites. Site 73 (km 196.0)(Mile 122.5) (see large mesh seine site 57).

Site 74 (km 196.2)(Mile 122.6) Right bank. Low current site along shoreline of small island. Shallow with sand substrate.

Site 75 (km 200.6)(Mile 125.4) (see large mesh seine site 59).

Site 76 (km 206.9)(Mile 129.3) (see large mesh seine site 61).

Site 77 (km 211.2)(Mile 132.0) (see large mesh seine site 62).

Site 78 (km 215.4)(Mile 134.6) Left bank. Slack water site at confluence of delta back channel (Pine Creek), floods back at high Athabasca discharge. Shallow with sloping mud shore and bottom.

Site 79 (km 216.5)(Mile 135.3) (see large mesh seine site 64).

Site 80 (km 220.8)(Mile 138.0) (see large mesh seine site 65).

Site 81 (km 222.6)(Mile 139.1) (see large mesh seine site 66).

Site 82 (km 2224.0)(Mile 140.0) Right bank. Low current area along sloping shoreline best at low to medium discharge. Shallow

with sand substrate.

Site 83 (km 241.4)(Mile 150.9) (see standard gang site 54).

Site 84 (km 251.2)(Mile 157.0R) (see standard gang site 55).

Site 85 (km 255.8)(Mile 159.9) (see standard gang site 56).

Site 86 (km 260.5)(Mile 162.8) (see large mesh seine site 72).

Site 87 (km 261.0)(Mile 163.1) Right bank. Slack water site behind point bar, persisting at high discharge levels. Shallow with sloping sand shore and substrate.

6.2 NUMBERS (N) AND PERCENTAGES (%) FOR FISH CAPTURED IN EACH MESH SIZE OF STANDARD GANGS, ATHABASCA RIVER, 1977. (TABLES 110 and 111).

Table 110. Numbers (N) and percentages (%) for fish captured in each mesh size of standard gangs, Mildred Lake study area, Athabasca River, 1977.

| Species | Mesh Size (cm) | Date of Sample | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|----------------|----------------|-------|------------|------|-------------|------|---------------|------|---------------|------|---------------|-------|---------------|------|----------------|-------|-----------------|-------|------------------|------|--------------------|-------|----------------|------|------------------|------|-----------------|------|-------|------|-----|------|----|------|
| | | 26 to 27 April | | 4 to 5 May | | 1 to 6 June | | 15 to 16 June | | 27 to 29 June | | 12 to 13 July | | 26 to 27 July | | 8 to 10 August | | 23 to 24 August | | 5 to 7 September | | 20 to 22 September | | 4 to 5 October | | 17 to 18 October | | 1 to 2 November | | Total | | | | | |
| | | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | | | | |
| Goldeye | 10.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 4.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 0.4 | | | | |
| | 8.9 | 6 | 37.5 | 1 | 2.6 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 3 | 3.4 | 2 | 25.0 | 1 | 2.5 | 4 | 10.2 | 1 | 9.1 | 7 | 16.7 | 2 | 8.0 | 4 | 26.7 | 1 | 6.3 | 1 | 12.5 | 33 | 6.9 | | |
| | 7.6 | 7 | 43.8 | 8 | 21.0 | 7 | 10.2 | 3 | 4.9 | 21 | 23.9 | 3 | 37.5 | 7 | 17.5 | 14 | 35.9 | 4 | 36.4 | 16 | 38.1 | 11 | 44.0 | 4 | 26.7 | 8 | 50.0 | 5 | 62.5 | 118 | 24.8 | | | | |
| | 6.3 | 0 | 0.0 | 26 | 68.4 | 34 | 50.0 | 39 | 63.9 | 45 | 51.1 | 1 | 12.5 | 22 | 55.0 | 18 | 46.1 | 6 | 54.5 | 16 | 38.1 | 11 | 44.0 | 3 | 20.0 | 5 | 31.2 | 1 | 12.5 | 227 | 47.8 | | | | |
| | 5.1 | 3 | 18.7 | 3 | 7.9 | 20 | 29.4 | 14 | 22.9 | 17 | 19.3 | 2 | 25.0 | 10 | 25.0 | 3 | 7.7 | 0 | 0.0 | 1 | 2.4 | 1 | 4.0 | 2 | 13.3 | 2 | 12.5 | 1 | 12.5 | 79 | 10.3 | | | | |
| | 3.8 | 0 | 0.0 | 0 | 0.0 | 7 | 10.2 | 5 | 8.2 | 2 | 2.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 13.3 | 0 | 0.0 | 0 | 0.0 | 16 | 3.4 | | |
| | Total | 16 | | 38 | | 68 | | 61 | | 88 | | 8 | | 40 | | 39 | | 11 | | 42 | | 25 | | 15 | | 16 | | 8 | | | | 475 | | | |
| Walleye | 10.2 | 4 | 44.4 | 2 | 25.0 | 0 | 0.0 | 0 | 0.0 | 1 | 6.7 | 1 | 20.0 | 0 | 0.0 | 1 | 8.3 | 0 | 0.0 | 4 | 40.0 | 5 | 26.3 | 1 | 8.3 | 6 | 54.5 | 2 | 33.3 | 27 | 20.0 | | | | |
| | 8.9 | 0 | 0.0 | 2 | 25.0 | 1 | 14.3 | 0 | 0.0 | 5 | 33.3 | 1 | 20.0 | 0 | 0.0 | 2 | 16.7 | 0 | 0.0 | 1 | 10.0 | 8 | 42.1 | 2 | 16.7 | 0 | 0.0 | 1 | 16.7 | 23 | 17.0 | | | | |
| | 7.6 | 1 | 11.1 | 1 | 12.5 | 3 | 42.9 | 5 | 27.8 | 5 | 33.3 | 1 | 20.0 | 1 | 50.0 | 4 | 33.3 | 0 | 0.0 | 3 | 30.0 | 5 | 26.3 | 1 | 8.3 | 4 | 36.4 | 2 | 33.3 | 36 | 26.7 | | | | |
| | 6.3 | 4 | 44.4 | 3 | 37.5 | 3 | 42.9 | 6 | 33.3 | 1 | 6.7 | 0 | 0.0 | 1 | 50.0 | 1 | 8.3 | 0 | 0.0 | 1 | 10.0 | 1 | 5.3 | 3 | 25.0 | 1 | 9.1 | 1 | 16.7 | 26 | 19.2 | | | | |
| | 5.1 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 4 | 22.2 | 3 | 20.0 | 2 | 40.0 | 0 | 0.0 | 3 | 25.0 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 16.7 | 0 | 0.0 | 0 | 0.0 | 15 | 11.1 | | |
| | 3.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 3 | 16.7 | 0 | 0.0 | 0 | 0.0 | 3 | 0.0 | 1 | 8.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 3 | 25.0 | 0 | 0.0 | 0 | 0.0 | 7 | 5.1 | | |
| | Total | 9 | | 8 | | 7 | | 18 | | 15 | | 5 | | 2 | | 12 | | 1 | | 10 | | 19 | | 12 | | 11 | | 6 | | | | 135 | | | |
| Lake whitefish | 10.2 | 4 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 50.0 | 1 | 25.0 | 5 | 35.7 | 6 | 33.3 | 3 | 8.3 | 11 | 31.4 | 3 | 23.1 | 34 | 25.3 | | | | |
| | 8.9 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 50.0 | 2 | 14.2 | 5 | 28.6 | 8 | 22.2 | 10 | 28.6 | 4 | 30.8 | 31 | 23.1 | | | | |
| | 7.6 | 3 | 37.5 | 3 | 75.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 50.0 | 1 | 25.0 | 4 | 28.5 | 3 | 16.7 | 12 | 33.3 | 3 | 8.6 | 3 | 23.1 | 33 | 24.6 | | | | |
| | 6.3 | 1 | 12.5 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 3 | 21.4 | 4 | 22.2 | 11 | 30.5 | 6 | 17.1 | 1 | 7.7 | 26 | 19.4 | | | | |
| | 5.1 | 0 | 0.0 | 1 | 25.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 5.5 | 4 | 11.4 | 2 | 15.4 | 9 | 6.7 | | | | |
| | 3.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 7.8 | 0 | 0.0 | 1 | 0.7 | | |
| | Total | 8 | | 4 | | 0 | | 0 | | 0 | | 0 | | 0 | | 2 | | 4 | | 14 | | 18 | | 36 | | 35 | | 13 | | | | 134 | | | |
| Northern pike | 10.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 40.0 | 0 | 0.0 | 1 | 10.0 | 1 | 25.0 | 4 | 7.1 | | | | |
| | 8.9 | 0 | 0.0 | 1 | 20.0 | 2 | 66.7 | 0 | 0.0 | 1 | 11.1 | 0 | 0.0 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 100.0 | 1 | 33.3 | 2 | 40.0 | 1 | 12.5 | 2 | 20.0 | 0 | 0.0 | 13 | 23.2 |
| | 7.6 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 20.0 | 4 | 50.0 | 2 | 20.0 | 2 | 50.0 | 10 | 17.8 | | | | | | |
| | 6.3 | 1 | 50.0 | 1 | 20.0 | 1 | 33.3 | 0 | 0.0 | 6 | 66.7 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 5 | 50.0 | 0 | 0.0 | 15 | 26.8 | | |
| | 5.1 | 0 | 0.0 | 1 | 20.0 | 0 | 0.0 | 1 | 50.0 | 1 | 11.1 | 0 | 0.0 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 2 | 66.7 | 0 | 0.0 | 2 | 25.0 | 0 | 0.0 | 0 | 0.0 | 8 | 14.3 | | | | |
| | 3.8 | 0 | 0.0 | 2 | 40.0 | 0 | 0.0 | 1 | 50.0 | 1 | 11.1 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 17.5 | 0 | 0.0 | 1 | 25.0 | 6 | 10.7 | | |
| | Total | 2 | | 5 | | 3 | | 2 | | 9 | | 1 | | 2 | | 0 | | 2 | | 3 | | 5 | | 8 | | 10 | | 4 | | | | 56 | | | |
| Flathead chub | 10.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | | | | |
| | 8.9 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | | | | |
| | 7.6 | 0 | 0.0 | 1 | 10.0 | 3 | 7.1 | 0 | 0.0 | 1 | 50.0 | 2 | 33.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 7 | 7.4 | | |
| | 6.3 | 1 | 100.0 | 6 | 60.0 | 11 | 26.2 | 5 | 45.5 | 0 | 0.0 | 0 | 0.0 | 1 | 20.0 | 1 | 14.3 | 0 | 0.0 | 0 | 0.0 | 1 | 50.0 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 27 | 28.7 | | |
| | 5.1 | 0 | 0.0 | 2 | 20.0 | 18 | 42.8 | 5 | 45.5 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 4 | 57.1 | 2 | 66.7 | 1 | 33.3 | 0 | 0.0 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 33 | 35.1 | | |
| | 3.8 | 0 | 0.0 | 1 | 10.0 | 10 | 23.8 | 1 | 9.1 | 1 | 50.0 | 4 | 66.7 | 4 | 80.0 | 2 | 28.6 | 1 | 33.3 | 2 | 66.7 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 27 | 28.7 | | |
| | Total | 1 | | 10 | | 42 | | 11 | | 2 | | 6 | | 5 | | 7 | | 3 | | 3 | | 2 | | 2 | | 0 | | 0 | | | | 94 | | | |
| Suckers | 10.2 | 0 | 0.0 | 4 | 57.1 | 3 | 14.3 | 4 | 36.4 | 1 | 33.3 | 1 | 50.0 | 1 | 50.0 | 2 | 100.0 | 0 | 0.0 | 3 | 75.0 | 1 | 33.3 | 3 | 33.3 | 4 | 40.0 | 0 | 0.0 | 27 | 33.3 | | | | |
| | 8.9 | 3 | 75.0 | 1 | 14.3 | 6 | 28.6 | 3 | 27.3 | 2 | 66.7 | 1 | 50.0 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 1 | 25.0 | 1 | 33.3 | 3 | 33.3 | 4 | 40.0 | 0 | 0.0 | 26 | 32.1 | | | | |
| | 7.6 | 0 | 0.0 | 2 | 28.6 | 7 | 33.3 | 3 | 27.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 33.3 | 1 | 11.1 | 0 | 0.0 | 2 | 66.7 | 16 | 19.7 | | | | | | |
| | 6.3 | 1 | 25.0 | 0 | 0.0 | 4 | 19.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 11.1 | 0 | 0.0 | 1 | 33.3 | 7 | 8.6 | | | | |
| | 5.1 | 0 | 0.0 | 0 | 0.0 | 1 | 4.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 11.1 | 2 | 20.0 | 0 | 0.0 | 4 | 4.9 | | | | | | |
| | 3.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 9.1 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 1.2 | | | | |
| | Total | 4 | | 7 | | 21 | | 11 | | 3 | | 2 | | 2 | | 2 | | 0 | | 4 | | 3 | | 9 | | 10 | | 3 | | | | 81 | | | |

Table 111. Numbers (N) and percentages (%) for fish captured in each mesh size of standard gangs, Delta study area, Athabasca River, 1977.

| Species | Mesh Size (cm) | Date of Sample | | | | | | | | | | | | | | Total | | | | | | | |
|----------------|----------------|----------------|-------|---------------|-------|---------------|-------|---------------|-------|---------------|-------|---------------|-------|-----------------|-------|-------|------------------|----|--------------------|---|----------------|----|------|
| | | 1 to 6 June | | 15 to 16 June | | 27 to 29 June | | 11 to 13 July | | 25 to 27 July | | 8 to 5 August | | 22 to 24 August | | | 6 to 7 September | | 15 to 21 September | | 3 to 7 October | | |
| | | N | % | N | % | N | % | N | % | N | % | N | % | N | % | | N | % | N | % | N | % | |
| Goldeye | 10.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 8.9 | 0 | 0.0 | 5 | 10.4 | 3 | 9.7 | 0 | 0.0 | 1 | 5.6 | 2 | 11.1 | 0 | 0.0 | 0 | 0.0 | 2 | 28.6 | 0 | 0.0 | 13 | 7.1 |
| | 7.6 | 2 | 33.3 | 2 | 4.2 | 6 | 15.4 | 2 | 12.5 | 3 | 16.7 | 7 | 35.9 | 6 | 27.3 | 4 | 25.7 | 0 | 0.0 | 1 | 50.0 | 33 | 18.0 |
| | 6.3 | 3 | 50.0 | 21 | 43.7 | 12 | 43.0 | 8 | 50.0 | 8 | 44.4 | 6 | 44.4 | 10 | 45.5 | 3 | 20.0 | 1 | 14.3 | 0 | 0.0 | 74 | 40.4 |
| | 5.1 | 1 | 16.7 | 15 | 31.2 | 10 | 41.0 | 6 | 37.5 | 5 | 27.8 | 1 | 5.6 | 5 | 22.7 | 6 | 40.0 | 2 | 28.6 | 0 | 0.0 | 51 | 27.9 |
| | 3.8 | 0 | 0.0 | 5 | 10.4 | 0 | 0.0 | 0 | 0.0 | 1 | 5.6 | 0 | 0.0 | 1 | 4.5 | 2 | 13.3 | 2 | 28.6 | 1 | 50.0 | 12 | 6.6 |
| Total | 6 | | 48 | | 31 | | 16 | | 18 | | 18 | | 22 | | 15 | | 7 | | 2 | | 183 | | |
| Walleye | 10.2 | 3 | 17.6 | 1 | 7.1 | 0 | 0.0 | 0 | 0.0 | 5 | 38.5 | 1 | 25.0 | 2 | 20.0 | 3 | 37.5 | 10 | 27.0 | 1 | 100.0 | 26 | 22.8 |
| | 8.9 | 2 | 11.8 | 1 | 7.1 | 1 | 20.0 | 1 | 20.0 | 1 | 7.7 | 1 | 25.0 | 1 | 10.0 | 2 | 25.0 | 3 | 8.1 | 0 | 0.0 | 13 | 11.4 |
| | 7.6 | 6 | 35.3 | 4 | 28.6 | 0 | 0.0 | 2 | 40.0 | 1 | 7.7 | 1 | 25.0 | 3 | 30.0 | 1 | 12.5 | 12 | 32.4 | 0 | 0.0 | 30 | 26.3 |
| | 6.3 | 3 | 17.6 | 5 | 35.7 | 0 | 0.0 | 0 | 0.0 | 3 | 23.1 | 1 | 25.0 | 1 | 10.0 | 1 | 12.5 | 7 | 18.9 | 0 | 0.0 | 21 | 18.4 |
| | 5.1 | 3 | 17.6 | 1 | 7.1 | 2 | 40.0 | 1 | 20.0 | 2 | 15.4 | 0 | 0.0 | 1 | 10.0 | 1 | 12.5 | 4 | 10.8 | 0 | 0.0 | 15 | 13.1 |
| | 3.8 | 0 | 0.0 | 2 | 14.3 | 2 | 40.0 | 1 | 20.0 | 1 | 7.7 | 0 | 0.0 | 2 | 20.0 | 0 | 0.0 | 1 | 2.7 | 0 | 0.0 | 5 | 7.9 |
| Total | 17 | | 14 | | 5 | | 5 | | 13 | | 4 | | 10 | | 8 | | 37 | | 1 | | 114 | | |
| Lake whitefish | 10.2 | 0 | 0.0 | 0 | 0.0 | 1 | 50.0 | 0 | 0.0 | 4 | 66.7 | 2 | 100.0 | 2 | 15.4 | 3 | 14.3 | 1 | 6.2 | 1 | 14.3 | 14 | 18.9 |
| | 8.9 | 0 | 0.0 | 0 | 0.0 | 1 | 50.0 | 4 | 66.7 | 2 | 33.3 | 0 | 0.0 | 7 | 53.8 | 3 | 14.3 | 2 | 12.5 | 2 | 28.6 | 21 | 28.4 |
| | 7.6 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 2 | 33.3 | 0 | 0.0 | 0 | 0.0 | 3 | 23.1 | 6 | 28.6 | 2 | 12.5 | 3 | 42.9 | 17 | 23.0 |
| | 6.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 7.7 | 5 | 23.8 | 5 | 31.2 | 1 | 14.3 | 12 | 16.2 |
| | 5.1 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 9.5 | 3 | 12.7 | 0 | 0.0 | 5 | 6.8 |
| | 3.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 2 | 9.5 | 3 | 12.7 | 0 | 0.0 | 5 | 6.8 |
| Total | 0 | 0.0 | 1 | | 2 | | 6 | | 6 | | 2 | | 13 | | 21 | | 16 | | 7 | | 74 | | |
| Northern pike | 10.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 8.9 | 1 | 100.0 | 1 | 7.7 | 1 | 6.7 | 0 | 0.0 | 0 | 0.0 | 1 | 7.1 | 0 | 0.0 | 2 | 30.0 | 0 | 0.0 | 0 | 0.0 | 6 | 9.0 |
| | 7.6 | 0 | 0.0 | 2 | 15.4 | 2 | 13.3 | 1 | 11.1 | 0 | 0.0 | 1 | 7.1 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 6.3 | 0 | 0.0 | 3 | 23.1 | 6 | 40.0 | 0 | 0.0 | 3 | 75.0 | 6 | 42.9 | 3 | 50.0 | 1 | 25.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 5.1 | 0 | 0.0 | 6 | 46.2 | 5 | 33.3 | 2 | 22.2 | 1 | 25.0 | 4 | 25.8 | 2 | 33.3 | 1 | 25.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 3.8 | 0 | 0.0 | 1 | 7.7 | 1 | 6.7 | 6 | 66.7 | 0 | 0.0 | 2 | 14.3 | 1 | 16.7 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 12 | 17.9 |
| Total | 1 | | 13 | | 15 | | 9 | | 4 | | 14 | | 6 | | 4 | | 1 | | 0 | | 67 | | |
| Flathead chub | 10.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 8.9 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 7.7 |
| | 7.6 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 6.3 | 2 | 75.0 | 1 | 25.0 | 0 | 0.0 | 1 | 100.0 | 1 | 100.0 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 5.1 | 1 | 25.0 | 2 | 50.0 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 4 | 30.8 |
| | 3.8 | 0 | 0.0 | 1 | 25.0 | 1 | 50.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 3 | | 4 | | 2 | | 1 | | 1 | | 1 | | 1 | | 0 | | 0 | | 0 | | 13 | | |
| Suckers | 10.2 | 3 | 33.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 1 | 33.3 | 2 | 50.0 | 4 | 57.1 | 11 | 40.7 |
| | 8.9 | 2 | 22.2 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 14.3 | 4 | 14.8 |
| | 7.6 | 1 | 11.1 | 0 | 0.0 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 33.3 | 1 | 25.0 | 1 | 14.3 | 5 | 18.5 |
| | 6.3 | 2 | 22.2 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 33.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | 5.1 | 1 | 11.1 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 14.3 | 3 | 11.1 |
| | 3.8 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 25.0 | 0 | 0.0 | 1 | 3.7 |
| Total | 9 | | 1 | | 1 | | 1 | | 0 | | 1 | | 0 | | 3 | | 4 | | 7 | | 27 | | |

6.3 NUMBER (N), PERCENTAGE (%), AND CATCH-PER-UNIT-EFFORT (C/E)
FOR FISH CAPTURED IN STANDARD GANGS AT EACH SAMPLING SITE
DURING EACH SAMPLING PERIOD, ATHABASCA RIVER, 1977.
(TABLES 112 TO 137)

Abbreviations used for fish species are as follows:

- GO - Goldeye
- WA - Walleye
- NP - Northern Pike
- LW - Lake Whitefish
- MW - Mountain Whitefish
- AG - Arctic Grayling
- DV - Dolly Varden
- LS - Longnose Sucker
- WS - White Sucker
- BU - Burbot
- FC - Flathead Chub

Site numbers refer to Figure 4 and Appendix 6.1.

Table 112. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 26 to 27 April 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-------|-------|-------|-------|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 3 | N | 16 | 9 | 2 | 8 | 3 | 1 | 0 | 1 | 40 | 17.0 |
| | % | 40.0 | 22.5 | 5.0 | 20.0 | 7.5 | 2.5 | 0 | 2.5 | | |
| | C/E | 0.941 | 0.529 | 0.117 | 0.470 | 0.176 | 0.058 | 0 | 0.058 | 2.352 | |
| 4 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 5 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | 0 | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 16 | 9 | 2 | 8 | 3 | 1 | 0 | 1 | 40 | 17.0 |
| | % | 40.0 | 22.5 | 5.0 | 20.0 | 7.5 | 2.5 | 0 | 2.5 | | |
| | C/E | 0.941 | 0.529 | 0.117 | 0.470 | 0.176 | 0.058 | 0 | 0.058 | 2.352 | |
| % Occurrence | | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 0.0 | 100.0 | | |

Table 113. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 4 to 5 May 1977.

| Site | | Species Captured | | | | | | | Total | Hours of Set | |
|-----------------|-----|------------------|-------|-------|-------|-------|-------|-----|-------|--------------|------|
| | | GO | WA | NP | LW | LS | WS | BU | | | FC |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 38 | 8 | 5 | 4 | 6 | 1 | 0 | 10 | 72 | 17.5 |
| | % | 52.8 | 11.1 | 6.9 | 5.5 | 8.3 | 1.4 | 0 | 13.9 | | |
| | C/E | 2.171 | 0.457 | 0.285 | 0.228 | 0.342 | 0.057 | 0 | 0.571 | 4.114 | |
| 3 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 4 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 5 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 38 | 8 | 5 | 4 | 6 | 1 | 0 | 10 | 72 | 17.5 |
| | % | 52.8 | 11.1 | 6.9 | 5.5 | 8.3 | 1.4 | 0 | 13.9 | | |
| | C/E | 2.171 | 0.457 | 0.285 | 0.228 | 0.342 | 0.057 | 0 | 0.571 | 4.114 | |
| % Occurrence | | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 0.0 | 100.0 | 100.0 | |

Table 114. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 1 to 6 June 1977.

| Site | Species Captured ^a | | | | | | | | | Total | Hours of Set |
|-----------------|-------------------------------|-------|-------|-------|-----|-------|-----|-----|-------|-------|--------------|
| | GO | WA | NP | LW | LS | WS | BU | FC | | | |
| 1 | N | 6 | 1 | 0 | 0 | 3 | 0 | 0 | 9 | 19 | 18.0 |
| | % | 31.5 | 5.2 | 0 | 0 | 15.8 | 0 | 0 | 47.4 | | |
| | C/E | 0.333 | 0.055 | 0 | 0 | 0.166 | 0 | 0 | 0.500 | | |
| 2 | N | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 4 | 17 | 17.5 |
| | % | 0 | 0 | 0 | 0 | 70.6 | 0 | 0 | 23.5 | | |
| | C/E | 0 | 0 | 0 | 0 | 0.685 | 0 | 0 | 0.228 | | |
| 3 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | | |
| 4 | N | 27 | 6 | 2 | 0 | 1 | 0 | 0 | 17 | 54 | 19.5 |
| | % | 49.0 | 10.9 | 3.6 | 0 | 1.8 | 0 | 0 | 30.9 | | |
| | C/E | 1.384 | 0.307 | 0.102 | 0 | 0.051 | 0 | 0 | 0.871 | | |
| 5 | N | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 39 | 19.5 |
| | % | 74.3 | 0 | 0 | 0 | 0 | 0 | 0 | 25.6 | | |
| | C/E | 1.487 | 0 | 0 | 0 | 0 | 0 | 0 | 0.512 | | |
| 6 | N | 6 | 0 | 1 | 0 | 5 | 0 | 0 | 2 | 14 | 18.5 |
| | % | 42.8 | 0 | 7.1 | 0 | 35.7 | 0 | 0 | 14.3 | | |
| | C/E | 0.324 | 0 | 0.054 | 0 | 0.270 | 0 | 0 | 0.108 | | |
| Com- bined | N | 68 | 7 | 3 | 0 | 21 | 0 | 0 | 42 | 142 | 93.0 |
| | % | 47.5 | 4.9 | 2.0 | 0 | 14.7 | 0 | 0 | 29.3 | | |
| | C/E | 0.731 | 0.075 | 0.032 | 0 | 0.225 | 0 | 0 | 0.451 | | |
| % Occurrence | | 80.0 | 40.0 | 40.0 | 0.0 | 80.0 | 0.0 | 0.0 | 100.0 | | |

^a One Dolly Varden captured at Site 2 and one Arctic grayling captured at Site 4.

Table 115. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 15 to 16 June 1977.

| Site | Species Captured ^a | | | | | | | | | Total | Hours of Set |
|------------|-------------------------------|-------|-------|-------|-----|-------|-------|-------|-------|-------|--------------|
| | GO | WA | NP | LW | LS | WS | BU | FC | | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 7 | 4 | 1 | 0 | 2 | 0 | 0 | 2 | 16 | 14.0 |
| | % | 43.7 | 25.0 | 6.25 | 0 | 12.5 | 0 | 0 | 12.5 | | |
| | C/E | 0.500 | 0.285 | 0.071 | 0 | 0.142 | 0 | 0 | 0.142 | 1.142 | |
| 3 | N | 28 | 7 | 0 | 0 | 1 | 0 | 1 | 2 | 59 | 13.5 |
| | % | 71.8 | 17.9 | 0 | 0 | 2.5 | 0 | 2.5 | 5.1 | | |
| | C/E | 2.074 | 0.518 | 0 | 0 | 0.074 | 0 | 0.074 | 0.148 | 2.888 | |
| 4 | N | 20 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 35 | 16.0 |
| | % | 57.1 | 14.3 | 0 | 0 | 14.3 | 0 | 0 | 14.3 | | |
| | C/E | 1.250 | 0.312 | 0 | 0 | 0.312 | 0 | 0 | 0.312 | 2.187 | |
| 5 | N | 6 | 2 | 1 | 0 | 2 | 1 | 0 | 2 | 15 | 16.0 |
| | % | 40.0 | 13.3 | 6.7 | 0 | 13.3 | 6.7 | 0 | 13.3 | | |
| | C/E | 0.375 | 0.125 | 0.062 | 0 | 0.125 | 0.062 | 0 | 0.125 | 0.937 | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- | N | 61 | 18 | 2 | 0 | 10 | 1 | 1 | 11 | 105 | 59.5 |
| bined | % | 58.0 | 17.1 | 1.9 | 0 | 9.5 | 0.95 | 0.95 | 10.5 | | |
| | C/E | 1.020 | 0.302 | 0.033 | 0 | 0.168 | 0.016 | 0.016 | 0.184 | 1.764 | |
| | % | | | | | | | | | | |
| Occurrence | | 100.0 | 100.0 | 50.0 | 0.0 | 100.0 | 25.0 | 25.0 | 100.0 | | |

^a One mountain whitefish captured at Site 5.

Table 116. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 27 to 29 June 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|---------------|------------|------------------|-------|-------|-----|-------|-----|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 26 | 5 | 3 | 0 | 1 | 0 | 0 | 0 | 35 | 14.0 |
| | % | 74.3 | 14.3 | 8.6 | 0 | 2.8 | 0 | 0 | 0 | | |
| | C/E | 1.857 | 0.357 | 0.214 | 0 | 0.071 | 0 | 0 | 0 | 2.500 | |
| 3 | N | 15 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 19 | 13.5 |
| | % | 78.9 | 10.5 | 0 | 0 | 5.3 | 0 | 0 | 5.3 | | |
| | C/E | 1.111 | 0.148 | 0 | 0 | 0.074 | 0 | 0 | 0.074 | 1.407 | |
| 4 | N | 25 | 5 | 1 | 0 | 1 | 0 | 0 | 1 | 33 | 16.0 |
| | % | 75.8 | 15.2 | 3.0 | 0 | 3.0 | 0 | 0 | 3.0 | | |
| | C/E | 1.562 | 0.312 | 0.062 | 0 | 0.062 | 0 | 0 | 0.062 | 2.063 | |
| 5 | N | 22 | 3 | 5 | 0 | 0 | 0 | 0 | 0 | 30 | 16.0 |
| | % | 73.3 | 10 | 16.7 | 0 | 0 | 0 | 0 | 0 | | |
| | C/E | 1.375 | 0.187 | 0.312 | 0 | 0 | 0 | 0 | 0 | 1.875 | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 88 | 15 | 9 | 0 | 3 | 0 | 0 | 2 | 117 | 59.5 |
| | % | 75.2 | 12.8 | 7.7 | 0 | 2.6 | 0 | 0 | 1.7 | | |
| | C/E | 1.478 | 0.252 | 0.151 | 0 | 0.050 | 0 | 0 | 0.033 | 1.966 | |
| % | Occurrence | 100.0 | 100.0 | 75.0 | 0.0 | 75.0 | 0.0 | 0.0 | 50.0 | | |

Table 117. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 12 to 13 July 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-------|-----|-------|-----|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 5 | 2 | 0 | 0 | 2 | 0 | 0 | 3 | 12 | 18.0 |
| | % | 41.7 | 16.7 | 0 | 0 | 16.7 | 0 | 0 | 25.0 | | |
| | C/E | 0.277 | 0.111 | 0 | 0 | 0.111 | 0 | 0 | 0.166 | 0.666 | |
| 3 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 4 | N | 3 | 3 | 1 | 0 | 0 | 0 | 0 | 3 | 10 | 17.0 |
| | % | 30.0 | 30.0 | 10.0 | 0 | 0 | 0 | 0 | 30.0 | | |
| | C/E | 0.176 | 0.176 | 0.058 | 0 | 0 | 0 | 0 | 0.176 | 0.588 | |
| 5 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 8 | 5 | 1 | 0 | 2 | 0 | 0 | 6 | 22 | 35.0 |
| | % | 36.4 | 22.7 | 4.5 | 0 | 9.0 | 0 | 0 | 27.3 | | |
| | C/E | 0.228 | 0.142 | 0.028 | 0 | 0.057 | 0 | 0 | 0.171 | 0.628 | |
| % Occurrence | | 100.0 | 100.0 | 50.0 | 0.0 | 50.0 | 0.0 | 0.0 | 100.0 | | |

Table 112. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 26 to 27 July 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|---------------|-----|------------------|-------|-------|-----|-------|-----|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 26 | 0 | 2 | 0 | 2 | 0 | 0 | 1 | 31 | 17.5 |
| | % | 83.9 | 0 | 6.5 | 0 | 6.5 | 0 | 0 | 3.2 | | |
| | C/E | 1.485 | 0 | 0.114 | 0 | 0.114 | 0 | 0 | 0.057 | 1.771 | |
| 3 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 4 | N | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 4 | 20 | 15.5 |
| | % | 70.0 | 10.0 | 0 | 0 | 0 | 0 | 0 | 20.0 | | |
| | C/E | 0.903 | 0.129 | 0 | 0 | 0 | 0 | 0 | 0.258 | 1.290 | |
| 5 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 40 | 2 | 2 | 0 | 2 | 0 | 0 | 5 | 51 | 33.0 |
| | % | 78.4 | 3.9 | 3.9 | 0 | 3.9 | 0 | 0 | 9.8 | | |
| | C/E | 1.212 | 0.060 | 0.060 | 0 | 0.060 | 0 | 0 | 0.151 | 1.545 | |
| % Occurrence | | 100.0 | 50.0 | 50.0 | 0.0 | 50.0 | 0.0 | 0.0 | 100.0 | | |

Table 119. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 8 to 10 August 1977.

| Site | Species Captured | | | | | | | | | Total | Hours of Set |
|-----------------|------------------|-------|-------|-----|-------|-------|-------|-------|-------|-------|--------------|
| | GO | WA | NP | LW | LS | WS | BU | FC | | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 16 | 3 | 0 | 1 | 0 | 0 | 0 | 2 | 22 | 15.5 |
| | % | 72.7 | 13.6 | 0 | 4.5 | 0 | 0 | 0 | 9.0 | | |
| | C/E | 1.032 | 0.193 | 0 | 0.064 | 0 | 0 | 0 | 0.129 | 1.419 | |
| 3 | N | 6 | 7 | 0 | 0 | 0 | 0 | 0 | 2 | 15 | 14.0 |
| | % | 40.0 | 46.7 | 0 | 0 | 0 | 0 | 0 | 13.3 | | |
| | C/E | 0.428 | 0.500 | 0 | 0 | 0 | 0 | 0 | 0.142 | 1.071 | |
| 4 | N | 17 | 2 | 0 | 0 | 0 | 0 | 1 | 3 | 23 | 17.5 |
| | % | 73.9 | 8.7 | 0 | 0 | 0 | 0 | 4.3 | 13.0 | | |
| | C/E | 0.971 | 0.114 | 0 | 0 | 0 | 0 | 0.057 | 0.171 | 1.314 | |
| 5 | N | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 3 | 18.0 |
| | % | 0 | 0 | 0 | 33.3 | 33.3 | 33.3 | 0 | 0 | | |
| | C/E | 0 | 0 | 0 | 0.055 | 0.055 | 0.055 | 0 | 0 | 0.166 | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 39 | 12 | 0 | 2 | 1 | 1 | 1 | 7 | 65 | 65.0 |
| | % | 60.0 | 18.5 | 0 | 3.1 | 1.5 | 1.5 | 1.5 | 10.8 | | |
| | C/E | 0.600 | 0.184 | 0 | 0.030 | 0.015 | 0.015 | 0.015 | 0.107 | 1.000 | |
| % Occurrence | | 75.0 | 75.0 | 0.0 | 50.0 | 25.0 | 25.0 | 25.0 | 75.0 | | |

Table 120. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 23 to 24 August 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-------|-------|-----|-----|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | | |
| 2 | N | 11 | 1 | 2 | 3 | 0 | 0 | 0 | 2 | 19 | 18.0 |
| | % | 57.9 | 5.2 | 10.5 | 15.8 | 0 | 0 | 0 | 10.5 | | |
| | C/E | 0.611 | 0.055 | 0.111 | 0.166 | 0 | 0 | 0 | 0.111 | 1.055 | |
| 3 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | | |
| 4 | N | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 15.5 |
| | % | 0 | 0 | 0 | 50.0 | 0 | 0 | 0 | 50.0 | | |
| | C/E | 0 | 0 | 0 | 0.064 | 0 | 0 | 0 | 0.064 | 0.129 | |
| 5 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | | |
| Com- bined | N | 11 | 1 | 2 | 4 | 0 | 0 | 0 | 3 | 21 | 33.5 |
| | % | 52.4 | 4.7 | 9.5 | 19.0 | 0 | 0 | 0 | 9.5 | | |
| | C/E | 0.328 | 0.029 | 0.059 | 0.119 | 0 | 0 | 0 | 0.089 | 0.626 | |
| % Occurrence | | 50.0 | 50.0 | 50.0 | 100.0 | 0.0 | 0.0 | 0.0 | 100.0 | | |

Table 121. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 5 to 7 September 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-------|-------|-------|-----|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 16 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 24 | 15.0 |
| | % | 66.7 | 16.7 | 8.3 | 8.3 | 0 | 0 | 0 | 0 | - | |
| | C/E | 1.066 | 0.266 | 0.133 | 0.133 | 0 | 0 | 0 | 0 | 1.600 | |
| 3 | N | 0 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 4 | 14.5 |
| | % | 0 | 25.0 | 0 | 50.0 | 25.0 | 0 | 0 | 0 | - | |
| | C/E | 0 | 0.068 | 0 | 0.137 | 0.068 | 0 | 0 | 0 | 0.275 | |
| 4 | N | 1 | 1 | 0 | 4 | 2 | 0 | 0 | 2 | 11 | 17.0 |
| | % | 9.0 | 9.0 | 0 | 45.5 | 18.2 | 0 | 0 | 18.2 | - | |
| | C/E | 0.058 | 0.058 | 0 | 0.294 | 0.117 | 0 | 0 | 0.117 | 0.647 | |
| 5 | N | 25 | 4 | 1 | 5 | 1 | 0 | 0 | 1 | 37 | 17.5 |
| | % | 67.5 | 10.8 | 2.7 | 13.5 | 2.7 | 0 | 0 | 2.7 | - | |
| | C/E | 1.428 | 0.228 | 0.057 | 0.285 | 0.057 | 0 | 0 | 0.057 | 2.114 | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 42 | 10 | 3 | 14 | 4 | 0 | 0 | 3 | 76 | 64.0 |
| | % | 55.3 | 13.1 | 3.9 | 18.4 | 5.3 | 0 | 0 | 3.9 | - | |
| | C/E | 0.656 | 0.156 | 0.046 | 0.218 | 0.062 | 0 | 0 | 0.046 | 1.187 | |
| % Occurrence | | 75.0 | 100.0 | 50.0 | 100.0 | 75.0 | 0.0 | 0.0 | 50.0 | | |

Table 122. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 20 to 22 September 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|---------------|-----|------------------|-------|-------|-------|-------|-----|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 2 | N | 10 | 8 | 2 | 9 | 0 | 0 | 0 | 1 | 30 | 16.5 |
| | % | 33.3 | 26.7 | 6.7 | 30.0 | 0 | 0 | 0 | 3.3 | | |
| | C/E | 0.606 | 0.484 | 0.121 | 0.545 | 0 | 0 | 0 | 0.060 | 1.818 | |
| 3 | N | 6 | 3 | 3 | 1 | 0 | 0 | 0 | 1 | 14 | 16.5 |
| | % | 42.8 | 21.4 | 21.4 | 7.2 | 0 | 0 | 0 | 7.2 | | |
| | C/E | 0.363 | 0.181 | 0.181 | 0.060 | 0 | 0 | 0 | 0.060 | 0.848 | |
| 4 | N | 6 | 8 | 0 | 8 | 2 | 0 | 0 | 0 | 24 | 18.0 |
| | % | 25.0 | 33.3 | 0 | 33.3 | 8.3 | 0 | 0 | 0 | | |
| | C/E | 0.333 | 0.444 | 0 | 0.444 | 0.111 | 0 | 0 | 0 | 1.333 | |
| 5 | N | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 17.5 |
| | % | 75.0 | 0 | 0 | 0 | 25.0 | 0 | 0 | 0 | | |
| | C/E | 0.171 | 0 | 0 | 0 | 0.057 | 0 | 0 | 0 | 0.228 | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | - | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 25 | 19 | 5 | 18 | 3 | 0 | 0 | 2 | 72 | 68.5 |
| | % | 34.7 | 26.4 | 6.9 | 25.0 | 4.2 | 0 | 0 | 2.8 | | |
| | C/E | 0.364 | 0.277 | 0.072 | 0.262 | 0.043 | 0 | 0 | 0.029 | 1.051 | |
| % Occurrence | | 100.0 | 75.0 | 50.0 | 75.0 | 50.0 | 0.0 | 0.0 | 50.0 | | |

Table 123. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 4 to 5 October 1977.

| Site | Species Captured | | | | | | | | | Total | Hours of Set |
|-----------------|------------------|-------|-------|-------|-------|-------|-----|-------|-------|-------|--------------|
| | GO | WA | NP | LW | LS | WS | BU | FC | | | |
| 1 | N | 8 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 12 | 17.0 |
| | % | 66.7 | 16.7 | 8.3 | 8.3 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.470 | 0.117 | 0.058 | 0.058 | 0 | 0 | 0 | 0 | 0.705 | |
| 2 | N | 0 | 1 | 4 | 13 | 2 | 0 | 0 | 0 | 20 | 17.5 |
| | % | 0 | 5.0 | 20.0 | 65.0 | 10.0 | 0 | 0 | 0 | | |
| | C/E | 0 | 0.057 | 0.228 | 0.742 | 0.114 | 0 | 0 | 0 | 1.142 | |
| 3 | N | 2 | 5 | 1 | 6 | 2 | 0 | 0 | 1 | 17 | 17.5 |
| | % | 11.7 | 29.4 | 5.9 | 35.2 | 11.7 | 0 | 0 | 35.2 | | |
| | C/E | 0.114 | 0.285 | 0.057 | 0.342 | 0.114 | 0 | 0 | 0.057 | 0.971 | |
| 4 | N | 1 | 0 | 0 | 4 | 4 | 0 | 1 | 0 | 10 | 17.5 |
| | % | 10.0 | 0 | 0 | 40.0 | 40.0 | 0 | 10.0 | 0 | | |
| | C/E | 0.057 | 0 | 0 | 0.228 | 0.228 | 0 | 0.057 | 0 | 0.571 | |
| 5 | N | 2 | 4 | 2 | 12 | 1 | 0 | 0 | 0 | 21 | 16.0 |
| | % | 9.5 | 19.0 | 9.5 | 57.1 | 4.8 | 0 | 0 | 0 | | |
| | C/E | 0.125 | 0.250 | 0.125 | 0.750 | 0.062 | 0 | 0 | 0 | 1.312 | |
| 6 | N | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 17.0 |
| | % | 50.0 | 0 | 0 | 0 | 0 | 0 | 25.0 | 25.0 | | |
| | C/E | 0.117 | 0 | 0 | 0 | 0 | 0 | 0.058 | 0.058 | 0.235 | |
| Com- bined | N | 15 | 12 | 8 | 36 | 9 | 0 | 2 | 2 | 84 | 102.5 |
| | % | 17.8 | 14.3 | 9.5 | 42.8 | 10.7 | 0 | 2.4 | 2.4 | | |
| | C/E | 0.146 | 0.117 | 0.078 | 0.351 | 0.087 | 0 | 0.020 | 0.020 | 0.819 | |
| % Occurrence | | 83.3 | 66.7 | 66.7 | 83.3 | 66.7 | 0.0 | 33.3 | 33.3 | | |

Table 124. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 17 to 18 October 1977.

| Site | Species Captured | | | | | | | | | Total | Hours of Set |
|-----------------|------------------|-------|-------|-------|-------|-------|-------|-----|-----|-------|--------------|
| | GO | WA | NP | LW | LS | WS | BU | FC | | | |
| 1 | N | 1 | 2 | 2 | 12 | 1 | 1 | 0 | 0 | 19 | 17.0 |
| | % | 5.3 | 10.5 | 10.5 | 63.1 | 5.3 | 5.3 | 0 | 0 | | |
| | C/E | 0.058 | 0.117 | 0.117 | 0.705 | 0.058 | 0.058 | 0 | 0 | | |
| 2 | N | 13 | 2 | 4 | 9 | 0 | 0 | 0 | 0 | 28 | 17.5 |
| | % | 46.4 | 7.1 | 14.3 | 32.1 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.742 | 0.114 | 0.228 | 0.514 | 0 | 0 | 0 | 0 | | |
| 3 | N | 1 | 5 | 0 | 3 | 3 | 1 | 0 | 0 | 13 | 18.0 |
| | % | 7.7 | 38.5 | 0 | 23.1 | 23.1 | 7.7 | 0 | 0 | | |
| | C/E | 0.055 | 0.277 | 0 | 0.166 | 0.166 | 0.055 | 0 | 0 | | |
| 4 | N | 1 | 2 | 4 | 9 | 2 | 0 | 0 | 0 | 18 | 18.0 |
| | % | 5.5 | 11.1 | 22.2 | 50.0 | 11.1 | 0 | 0 | 0 | | |
| | C/E | 0.055 | 0.111 | 0.222 | 0.500 | 0.111 | 0 | 0 | 0 | | |
| 5 | N | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 3 | 18.0 |
| | % | 0 | 0 | 0 | 66.7 | 33.3 | 0 | 0 | 0 | | |
| | C/E | 0 | 0 | 0 | 0.111 | 0.055 | 0 | 0 | 0 | | |
| 6 | N | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 18.0 |
| | % | 0 | 0 | 0 | 0 | 100.0 | 0 | 0 | 0 | | |
| | C/E | 0 | 0 | 0 | 0 | 0.055 | 0 | 0 | 0 | | |
| Com- bined | N | 16 | 11 | 10 | 35 | 8 | 2 | 0 | 0 | 82 | 106.5 |
| | % | 19.5 | 13.4 | 12.2 | 42.7 | 9.7 | 2.4 | 0 | 0 | | |
| | C/E | 0.150 | 0.103 | 0.093 | 0.328 | 0.075 | 0.018 | 0 | 0 | | |
| % Occurrence | | 66.7 | 66.7 | 50.0 | 83.3 | 83.3 | 33.3 | 0.0 | 0.0 | | |

Table 125. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, 1 to 2 November 1977.

| Site | | Species Captured | | | | | | | | Total | Hours of Set |
|---------------|-----|------------------|-------|-------|-------|-------|-----|-----|-----|-------|--------------|
| | | GO | WA | NP | LW | LS | WS | BU | FC | | |
| 1 | N | 0 | 4 | 3 | 11 | 0 | 0 | 0 | 0 | 18 | 18.0 |
| | % | 0 | 22.2 | 16.7 | 61.1 | 0 | 0 | 0 | 0 | | |
| | C/E | 0 | 0.222 | 0.166 | 0.611 | 0 | 0 | 0 | 0 | 1.000 | |
| 2 | N | 7 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 11 | 18.0 |
| | % | 63.6 | 18.2 | 9.1 | 9.1 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.388 | 0.111 | 0.055 | 0.055 | 0 | 0 | 0 | 0 | 0.611 | |
| 3 | N | 1 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 5 | 18.0 |
| | % | 20.0 | 0 | 0 | 20.0 | 60.0 | 0 | 0 | 0 | | |
| | C/E | 0.055 | 0 | 0 | 0.055 | 0.166 | 0 | 0 | 0 | 0.277 | |
| 4 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 5 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| 6 | N | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | - | - | |
| Com- bined | N | 8 | 6 | 4 | 13 | 3 | 0 | 0 | 0 | 34 | 54.0 |
| | % | 23.5 | 17.6 | 11.8 | 38.2 | 8.8 | 0 | 0 | 0 | | |
| | C/E | 0.148 | 0.111 | 0.074 | 0.240 | 0.055 | 0 | 0 | 0 | 0.629 | |
| % Occurrence | | 66.7 | 66.7 | 66.7 | 100.0 | 33.3 | 0.0 | 0.0 | 0.0 | | |

Table 126. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Mildred Lake study area, all dates combined, 1977.

| Site | Species Captured | | | | | | | | | | | | Total | Hours of Set |
|-----------------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------------|
| | GO | WA | NP | LW | MW | AG | DV | LS | WS | BU | FC | | | |
| 1 | N | 15 | 9 | 6 | 24 | 0 | 0 | 0 | 4 | 1 | 0 | 9 | 68 | 70.0 |
| | % | 22.0 | 13.2 | 8.8 | 35.3 | 0 | 0 | 0 | 5.9 | 1.7 | 0 | 13.2 | | |
| | C/E | 0.214 | 0.128 | 0.085 | 0.342 | 0 | 0 | 0 | 0.057 | 0.014 | 0 | 0.128 | | |
| 2 | N | 175 | 40 | 26 | 42 | 0 | 0 | 1 | 27 | 1 | 0 | 25 | 337 | 220.0 |
| | % | 51.9 | 11.8 | 7.7 | 12.5 | 0 | 0 | 0.3 | 8.0 | 0.3 | 0 | 7.4 | | |
| | C/E | 0.795 | 0.181 | 0.118 | 0.190 | 0 | 0 | 0.034 | 0.122 | 0.004 | 0 | 0.113 | | |
| 3 | N | 75 | 39 | 6 | 21 | 0 | 0 | 0 | 14 | 2 | 1 | 8 | 166 | 145.5 |
| | % | 45.2 | 23.5 | 3.6 | 12.6 | 0 | 0 | 0 | 8.4 | 1.2 | 0.6 | 4.8 | | |
| | C/E | 0.515 | 0.268 | 0.041 | 0.144 | 0 | 0 | 0 | 0.096 | 0.013 | 0.006 | 0.054 | | |
| 4 | N | 115 | 34 | 8 | 27 | 0 | 1 | 0 | 17 | 0 | 2 | 36 | 240 | 189.0 |
| | % | 47.9 | 14.2 | 3.3 | 11.2 | 0 | 0.4 | 0 | 7.0 | 0 | 0.8 | 15.0 | | |
| | C/E | 0.608 | 0.179 | 0.042 | 0.142 | 0 | 0.005 | 0 | 0.089 | 0 | 0.010 | 0.190 | | |
| 5 | N | 87 | 13 | 9 | 20 | 1 | 0 | 0 | 7 | 2 | 0 | 13 | 152 | 140.0 |
| | % | 57.2 | 8.5 | 5.9 | 13.1 | 0.6 | 0 | 0 | 4.6 | 1.3 | 0 | 8.5 | | |
| | C/E | 0.621 | 0.092 | 0.064 | 0.142 | 0.007 | 0 | 0 | 0.050 | 0.014 | 0 | 0.092 | | |
| 6 | N | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 6 | 0 | 1 | 3 | 19 | 53.5 |
| | % | 42.1 | 0 | 5.3 | 0 | 0 | 0 | 0 | 31.6 | 0 | 5.3 | 15.7 | | |
| | C/E | 0.149 | 0 | 0.018 | 0 | 0 | 0 | 0 | 0.112 | 0 | 0.018 | 0.056 | | |
| Com- bined | N | 475 | 135 | 56 | 134 | 1 | 1 | 1 | 75 | 6 | 4 | 94 | 982 | 818.0 |
| | % | 48.4 | 13.7 | 5.7 | 13.6 | 0.1 | 0.1 | 0.1 | 7.6 | 0.6 | 0.4 | 9.6 | | |
| | C/E | 0.580 | 0.165 | 0.068 | 0.163 | 0.001 | 0.001 | 0.001 | 0.091 | 0.007 | 0.004 | 0.114 | | |
| % Occurrence | | 83.3 | 75.0 | 52.1 | 54.2 | 2.1 | 2.1 | 2.1 | 64.6 | 12.5 | 8.3 | 58.3 | | |

Table 127. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 1 to 6 June 1977.

| Site | Species Captured | | | | | | | Total | Hours of Set |
|----------------|------------------|-------|-------|-------|-----|-------|-------|-------|--------------|
| | GO | WA | NP | LW | LS | FC | | | |
| ✓ 51 | N | 2 | 1 | 0 | 0 | 0 | 1 | 4 | 16.5 |
| | % | 50.0 | 25.0 | 0 | 0 | 0 | 25.0 | | |
| | C/E | 0.121 | 0.060 | 0 | 0 | 0 | 0.060 | 0.242 | |
| ✓ km 222.4L | N | 2 | 4 | 1 | 0 | 1 | 0 | 8 | 16.0 |
| | % | 25.0 | 50.0 | 12.5 | 0 | 12.5 | 0 | | |
| | C/E | 0.125 | 0.250 | 0.062 | 0 | 0.062 | 0 | 0.500 | |
| ✓ 52 | N | 1 | 3 | 0 | 0 | 3 | 0 | 7 | 16.5 |
| | % | 14.3 | 42.8 | 0 | 0 | 42.8 | 0 | | |
| | C/E | 0.060 | 0.181 | 0 | 0 | 0.181 | 0 | 0.424 | |
| ✓ 54 | N | 0 | 5 | 0 | 0 | 2 | 1 | 8 | 18.0 |
| | % | 0 | 62.5 | 0 | 0 | 25.0 | 12.5 | | |
| | C/E | 0 | 0.277 | 0 | 0 | 0.111 | 0.055 | 0.444 | |
| ✓ 56 | N | 0 | 3 | 0 | 0 | 0 | 1 | 4 | 19.5 |
| | % | 0 | 75.0 | 0 | 0 | 0 | 25.0 | | |
| | C/E | 0 | 0.153 | 0 | 0 | 0 | 0.051 | 0.205 | |
| ✓ km 261.1R | N | 1 | 1 | 0 | 0 | 3 | 0 | 5 | 20.0 |
| | % | 20.0 | 20.0 | 0 | 0 | 60.0 | 0 | | |
| | C/E | 0.050 | 0.050 | 0 | 0 | 0.150 | 0 | 0.250 | |
| Com- bined | N | 6 | 17 | 1 | 0 | 9 | 3 | 36 | 106.5 |
| | % | 16.6 | 47.2 | 2.8 | 0 | 25.0 | 8.3 | | |
| | C/E | 0.056 | 0.159 | 0.009 | 0 | 0.084 | 0.028 | 0.338 | |
| % Occurrence | | 66.7 | 100.0 | 16.7 | 0.0 | 66.7 | 50.0 | | |

Table 128. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 15 to 16 June 1977.

| Site | | Species Captured | | | | | | Total | Hours of Set |
|---------------|-----|------------------|-------|-------|-------|-------|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | FC | | |
| 55 | N | 7 | 3 | 0 | 0 | 0 | 0 | 10 | 18.0 |
| | % | 70.0 | 30.0 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.388 | 0.166 | 0 | 0 | 0 | 0 | 0.555 | |
| 51 | N | 12 | 1 | 0 | 0 | 1 | 2 | 16 | 17.5 |
| | % | 75.0 | 6.2 | 0 | 0 | 6.2 | 12.5 | | |
| | C/E | 0.685 | 0.057 | 0 | 0 | 0.057 | 0.114 | 0.914 | |
| 52 | N | 11 | 2 | 7 | 0 | 0 | 0 | 20 | 17.0 |
| | % | 55.0 | 10.0 | 35.0 | 0 | 0 | 0 | | |
| | C/E | 0.647 | 0.117 | 0.411 | 0 | 0 | 0 | 1.176 | |
| 53 | N | 0 | 1 | 0 | 0 | 0 | 2 | 3 | 17.5 |
| | % | 0 | 33.3 | 0 | 0 | 0 | 66.7 | | |
| | C/E | 0 | 0.057 | 0 | 0 | 0 | 0.114 | 0.171 | |
| 54 | N | 12 | 1 | 4 | 0 | 0 | 0 | 17 | 19.0 |
| | % | 70.6 | 5.9 | 23.5 | 0 | 0 | 0 | | |
| | C/E | 0.631 | 0.052 | 0.210 | 0 | 0 | 0 | 0.894 | |
| 56 | N | 6 | 6 | 2 | 1 | 0 | 0 | 15 | 18.0 |
| | % | 40.0 | 40.0 | 13.3 | 6.6 | 0 | 0 | | |
| | C/E | 0.333 | 0.333 | 0.111 | 0.055 | 0 | 0 | 0.833 | |
| Com- bined | N | 48 | 14 | 13 | 1 | 1 | 4 | 81 | 107.0 |
| | % | 59.2 | 17.3 | 16.0 | 1.2 | 1.2 | 4.9 | | |
| | C/E | 0.448 | 0.130 | 0.121 | 0.009 | 0.009 | 0.037 | 0.757 | |
| % Occurrence | | 83.3 | 100.0 | 50.0 | 16.7 | 16.7 | 33.3 | | |

Table 129. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 27 to 29 June 1977.

| Site | Species Captured | | | | | | Total | Hours of Set | |
|-----------------|------------------|-------|-------|-------|-------|-------|-------|--------------|-------|
| | GO | WA | NP | LW | LS | FC | | | |
| 51 | N | 17 | 1 | 0 | 0 | 0 | 1 | 19 | 18.0 |
| | % | 89.5 | 5.3 | 0 | 0 | 0 | 5.3 | | |
| | C/E | 0.944 | 0.055 | 0 | 0 | 0 | 0.055 | | |
| 52 | N | 5 | 1 | 0 | 0 | 1 | 1 | 8 | 18.0 |
| | % | 62.5 | 12.5 | 0 | 0 | 12.5 | 12.5 | | |
| | C/E | 0.277 | 0.055 | 0 | 0 | 0.055 | 0.055 | | |
| 53 | N | ND | ND | ND | ND | ND | ND | ND | 17.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | | |
| 54 | N | 3 | 2 | 4 | 1 | 0 | 0 | 10 | 18.5 |
| | % | 30.0 | 20.0 | 40.0 | 10.0 | 0 | 0 | | |
| | C/E | 0.162 | 0.108 | 0.216 | 0.054 | 0 | 0 | | |
| 55 | N | 2 | 1 | 1 | 0 | 0 | 0 | 4 | 18.5 |
| | % | 50.0 | 25.0 | 25.0 | 0 | 0 | 0 | | |
| | C/E | 0.108 | 0.054 | 0.054 | 0 | 0 | 0 | | |
| km 255.5R | N | 4 | 0 | 10 | 1 | 0 | 0 | 15 | 18.0 |
| | % | 26.7 | 0 | 66.6 | 6.6 | 0 | 0 | | |
| | C/E | 0.222 | 0 | 0.555 | 0.055 | 0 | 0 | | |
| Com- bined | N | 31 | 5 | 15 | 2 | 1 | 2 | 56 | 108.0 |
| | % | 55.3 | 8.9 | 26.8 | 3.6 | 1.8 | 3.6 | | |
| | C/E | 0.287 | 0.046 | 0.138 | 0.018 | 0.009 | 0.018 | | |
| % Occurrence | | 83.3 | 66.7 | 50.0 | 33.3 | 16.7 | 33.3 | | |

Table 130. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 11 to 13 July 1977.

| Site | | Species Captured | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-------|-------|-------|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | FC | | |
| 51 | N | 5 | 1 | 0 | 0 | 0 | 1 | 7 | 17.0 |
| | % | 71.4 | 14.3 | 0 | 0 | 0 | 14.3 | | |
| | C/E | 0.294 | 0.058 | 0 | 0 | 0 | 0.058 | | |
| 52 | N | 4 | 1 | 2 | 0 | 0 | 0 | 7 | 17.0 |
| | % | 57.1 | 14.3 | 28.6 | 0 | 0 | 0 | | |
| | C/E | 0.235 | 0.058 | 0.117 | 0 | 0 | 0 | | |
| 54 | N | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 17.5 |
| | % | 100.0 | 0 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.057 | 0 | 0 | 0 | 0 | 0 | | |
| 56 | N | 6 | 3 | 7 | 6 | 1 | 0 | 23 | 17.5 |
| | % | 26.1 | 13.0 | 30.4 | 26.1 | 4.3 | 0 | | |
| | C/E | 0.342 | 0.171 | 0.400 | 0.342 | 0.057 | 0 | | |
| 53 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | | |
| 55 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | | |
| Com- bined | N | 16 | 5 | 9 | 6 | 1 | 1 | 38 | 69.0 |
| | % | 42.1 | 13.1 | 23.7 | 15.8 | 2.6 | 2.6 | | |
| | C/E | 0.231 | 0.072 | 0.130 | 0.086 | 0.014 | 0.014 | | |
| % Occurrence | | 100.0 | 75.0 | 50.0 | 25.0 | 25.0 | 25.0 | | |

Table 131. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 25 to 27 July 1977.

| Site | | Species Captured | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-------|-------|-----|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | FC | | |
| 51 | N | 10 | 1 | 0 | 0 | 0 | 1 | 12 | 17.0 |
| | % | 83.3 | 8.3 | 0 | 0 | 0 | 8.3 | | |
| | C/E | 0.588 | 0.058 | 0 | 0 | 0 | 0.058 | | |
| 52 | N | 4 | 2 | 4 | 0 | 0 | 0 | 10 | 17.0 |
| | % | 40.0 | 20.0 | 40.0 | 0 | 0 | 0 | | |
| | C/E | 0.235 | 0.117 | 0.235 | 0 | 0 | 0 | | |
| 54 | N | 4 | 2 | 0 | 0 | 0 | 0 | 6 | 17.0 |
| | % | 66.6 | 33.3 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.235 | 0.117 | 0 | 0 | 0 | 0 | | |
| 56 | N | 0 | 8 | 0 | 6 | 0 | 0 | 14 | 17.0 |
| | % | 0 | 57.1 | 0 | 42.8 | 0 | 0 | | |
| | C/E | 0 | 0.470 | 0 | 0.352 | 0 | 0 | | |
| 53 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | | |
| 55 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | | |
| Com- bined | N | 18 | 13 | 4 | 6 | 0 | 1 | 42 | 68.0 |
| | % | 42.8 | 30.9 | 9.5 | 14.3 | 0 | 2.4 | | |
| | C/E | 0.264 | 0.191 | 0.058 | 0.088 | 0 | 0.014 | | |
| % Occurrence | | 75.0 | 100.0 | 25.0 | 25.0 | 0.0 | 25.0 | | |

Table 132. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 8 to 9 August 1977.

| Site | | Species Captured | | | | | | Total | Hours of Set |
|---------------|-----|------------------|-------|-------|-------|-------|-------|-------|--------------|
| | | GO | WA | NP | LW | LS | FC | | |
| 51 | N | 9 | 0 | 0 | 0 | 0 | 1 | 10 | 17.0 |
| | % | 90.0 | 0 | 0 | 0 | 0 | 10.0 | | |
| | C/E | 0.529 | 0 | 0 | 0 | 0 | 0.058 | 0.588 | |
| 52 | N | 6 | 1 | 1 | 0 | 0 | 0 | 8 | 17.0 |
| | % | 75.0 | 12.5 | 12.5 | 0 | 0 | 0 | | |
| | C/E | 0.352 | 0.058 | 0.058 | 0 | 0 | 0 | 0.470 | |
| 54 | N | 0 | 2 | 3 | 0 | 0 | 0 | 5 | 16.0 |
| | % | 0 | 40.0 | 60.0 | 0 | 0 | 0 | | |
| | C/E | 0 | 0.125 | 0.187 | 0 | 0 | 0 | 0.312 | |
| 56 | N | 3 | 1 | 10 | 2 | 1 | 0 | 17 | 17.0 |
| | % | 17.6 | 5.9 | 58.8 | 11.8 | 5.9 | 0 | | |
| | C/E | 0.176 | 0.058 | 0.588 | 0.117 | 0.058 | 0 | 1.000 | |
| 53 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| 55 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| Com- bined | N | 18 | 4 | 14 | 2 | 1 | 1 | 40 | 67.0 |
| | % | 45.0 | 10.0 | 35.0 | 5.0 | 2.5 | 2.5 | | |
| | C/E | 0.268 | 0.059 | 0.208 | 0.029 | 0.014 | 0.014 | 0.597 | |
| % Occurrence | | 75.0 | 75.0 | 75.0 | 25.0 | 25.0 | 25.0 | | |

Table 133. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 22 to 24 August 1977.

| Site | | Species Captured | | | | | | Total | Hours per Set |
|-----------------|-----|------------------|-------|-------|-------|-----|-------|-------|---------------|
| | | GO | WA | NP | LW | LS | FC | | |
| 54 | N | 2 | 3 | 1 | 5 | 0 | 1 | 12 | 18.0 |
| | % | 16.6 | 25.0 | 8.3 | 41.7 | 0 | 8.3 | | |
| | C/E | 0.111 | 0.166 | 0.055 | 0.277 | 0 | 0.055 | 0.666 | |
| 56 | N | 6 | 4 | 5 | 8 | 0 | 0 | 23 | 18.0 |
| | % | 26.1 | 17.4 | 21.7 | 34.8 | 0 | 0 | | |
| | C/E | 0.333 | 0.222 | 0.277 | 0.444 | 0 | 0 | 1.277 | |
| 51 | N | 9 | 3 | 0 | 0 | 0 | 0 | 12 | 16.0 |
| | % | 75.0 | 25.0 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.562 | 0.187 | 0 | 0 | 0 | 0 | 0.750 | |
| 52 | N | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 16.5 |
| | % | 100.0 | 0 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.303 | 0 | 0 | 0 | 0 | 0 | 0.303 | |
| 53 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| 54 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| Com- bined | N | 22 | 10 | 6 | 13 | 0 | 1 | 52 | 68.5 |
| | % | 42.3 | 19.2 | 11.5 | 25.0 | 0 | 1.9 | | |
| | C/E | 0.321 | 0.145 | 0.087 | 0.189 | 0 | 0.014 | 0.759 | |
| % Occurrence | | 100.0 | 75.0 | 50.0 | 50.0 | 0.0 | 25.0 | | |

Table 134. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 6 to 7 September 1977.

| Site | | Species Captured | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-------|-------|-------|-----|-------|--------------|
| | | GO | WA | NP | LW | LS | FC | | |
| 51 | N | 6 | 0 | 1 | 0 | 1 | 0 | 8 | 16.5 |
| | % | 75.0 | 0 | 12.5 | 0 | 12.5 | 0 | | |
| | C/E | 0.363 | 0 | 0.060 | 0 | 0.060 | 0 | | |
| 52 | N | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 16.0 |
| | % | 100.0 | 0 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.312 | 0 | 0 | 0 | 0 | 0 | | |
| 54 | N | 0 | 1 | 1 | 12 | 0 | 0 | 14 | 16.5 |
| | % | 0 | 7.1 | 7.1 | 85.7 | 0 | 0 | | |
| | C/E | 0 | 0.060 | 0.060 | 0.727 | 0 | 0 | | |
| 56 | N | 4 | 7 | 2 | 9 | 2 | 0 | 24 | 17.5 |
| | % | 16.7 | 29.2 | 8.3 | 37.5 | 8.3 | 0 | | |
| | C/E | 0.228 | 0.400 | 0.114 | 0.514 | 0.114 | 0 | | |
| 53 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | | |
| 55 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | | |
| Com- bined | N | 15 | 8 | 4 | 21 | 3 | 0 | 51 | 66.5 |
| | % | 29.4 | 15.7 | 7.8 | 41.2 | 5.9 | 0 | | |
| | C/E | 0.225 | 0.120 | 0.060 | 0.315 | 0.045 | 0 | | |
| % Occurrence | | 75.0 | 50.0 | 75.0 | 50.0 | 50.0 | 0.0 | | |

Table 135. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 19 to 21 September 1977.

| Site | | Species Captured | | | | | | Total | Hours per Set |
|-----------------|-----|------------------|-------|-------|-------|-------|-----|-------|---------------|
| | | GO | WA | NP | LW | LS | FC | | |
| ✓ 51 | N | 2 | 1 | 0 | 1 | 3 | 0 | 7 | 15.0 |
| | % | 28.6 | 14.3 | 0 | 14.3 | 42.8 | 0 | | |
| | C/E | 0.133 | 0.066 | 0 | 0.066 | 0.200 | 0 | 0.466 | |
| ✓ 52 | N | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 15.5 |
| | % | 50.0 | 50.0 | 0 | 0 | 0 | 0 | | |
| | C/E | 0.064 | 0.064 | 0 | 0 | 0 | 0 | 0.129 | |
| ✓ 54 | N | 1 | 3 | 0 | 6 | 0 | 0 | 10 | 16.5 |
| | % | 10.0 | 30.0 | 0 | 60.0 | 0 | 0 | | |
| | C/E | 0.060 | 0.181 | 0 | 0.363 | 0 | 0 | 0.606 | |
| ✓ 56 | N | 3 | 32 | 1 | 9 | 1 | 0 | 46 | 17.0 |
| | % | 6.5 | 69.5 | 2.2 | 19.6 | 2.2 | 0 | | |
| | C/E | 0.176 | 1.882 | 0.058 | 0.529 | 0.058 | 0 | 2.705 | |
| 53 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| 55 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| Com- bined | N | 7 | 37 | 1 | 16 | 4 | 0 | 65 | 64.0 |
| | % | 10.8 | 56.9 | 1.5 | 24.6 | 6.1 | 0 | | |
| | C/E | 0.109 | 0.578 | 0.015 | 0.250 | 0.062 | 0 | 1.015 | |
| % Occurrence | | 100.0 | 100.0 | 25.0 | 75.0 | 50.0 | 0.0 | | |

Table 136. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, 3 to 7 October 1977.

| Site | | Species Captured | | | | | | Total | Hours of Set |
|-----------------|-----|------------------|-------|-----|-------|-------|-----|-------|--------------|
| | | GO | WA | NP | LW | LS | FC | | |
| ✓ 51 | N | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 16.0 |
| | % | 50.0 | 0 | 0 | 0 | 50.0 | 0 | | |
| | C/E | 0.062 | 0 | 0 | 0 | 0.062 | 0 | 0.125 | |
| ✓ 52 | N | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 16.0 |
| | % | 0 | 0 | 0 | 0 | 100.0 | 0 | | |
| | C/E | 0 | 0 | 0 | 0 | 0.062 | 0 | 0.062 | |
| ✓ 53 | N | 1 | 0 | 0 | 6 | 5 | 0 | 12 | 18.5 |
| | % | 8.3 | 0 | 0 | 50.0 | 41.7 | 0 | | |
| | C/E | 0.054 | 0 | 0 | 0.324 | 0.270 | 0 | 0.648 | |
| 54 | N | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 18.5 |
| | % | 0 | 50.0 | 0 | 50.0 | 0 | 0 | | |
| | C/E | 0 | 0.054 | 0 | 0.054 | 0 | 0 | 0.108 | |
| 55 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| 56 | N | ND | ND | ND | ND | ND | ND | ND | 0.0 |
| | % | - | - | - | - | - | - | | |
| | C/E | - | - | - | - | - | - | - | |
| Com- bined | N | 2 | 1 | 0 | 7 | 7 | 0 | 17 | 69.0 |
| | % | 11.8 | 5.9 | 0 | 41.2 | 41.2 | 0 | | |
| | C/E | 0.028 | 0.014 | 0 | 0.101 | 0.101 | 0 | 0.246 | |
| % Occurrence | | 50.0 | 25.0 | 0.0 | 50.0 | 75.0 | 0.0 | | |

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Table 137. Number (N), percentage (%), and catch-per-unit-effort (C/E) for fish captured in standard gangs at each sampling site in the Delta study area, Athabasca River, all dates combined, 1977.

| Site | Species Captured | | | | | | | Total | Hours of Set |
|-----------------|------------------|-------|-------|-------|-------|-------|-------|-------|--------------|
| | GO | WA | NP | LW | LS | FC | | | |
| 51 | N | 73 | 9 | 1 | 1 | 6 | 7 | 97 | 166.5 |
| | % | 75.2 | 9.3 | 1.0 | 1.0 | 6.2 | 7.2 | | |
| | C/E | 0.438 | 0.054 | 0.006 | 0.006 | 0.036 | 0.042 | | |
| 56 | N | 32 | 64 | 37 | 42 | 5 | 1 | 181 | 159.5 |
| | % | 17.7 | 35.3 | 20.4 | 23.2 | 2.8 | 0.5 | | |
| | C/E | 0.200 | 0.401 | 0.231 | 0.263 | 0.031 | 0.006 | | |
| 52 | N | 42 | 11 | 14 | 0 | 5 | 1 | 73 | 166.5 |
| | % | 57.5 | 15.1 | 19.2 | 0 | 6.8 | 1.4 | | |
| | C/E | 0.252 | 0.066 | 0.084 | 0 | 0.030 | 0.006 | | |
| 54 | N | 23 | 20 | 13 | 25 | 2 | 2 | 85 | 175.5 |
| | % | 27.0 | 23.5 | 15.3 | 29.4 | 2.3 | 2.3 | | |
| | C/E | 0.131 | 0.113 | 0.074 | 0.142 | 0.011 | 0.011 | | |
| OTHERS | N | 13 | 10 | 2 | 6 | 9 | 2 | 42 | 125.5 |
| | % | 30.9 | 23.8 | 4.8 | 14.3 | 21.4 | 4.8 | | |
| | C/E | 0.103 | 0.079 | 0.015 | 0.047 | 0.071 | 0.015 | | |
| Com- bined | N | 183 | 114 | 67 | 74 | 27 | 13 | 478 | 793.5 |
| | % | 38.3 | 23.8 | 14.0 | 15.5 | 5.6 | 2.7 | | |
| | C/E | 0.230 | 0.143 | 0.084 | 0.093 | 0.034 | 0.016 | | |
| % Occurrence | | 82.2 | 80.0 | 42.2 | 33.3 | 33.3 | 24.4 | | |

6.4 DATES OF TAGGING AND RECAPTURE, LOCATIONS OF RELEASE AND RECAPTURE, DISTANCE TRAVELLED, AND ELAPSED TIME BETWEEN RELEASE AND RECAPTURE FOR FISH TAGGED IN THE ATHABASCA RIVER IN 1976 AND 1977 AND RECAPTURED IN AND SINCE 1977 (TABLES 138 AND 139).

Table 138. Dates of tagging and recapture, locations of release and recapture, distances travelled, and elapsed time between release and recapture for fish tagged in the Mildred Lake study area in 1976 and 1977 and recaptured in and since 1977.

| Species | Tag Releases | | Tag Recaptures | | Elapsed Time (Days) | Distance Travelled ^a (km) |
|---------------|---------------|-------------------|-------------------------|----------------------------------|---------------------|--------------------------------------|
| | Date | Site ^b | Date | Site ^b | | |
| Walleye | 6 May 1976 | 42.1L | 31 May 1978 | km 6.0 Athabasca River | 755 | + 36 |
| | 6 May 1976 | 42.1L | 16 June 1977 | Old Fort Point ^c | 406 | -272 |
| | 6 May 1976 | 42.1L | 4 May 1977 | 40.0R | 363 | + 2 |
| | 9 May 1976 | 42.1L | 21 June 1977 | Big Point ^c | 408 | -264 |
| | 10 May 1976 | 42.1L | 12 June 1977 | Old Fort Point ^c | 397 | -272 |
| | 10 May 1976 | 42.1L | 21 June 1977 | Mouth Fletcher Ch. ^c | 406 | -256 |
| | 10 May 1976 | 38.2L | 21 June 1977 | Old Fort Point ^c | 407 | -275 |
| | 21 May 1976 | 40.0L | 1 June 1977 | 248.0 | 376 | -208 |
| | 15 June 1976 | 132.8L | 1 June 1977 | Big Point ^c | 351 | -172 |
| | 15 June 1976 | 132.8L | 15 June 1977 | Old Fort Point ^c | 365 | -180 |
| | 17 June 1976 | 60.0L | Nov. 1978 | Lake Athabasca | 880 | >-250 |
| | 20 July 1976 | 42.1L | 28 June 1977 | 37.1L | 343 | + 5 |
| | 13 Sept. 1976 | 11.2R | 12 May 1977 | Muskeg River Fence | 241 | - 45 |
| | 14 Sept. 1976 | 55.5R | 22 May 1977 | Muskeg River Fence | 250 | + 1 |
| | 1 Oct. 1976 | 27.4L | 10 May 1977 | Mouth Horse River | 222 | + 24 |
| | 24 Apr. 1977 | 59.5R | 27 May 1977 | 59.5L | 33 | Across River |
| | 24 Apr. 1977 | 59.5L | 11 May 1977 | 2 km up MacKay River | 17 | + 2 |
| | 25 Apr. 1977 | 59.5L | 11 May 1977 | 59.5L | 16 | 0 |
| | 25 Apr. 1977 | 59.5L | 26 Apr. 1977 | 59.5L | 1 | 0 |
| | 26 Apr. 1977 | 59.5L | 20 Oct. 1977 | Poplar Creek Bridge | 177 | + 33 |
| | 26 Apr. 1977 | 59.5L | 26 May 1977 | 6.4R | 30 | + 53 |
| | 26 Apr. 1977 | 59.5L | 14 Sept. 1977 | 102.6R | 141 | - 43 |
| | 26 Apr. 1977 | 59.5L | 14 May 1977 | 59.5L | 18 | 0 |
| | 26 Apr. 1977 | 59.5L | 14 May 1977 | 59.5L | 18 | 0 |
| | 26 Apr. 1977 | 59.5L | 29 Sept. 1977 | 50.6R | 156 | + 9 |
| | 26 Apr. 1977 | 40.0R | 28 Apr. 1977 | 39.8L | 2 | 0 |
| | 26 Apr. 1977 | 42.1L | 13 Sept. 1977 | 102.6R | 140 | - 61 |
| | 27 Apr. 1977 | 59.5L | 7 May 1977 | 40.0R | 10 | + 20 |
| | 27 Apr. 1977 | 59.5L | 17 Aug. 1977 | 60 km up MacKay River | 112 | + 60 |
| | 27 Apr. 1977 | 59.5L | 31 May 1977 | Old Fort Point ^c | 34 | -246 |
| | 27 Apr. 1977 | 59.5L | 21 May 1977 | 59.5L | 24 | 0 |
| | 28 Apr. 1977 | 59.5L | 16 May 1977 | Mouth Horse River | 18 | + 56 |
| | 28 Apr. 1977 | 39.8L | 10 Oct. 1977 | Snye Outlet (km 5.0) | 165 | + 35 |
| | 28 Apr. 1977 | 39.8L | 6 July 1977 | 168.0L | 69 | -128 |
| | 28 Apr. 1977 | 39.8L | 4 May 1977 | 40.0R | 6 | Across River |
| | 28 Apr. 1977 | 42.1L | 14 June 1977 | Goose Island ^c | 47 | -264 |
| | 28 Apr. 1977 | 42.1L | 12 Oct. 1977 | 50.4R | 167 | - 8 |
| | 28 Apr. 1977 | 42.1L | 22 June 1977 | Old Fort Point ^c | 55 | -272 |
| | 28 Apr. 1977 | 42.1L | 17 Oct. 1977 | 59.5L | 172 | - 17 |
| | 28 Apr. 1977 | 42.1L | 20 Oct. 1977 | Poplar Creek Bridge | 175 | + 15 |
| 29 Apr. 1977 | 27.5L | 8 May 1977 | Mouth Horse River | 9 | + 24 | |
| 29 Apr. 1977 | 42.1L | June 1978 | Athabasca Delta | 426 | -250 | |
| 29 Apr. 1977 | 27.5L | Mar. 1978 | At Jarvie in Pembina R. | 366 to 396 | +600 | |
| 7 May 1977 | 37.0R | 7 May 1978 | Poplar Creek | 365 | + 11 | |
| 6 May 1977 | 59.5L | 16 July 1977 | 24 km up MacKay River | 71 | + 24 | |
| 7 May 1977 | 39.8L | 19 Oct. 1977 | 168.0L | 165 | -129 | |
| 14 May 1977 | 37.0R | 19 May 1977 | 42.1L | 5 | - 5 | |
| 14 May 1977 | 40.0R | 9 July 1977 | 40.0L | 56 | 0 | |
| 9 June 1977 | 94.9L | 20 Sept. 1977 | Quatre Fourches | 103 | -241 | |
| 17 June 1977 | 46.4L | June 1978 | Mouth Athabasca River | 365 | -254 | |
| 29 Sept. 1977 | 50.6R | 16 Oct. 1978 | 40.0L | 382 | + 11 | |
| 30 Sept. 1977 | 51.0R | 26 May 1979 | Poplar Creek Bridge | 603 | + 25 | |
| 12 Oct. 1977 | 50.4R | 5 May 1978 | MacKay Fence | 205 | - 20 | |
| Goldeye | 5 Aug. 1976 | 109.6R | Jan. 1978 | Potato Island ^c | 149 to 179 | -215 |
| | 6 Aug. 1976 | 116.5R | 28 May 1978 | Jackfish Creek | 660 | -156 |
| | 6 Aug. 1976 | 130.4L | 21 June 1977 | Big Point ^c | 319 | -170 |
| | 18 Aug. 1976 | 104.6L | 14 June 1977 | Goose Island ^c | 300 | -201 |
| | 13 Sept. 1976 | 9.6R | 6 Aug. 1977 | 216.3R | 327 | -193 |
| | 15 Sept. 1976 | 42.1L | 30 Aug. 1977 | Quatre Fourches | 380 | -294 |
| | 15 Sept. 1976 | 42.1L | 15 June 1977 | N. of Big Point Ch. ^c | 273 | -264 |

continued ...

Table 138. Continued.

| Species | Tag Releases | | Tag Recaptures | | Elapsed Time (Days) | Distance Travelled ^a (km) | |
|---------------------|---------------|-------------------|----------------|----------------------------------|---------------------|--------------------------------------|-----|
| | Date | Site ^b | Date | Site ^b | | | |
| Goldeye (con't.) | 29 Sept. 1976 | 95.8R | 6 May 1977 | 59.5L | 219 | + 36 | |
| | 30 Sept. 1976 | 59.7R | 10 June 1978 | W. of Big Point ^c | 618 | -245 | |
| | 23 Apr. 1977 | 59.5L | 14 May 1977 | 24.5R | 21 | + 35 | |
| | 24 Apr. 1977 | 59.5R | 16 June 1977 | E. of Big Point Ch. ^c | 53 | -246 | |
| | 25 Apr. 1977 | 70.6R | 10 June 1978 | MacKay Fence | 411 | + 22 | |
| | 26 Apr. 1977 | 39.8L | 14 May 1977 | 37.0R | 18 | + 3 | |
| | 26 Apr. 1977 | 39.8L | 28 Sept. 1977 | 43.0R | 155 | - 3 | |
| | 27 Apr. 1977 | 70.1R | 14 May 1977 | 40.0R | 17 | + 30 | |
| | 27 Apr. 1977 | 70.1R | 5 Aug. 1977 | MacKay River Bridge | 100 | + 12 | |
| | 5 May 1977 | 40.0R | 5 Aug. 1977 | MacKay River Bridge | 92 | - 21 | |
| | 6 May 1977 | 74.9L | 14 May 1977 | 37.0R | 8 | + 38 | |
| | 6 May 1977 | 59.5L | 22 May 1977 | MacKay River Bridge | 16 | + 1 | |
| | 6 May 1977 | 59.5L | 16 July 1977 | MacKay River Bridge | 71 | + 1 | |
| | 14 May 1977 | 42.1L | 18 May 1977 | 42.1L | 4 | 0 | |
| | 14 May 1977 | 30.6R | 28 Sept. 1977 | 41.3L | 137 | - 11 | |
| | 14 May 1977 | 40.0R | 28 Sept. 1977 | 43.0R | 137 | - 3 | |
| | 15 May 1977 | 81.8R | 8 June 1977 | 95.8R | 24 | - 14 | |
| | 19 May 1977 | 59.5R | Dec. 1978 | Quatre Fourches | 575 | -276 | |
| | 19 May 1977 | 37.0R | 23 May 1977 | MacKay River Bridge | 4 | - 23 | |
| | 19 May 1977 | 59.5R | 1 June 1977 | 248.0 | 13 | -189 | |
| | 29 June 1977 | 59.5R | 22 July 1977 | 216.5R | 23 | -158 | |
| | 12 July 1977 | 59.5R | 26 Sept. 1977 | 59.0R | 76 | 0 | |
| | 23 Aug. 1977 | 70.6R | 6 Sept. 1977 | 70.6R | 14 | 0 | |
| | 20 Sept. 1977 | 81.8R | 30 Sept. 1977 | 46.4L | 10 | + 36 | |
| | 25 Sept. 1977 | 40.0R | 4 Oct. 1977 | 37.0R | 9 | + 3 | |
| | 28 Sept. 1977 | 59.5R | 1 Oct. 1977 | 59.5R | 3 | 0 | |
| | Northern pike | 10 May 1976 | 37.0R | 4 May 1977 | 37.0R | 359 | 0 |
| | | 22 May 1976 | 42.1L | 26 Apr. 1977 | 40.0R | 343 | + 2 |
| 2nd Recapture | | | 31 July 1977 | 40.0R | 96 | 0 | |
| 14 June 1976 | | 126.6R | 10 Oct. 1977 | 216.5R | 483 | - 90 | |
| 15 June 1976 | | 133.3R | 5 Sept. 1977 | 133.3R | 447 | 0 | |
| 17 June 1976 | | 94.1L | 15 May 1977 | Poplar Creek Bridge | 332 | + 69 | |
| 21 July 1976 | | 53.3R | 3 May 1977 | Muskeg Fence | 286 | + 4 | |
| 15 June 1976 | | 132.8R | 24 June 1978 | Mouth Firebag River (133.3) | 739 | - 1 | |
| 30 July 1976 | | 11.4R | 5 May 1977 | 27.4L | 279 | - 16 | |
| 31 July 1976 | | 40.0L | 4 May 1977 | Muskeg Fence | 277 | - 16 | |
| 18 Aug. 1976 | | 126.4R | 4 June 1977 | 133.3R | 290 | - 7 | |
| 14 Sept. 1976 | | 29.6R | 11 May 1977 | Muskeg Fence | 239 | - 26 | |
| 14 Sept. 1976 | | 55.5R | 2 May 1977 | Muskeg Fence | 230 | + 1 | |
| 2nd Recapture | | | 18 Oct. 1977 | 5.5R | 169 | - 1 | |
| 15 Sept. 1976 | | 55.5R | 10 May 1977 | Muskeg Fence | 237 | + 1 | |
| 15 Sept. 1976 | | 59.5L | 6 Aug. 1977 | 133.3R | 325 | - 74 | |
| 18 Sept. 1976 | | 126.4R | 27 July 1977 | 168.0R | 312 | - 42 | |
| 20 Sept. 1976 | | 133.3R | 30 July 1977 | 133.3R | 313 | 0 | |
| 20 Sept. 1976 | | 133.3R | 20 Aug. 1977 | 167.2R | 334 | - 18 | |
| 17 Apr. 1977 | | 59.5R | 19 Apr. 1977 | 59.5L | 2 | 0 | |
| 19 Apr. 1977 | | 59.5L | 10 May 1977 | Muskeg Fence | 21 | + 6 | |
| 19 Apr. 1977 | | 59.5L | 2 June 1977 | Muskeg Fence | 44 | + 6 | |
| 1 May 1977 | | 40.0R | 9 May 1977 | Steepbank Fence | 8 | + 1 | |
| 5 May 1977 | | 37.0R | 7 May 1977 | 37.0R | 2 | 0 | |
| 5 May 1977 | | 39.8L | 7 May 1977 | 40.0R | 2 | 0 | |
| 2nd Recapture | | | Aug. 1978 | 6.4 | 465 | + 33 | |
| 7 May 1977 | | 39.8L | 20 July 1977 | 27.4L | 74 | + 13 | |
| 13 May 1977 | | 55.5R | 14 May 1977 | 55.5R | 1 | 0 | |
| 2nd Recapture | | | 6 June 1977 | Muskeg Fence | 23 | + 1 | |
| 14 May 1977 | | 55.5R | 6 June 1977 | 55.5R | 23 | 0 | |
| 14 May 1977 | | 55.5R | 5 Aug. 1977 | 55.5R | 83 | 0 | |
| 16 June 1977 | | 37.0R | 22 Oct. 1978 | 22.4 | 493 | + 15 | |
| 17 June 1977 | 46.4L | 7 Sept. 1977 | 42.1L | 82 | + 4 | | |
| 17 June 1977 | 46.4L | 24 Aug. 1977 | 42.1L | 82 | + 4 | | |
| 17 June 1977 | 46.4L | 20 June 1977 | 55.5R | 3 | - 9 | | |
| 17 June 1977 | 46.4L | 28 July 1977 | 37.6L | 41 | + 9 | | |
| 29 June 1977 | 55.5R | 12 July 1977 | 55.5R | 13 | 0 | | |

continued ...

Table 138. Continued.

| Species | Tag Releases | | Tag Recaptures | | Elapsed Time (Days) | Distance Travelled ^a (km) |
|---------------------------|----------------|-------------------|-----------------------|---|----------------------------------|--------------------------------------|
| | Date | Site ^b | Date | Site ^b | | |
| Northern pike (con't.) | 23 Aug. 1977 | 40.0R | 22 Sept. 1977 | 40.0R | 30 | 0 |
| | 7 May 1977 | 37.0R | 23 May 1978 | 27.5 (Poplar River) | 381 | + 10 |
| | 25 Sept. 1977 | 54.2L | July 1978 | MacKay River Bridge | 279 to 308 | - 5 |
| | 7 Sept. 1977 | 55.5R | 28 Sept. 1977 | 40.0L | 21 | + 16 |
| | 25 Sept. 1977 | 46.2L | 8 Oct. 1977 | 54.2L | 13 | - 8 |
| | 25 Sept. 1977 | 54.2L | 2 Oct. 1977 | 0.0 | 7 | + 55 |
| | 27 Sept. 1977 | 55.5R | 1 Oct. 1977 | 53.0L | 4 | + 3 |
| | 28 Sept. 1977 | 54.2L | 30 Sept. 1977 | 46.4L | 2 | + 8 |
| | 28 Sept. 1977 | 46.4L | 1 Oct. 1977 | 46.4L | 3 | 0 |
| | 10 Oct. 1977 | 40.0L | 20 Oct. 1977 | 40.6L | 10 | - 1 |
| | 28 Sept. 1977 | 54.20 | 5 May 1978 | MacKay Fence | 219 | - 16 |
| | 12 Oct. 1977 | 50.4R | 18 May 1978 | Poplar Creek | 218 | + 23 |
| | 24 Oct. 1977 | 39.8L | 6 May 1978 | MacKay Fence | 194 | + 31 |
| | 25 Oct. 1977 | 11.2R | 6 May 1978 | MacKay Fence | 193 | - 60 |
| | Lake whitefish | 16 Sept. 1976 | 94.1L | 22 June 1977 | Mouth Big Point Ch. ^c | 279 |
| 16 Sept. 1976 | | 94.1L | 22 June 1977 | Old Fort Bay ^c | 279 | -259 |
| 18 Sept. 1976 | | 102.6L | 22 June 1977 | Mouth Big Point Ch. ^c | 277 | -203 |
| 18 Sept. 1976 | | 102.6L | 28 Apr. 1977 | 42.1L | 222 | + 61 |
| 18 Sept. 1976 | | 102.6L | June 1978 | 8 km S. Bustard Is. ^c | 635 | -209 |
| 29 Sept. 1976 | | 100.0L | 15 June 1977 | Old Fort Point ^c | 259 | -212 |
| 29 Sept. 1976 | | 46.2L | 19 June 1977 | 1.6 km N.E. Fort Chipewyan ^c | 263 | -282 |
| 30 Sept. 1976 | | 770.L | 13 June 1977 | Old Fort Bay ^c | 256 | -277 |
| 30 Sept. 1976 | | 59.5R | 13 Oct. 1977 | Mountain Rapids | 378 | + 63 |
| 30 Sept. 1976 | | 77.0L | 16 June 1977 | Old Fort Bay ^c | 259 | -277 |
| 1 Oct. 1976 | | 27.4L | 15 May 1977 | 216.0R | 226 | -190 |
| 1 Oct. 1976 | | 24.5R | 13 June 1977 | Big Point ^c | 255 | -282 |
| 1 Oct. 1976 | | 36.5R | 23 Oct. 1977 | Quatre Fourches | 387 | -299 |
| 1 Oct. 1976 | | 27.4L | 1 June 1977 | 248.0 | 243 | -222 |
| 28 Apr. 1977 | | 40.0R | 2 May 1978 | Jackfish Creek | 369 | -232 |
| 4 May 1977 | | 40.0R | 5 May 1977 | 40.0R | 1 | 0 |
| 5 May 1977 | | 40.0R | 7 May 1977 | 40.0R | 2 | 0 |
| 10 Aug. 1977 | | 55.5R | 24 Sept. 1977 | 6.4 | 45 | + 50 |
| 7 Sept. 1977 | | 30.6R | 22 July 1979 | Jackfish Creek | 683 | -242 |
| 22 Sept. 1977 | | 59.5R | 6 Oct. 1977 | Mountain Rapids | 14 | + 63 |
| 25 Sept. 1977 | | 40.0R | 28 Sept. 1977 | 40.0R | 3 | 0 |
| 22 Sept. 1977 | | 59.5R | Dec. 1977 | Popular Pt.-Mamawi L. | 69 to 100 | -284 |
| 22 Sept. 1977 | | 40.0L | 28 May 1978 | Jackfish Creek | 248 | -232 |
| 25 Sept. 1977 | | 39.8R | 28 Sept. 1977 | 40.0L | 3 | Across River |
| 26 Sept. 1977 | | 55.5R | 27 Sept. 1977 | 55.5R | 1 | 0 |
| 30 Sept. 1977 | | 41.0L | 23 Oct. 1977 | Quatre Fourches | 23 | -295 |
| 28 Sept. 1977 | | 41.3L | 23 Oct. 1977 | Quatre Fourches | 25 | -295 |
| 7 Oct. 1977 | | 42.1L | 23 Oct. 1977 | Quatre Fourches | 16 | -294 |
| 25 Sept. 1977 | | 42.1L | Jan. 1978 | Potato Island ^c | 98 to 128 | -283 |
| 27 Sept. 1977 | | 50.4R | Jan. 1978 | Potato Island ^c | 96 to 126 | -275 |
| 1 Oct. 1977 | | 41.0L | Jan. 1978 | Potato Island ^c | 93 to 123 | -284 |
| 29 Sept. 1977 | | 102.6L | Jan. 1978 | Potato Island ^c | 94 to 124 | -222 |
| 26 Sept. 1977 | | 59.5R | Oct. 1977 | 248.0 | 5 to 35 | -189 |
| 27 Sept. 1977 | | 46.2L | Oct. 1977 | 248.0 | 4 to 34 | -202 |
| 27 Sept. 1977 | | 46.2L | Dec. 1977 | 248.0 | 65 to 95 | -202 |
| 28 Sept. 1977 | | 53.0L | 1 Oct. 1977 | 41.40 | 3 | + 12 |
| 28 Sept. 1977 | | 41.3L | 30 Sept. 1977 | 40.0R | 2 | + 1 |
| 28 Sept. 1977 | | 43.0R | Oct. 1977 | 248.0 | 3 to 33 | -206 |
| 29 Sept. 1977 | | 46.2L | 1 Oct. 1977 | 43.0R | 2 | + 3 |
| 29 Sept. 1977 | | 59.5R | 20 Oct. 1977 | Mountain Rapids | 21 | + 53 |
| 29 Sept. 1977 | | 53.0L | 14 Sept. 1978 | Jackfish Creek | 350 | -219 |
| 21 Oct. 1977 | | 59.7R | June 1978 | Bustard Island ^c | 222 to 252 | -252 |
| 29 Sept. 1977 | | 46.2L | 22 July 1978 | Jackfish Creek | 296 | -226 |
| 30 Sept. 1977 | | 46.4L | 1 Oct. 1977 | 47.7R | 1 | - 1 |
| 1 Oct. 1977 | | 59.5R | 2 Oct. 1977 | 59.7R | 1 | 0 |
| 7 Oct. 1977 | | 40.0L | June 1978 | Mouth Athabasca River ^c | 237 to 267 | -260 |
| 10 Oct. 1977 | | 39.8L | 20 Oct. 1977 | 40.6L | 10 | - 1 |
| 10 Oct. 1977 | 40.8L | Dec. 1977 | Popular Pt.-Mamawi L. | 52 to 82 | -300 | |

continued ...

Table 138. Continued.

| Species | Tag Releases | | Tag Recaptures | | Elapsed Time (Days) | Distance Travelled ^a (km) |
|----------------------------|---------------|-------------------|----------------|------------------------------------|---------------------|--------------------------------------|
| | Date | Site ^b | Date | Site ^b | | |
| White suckers (Mildred) | 4 May 1976 | 42.1L | 8 May 1977 | Muskeg Fence | 369 | - 15 |
| | | 2nd Recapture | 25 May 1977 | Muskeg Fence | 17 | 0 |
| | 5 May 1976 | 59.5L | 1 June 1978 | Mouth Athabasca River ^c | 392 to 422 | -240 |
| | 8 May 1976 | 31.4R | 1 June 1977 | Goose Island ^c | 389 | -274 |
| | 16 Aug. 1976 | 55.5R | 3 May 1977 | Muskeg Fence | 260 | + 1 |
| | 15 Sept. 1976 | 55.5R | 3 May 1977 | Muskeg Fence | 230 | + 1 |
| | 15 Sept. 1976 | 55.5R | 8 May 1977 | Muskeg Fence | 235 | + 1 |
| | 15 Sept. 1976 | 55.5R | 12 May 1977 | Muskeg Fence | 239 | + 1 |
| | 30 Sept. 1976 | 59.5L | 28 May 1977 | 59.5L | 240 | 0 |
| | 30 Sept. 1976 | 55.5R | 20 Oct. 1977 | 50.7R | 385 | + 5 |
| | 30 Sept. 1976 | 54.2L | 4 June 1977 | Muskeg Fence | 247 | - 3 |
| | 23 Apr. 1977 | 55.5R | 9 May 1977 | Muskeg Fence | 16 | + 1 |
| | 23 Apr. 1977 | 55.5R | 2 May 1977 | Muskeg Fence | 9 | + 1 |
| | 23 Apr. 1977 | 55.5R | 4 May 1977 | Muskeg Fence | 11 | + 1 |
| | 23 Apr. 1977 | 55.5R | 27 May 1977 | Muskeg Fence | 34 | + 1 |
| | 24 Apr. 1977 | 59.5L | 7 June 1977 | Goose Island ^c | 44 | -246 |
| | 25 Apr. 1977 | 59.5L | 16 June 1977 | E. of Big Point Ch. ^c | 52 | -246 |
| | 25 Apr. 1977 | 59.5L | June 1978 | Mouth Athabasca River ^c | 402 to 432 | -240 |
| | 25 Apr. 1977 | 59.5L | June 1978 | Mouth Athabasca River ^c | 402 to 432 | -240 |
| | 25 Apr. 1977 | 59.5L | 1 May 1978 | MacKay Fence | 371 | + 11 |
| | 25 Apr. 1977 | 59.5L | 3 May 1978 | MacKay Fence | 373 | + 11 |
| | 24 Apr. 1977 | 59.5L | 4 May 1978 | MacKay Fence | 375 | + 11 |
| | 25 Apr. 1977 | 59.5L | 4 May 1978 | MacKay Fence | 374 | + 11 |
| | 25 Apr. 1977 | 59.5L | 4 May 1978 | MacKay Fence | 374 | + 11 |
| | 26 Apr. 1977 | 59.5L | 7 May 1978 | MacKay Fence | 376 | + 11 |
| | 25 Apr. 1977 | 59.5L | 8 May 1978 | MacKay Fence | 378 | + 11 |
| | 25 Apr. 1977 | 59.5L | 8 May 1978 | MacKay Fence | 378 | + 11 |
| | 26 Apr. 1977 | 59.5L | 9 May 1978 | MacKay Fence | 378 | + 11 |
| | 25 Apr. 1977 | 59.5L | 14 May 1978 | MacKay Fence | 384 | + 11 |
| | 25 Apr. 1977 | 59.5L | 6 May 1978 | MacKay Fence | 376 | + 11 |
| | 25 Apr. 1977 | 59.5L | 1 May 1978 | MacKay Fence | 371 | + 11 |
| | 25 Apr. 1977 | 59.5R | 5 May 1977 | Muskeg Fence | 9 | + 4 |
| | 26 Apr. 1977 | 55.5R | 5 May 1977 | Muskeg Fence | 9 | + 1 |
| | 26 Apr. 1977 | 55.5R | 5 May 1977 | Muskeg Fence | 9 | + 1 |
| | 27 Apr. 1977 | 59.5L | 4 May 1977 | Muskeg Fence | 7 | + 4 |
| | 28 Apr. 1977 | 59.5L | 9 May 1978 | MacKay Fence | 376 | + 11 |
| | 2 May 1977 | 59.5L | 8 July 1977 | Quatre Fourches | 67 | -278 |
| | 4 May 1977 | 58.1L | 6 May 1977 | Muskeg Fence | 2 | - 15 |
| | 13 May 1977 | 55.5R | 5 June 1977 | Old Fort Point ^c | 23 | -257 |
| | 13 May 1977 | 55.5R | June 1978 | Mouth Athabasca River ^c | 384 to 414 | -245 |
| | 30 Sept. 1977 | 39.8L | 20 Oct. 1977 | 24.9L | 20 | 0 |
| | 1 Oct. 1977 | 46.4R | 12 Oct. 1977 | 46.4L | 11 | 0 |
| 25 Sept. 1977 | 54.2L | 4 May 1978 | MacKay Fence | 221 | - 15 | |
| 7 Oct. 1977 | 37.0R | 2 May 1978 | MacKay Fence | 207 | - 34 | |
| 12 Oct. 1977 | 50.4R | 4 May 1978 | MacKay Fence | 204 | - 20 | |
| 20 Oct. 1977 | 54.2L | 9 May 1978 | MacKay Fence | 201 | - 16 | |
| 20 Oct. 1977 | 40.8L | 1 May 1978 | MacKay Fence | 193 | - 30 | |
| 30 Oct. 1977 | 46.4R | 3 May 1978 | MacKay Fence | 216 | - 24 | |
| Longnose suckers | 21 May 1976 | 42.1L | June 1978 | Mouth Athabasca River ^c | 741 to 771 | -258 |
| | 5 May 1976 | 42.1L | 5 June 1977 | Old Fort Point ^c | 396 | -264 |
| | 23 Apr. 1977 | 59.5L | 26 Apr. 1977 | 59.5R | 3 | Across River |
| | 23 Apr. 1977 | 59.5L | 14 June 1977 | Old Fort Bay ^c | 52 | -294 |
| | 23 Apr. 1977 | 55.5R | 2 May 1977 | Muskeg Fence | 9 | + 1 |
| | 23 Apr. 1977 | 55.5R | 1 June 1977 | Muskeg Fence | 39 | + 1 |
| | 23 Apr. 1977 | 55.5R | 5 May 1977 | Muskeg Fence | 12 | + 1 |
| | 23 Apr. 1977 | 55.5R | 18 May 1977 | Muskeg Fence | 25 | + 1 |
| | 23 Apr. 1977 | 55.5R | 6 May 1977 | Muskeg Fence | 13 | + 1 |
| | 23 Apr. 1977 | 55.5R | 9 May 1977 | Muskeg Fence | 16 | + 1 |
| | 23 Apr. 1977 | 59.5L | 10 May 1977 | Muskeg Fence | 17 | + 4 |
| | 25 Apr. 1977 | 59.5L | 25 May 1977 | Muskeg Fence | 30 | + 4 |
| | 25 Apr. 1977 | 59.5L | 3 June 1977 | Muskeg Fence | 38 | + 4 |
| | 26 Apr. 1977 | 59.5L | 5 June 1977 | Muskeg Fence | 39 | + 4 |
| | 26 Apr. 1977 | 55.5R | 5 May 1977 | Muskeg Fence | 9 | + 1 |
| | | 2nd Recapture | 28 May 1977 | Muskeg Fence | 32 | + 1 |

continued ...

Table 138. Concluded.

| Species | Tag Releases | | Tag Recaptures | | Elapsed Time (Days) | Distance Travelled ^a (km) |
|------------------------------|---------------|-------------------|----------------|-------------------------------------|---------------------|--------------------------------------|
| | Date | Site ^b | Date | Site ^b | | |
| Longnose suckers (con't.) | 1 May 1977 | 42.1L | 22 June 1977 | Mouth Athabasca River ^c | 52 | -258 |
| | 24 Apr. 1977 | 59.5L | 25 Apr. 1977 | 59.5L | 1 | 0 |
| | | | 5 May 1978 | MacKay Fence | 376 | + 11 |
| | 28 Apr. 1977 | 39.8L | 5 June 1977 | Old Fort Point ^c | 38 | -273 |
| | 25 Apr. 1977 | 59.5L | 28 Apr. 1977 | 59.5L | 3 | 0 |
| | 25 Apr. 1977 | 59.5L | 12 Sept. 1977 | 223.4R | 140 | -164 |
| | 26 Apr. 1977 | 59.5L | 28 Apr. 1977 | 59.5L | 2 | 0 |
| | 24 Apr. 1977 | 42.1L | June 1978 | 6km N. Goose Island ^c | 403 to 433 | -270 |
| | 25 Apr. 1977 | 59.5L | 2 May 1978 | MacKay Fence | 372 | + 11 |
| | 25 Apr. 1977 | 59.5L | 2 May 1978 | MacKay Fence | 372 | + 11 |
| | 25 Apr. 1977 | 59.5L | 2 May 1978 | MacKay Fence | 372 | + 11 |
| | 29 Apr. 1977 | 42.1L | June 1978 | Mouth Athabasca River ^c | 398 to 428 | -258 |
| | 4 May 1977 | 40.0R | Dec. 1978 | Quatre Fourches | 553 to 583 | -300 |
| | 13 May 1977 | 94.9L | June 1978 | 8 km S. Bustard Island ^c | 384 to 414 | -217 |
| | 20 Oct. 1977 | 59.5R | June 1978 | Athabasca Delta | 224 to 254 | -240 |
| | 25 Apr. 1977 | 59.5L | 30 Apr. 1978 | MacKay Fence | 370 | + 11 |
| | 25 Apr. 1977 | 59.5L | 3 May 1978 | MacKay Fence | 373 | + 11 |
| | 9 July 1976 | 8.0 MacKay | 30 Apr. 1978 | 10.0 MacKay River | 660 | + 2 |
| | Burbot | 8 June 1977 | 81.8R | 5 Oct. 1977 | 99.8L | 119 |
| Flathead chub | 29 Sept. 1976 | 95.8R | 1 June 1977 | 95.8R | 245 | 0 |
| | 1 June 1977 | 59.5R | 29 June 1977 | 59.5R | 28 | 0 |

^a Distance shown is approximate distance upstream (+) or downstream(-) in the Athabasca River. On occasion movement was upstream or downstream in the Athabasca River and then upstream in a tributary.

^b Distance downstream of Waterways (km 0.0) on right (R) or left (L) bank.

^c Lake Athabasca.

Table 139. Dates of tagging and recapture, locations of release and recapture, distances travelled, and elapsed time between release and recapture for fish tagged in the Delta study area in 1977 and recaptured in and since 1977.

| Species | Tag Releases | | Tag Recaptures | | Elapsed Time (Days) | Distance Travelled ^a (km) |
|---------------|---------------|-------------------|-------------------------------------|---------------------------------------|---------------------|--------------------------------------|
| | Date | Site ^b | Date | Site ^b | | |
| Walleye | 17 May 1977 | 271.0L | Jan. 1978 | Potato Island ^c | 229 to 259 | - 54 |
| | 17 May 1977 | 260.6L | 8 June 1977 | Old Fort Point ^c | 22 | - 51 |
| | 17 May 1977 | 271.0R | 12 June 1977 | 5 mi. out from Big Pt. ^c | 26 | - 42 |
| | 17 May 1977 | 271.0R | 16 June 1977 | Goose Island ^c | 30 | - 34 |
| | 13 May 1977 | 271.0R | 8 June 1977 | Old Fort Point ^c | 22 | - 42 |
| | 17 May 1977 | 271.0R | 13 June 1977 | 3 mi. N.E. Big Point Ch. ^c | 27 | - 42 |
| | 10 June 1977 | 216.5R | 26 June 1977 | 216.3R | 16 | Across River |
| | 24 June 1977 | 195.7R | 4 May 1978 | MacKay Fence | 314 | +147 |
| | 25 Sept. 1977 | 223.5R | June 1978 | 8 km S. Bustard Island ^c | 249 to 279 | - 88 |
| | 24 Oct. 1977 | 195.7R | 4 May 1978 | MacKay Fence | 192 | +147 |
| Goldeye | 15 May 1977 | 241.4R | 27 May 1977 | 216.0R | 12 | + 25 |
| | 15 May 1977 | 241.4R | 28 June 1977 | 110.1R | 44 | +131 |
| | 17 May 1977 | 256.0R | 12 Sept. 1977 | Quatre Fourches | 118 | - 80 |
| | 12 June 1977 | 216.3Ll | 30 June 1977 | 248.0 | 18 | - 32 |
| | 13 June 1977 | 216.3Ll | 19 July 1977 | 216.3R | 36 | 0 |
| | 22 June 1977 | 215.4L | 25 July 1977 | 95.8R | 33 | +120 |
| | 24 June 1977 | 195.7R | 9 July 1977 | 168.0 | 15 | + 28 |
| | 26 June 1977 | 215.7R | 25 July 1977 | 216.3R | 29 | + 1 |
| | 29 June 1977 | 215.7R | 22 July 1977 | 215.4L | 23 | 0 |
| | 2 July 1977 | 222.4L | 15 July 1977 | Quatre Fourches | 13 | -114 |
| | 5 July 1977 | 215.4L | 8 July 1977 | 215.8R | 3 | 0 |
| | 16 July 1977 | 215.2L | 9 Aug. 1977 | 212.8Ll | 24 | + 2 |
| | 18 July 1977 | 215.4L | 25 July 1977 | 216.3R | 7 | + 1 |
| | 20 July 1977 | 195.5Ll | 23 July 1977 | 200.8L | 3 | + 5 |
| | 20 July 1977 | 215.4L | 13 Oct. 1977 | 6.4 km down from Peace Pt. (Peace R.) | 85 | +257 |
| | 22 July 1977 | 215.4L | 26 Sept. 1977 | Quatre Fourches | 66 | -121 |
| | 2 Aug. 1977 | 220.8L | 9 Sept. 1977 | Grayling Creek (167.4R) | 38 | + 55 |
| | 5 Aug. 1977 | 212.8Ll | 9 Aug. 1977 | 212.8Ll | 4 | 0 |
| | 10 Aug. 1977 | 207.0L | 15 Aug. 1977 | 196.8R | 5 | - 10 |
| | 16 Aug. 1977 | 217.0Rl | 30 Aug. 1977 | Quatre Fourches | 14 | -119 |
| 14 Aug. 1977 | 215.7R | June 1978 | 8 km S. Bustard Island ^c | 290 to 320 | - 96 | |
| 18 Aug. 1977 | 220.8L | 12 Sept. 1977 | 223.5R | 15 | + 3 | |
| 19 Aug. 1977 | 223.4L | 27 Aug. 1977 | 223.5Ll | 8 | 0 | |
| 20 Sept. 1977 | 223.4L | 4 June 1978 | Potato Island ^c | 257 | -102 | |
| Northern pike | 17 May 1977 | 262.1L | 19 July 1977 | Quatre Fourches | 63 | - 74 |
| | 12 June 1977 | 220.8L | 5 July 1977 | 220.8L | 23 | 0 |
| | 12 June 1977 | 216.5R | 10 Oct. 1977 | 216.3R | 120 | 0 |
| | 12 June 1977 | 216.5R | 5 July 1977 | 215.4L | 23 | + 1 |
| | 22 June 1977 | 215.4L | 19 Sept. 1977 | 216.3R | 89 | - 1 |
| | 22 June 1977 | 215.4L | 5 July 1977 | 215.4L | 13 | 0 |
| | 22 June 1977 | 215.4L | 24 June 1977 | 215.4L | 2 | 0 |
| | 22 June 1977 | 215.4L | 17 June 1979 | 2 km S. Ft. Chipewyan ^c | 360 | -113 |
| | 24 June 1977 | 206.6L | 7 Sept. 1977 | 207.0L | 75 | - 1 |
| | 24 June 1977 | 215.4L | 5 July 1977 | 215.4L | 11 | 0 |
| | 26 June 1977 | 215.4L | 5 July 1977 | 215.4L | 9 | 0 |
| | 26 June 1977 | 215.4L | 5 July 1977 | 215.4L | 9 | 0 |
| | 26 June 1977 | 215.4L | 5 July 1977 | 215.4L | 9 | 0 |
| | 5 July 1977 | 215.4L | 22 July 1977 | 215.4L | 17 | 0 |
| | 5 July 1977 | 215.4L | 10 July 1977 | 215.7L | 5 | 0 |
| | 5 July 1977 | 215.4L | 24 Oct. 1977 | 215.4L | 111 | 0 |
| | 8 July 1977 | 215.4L | 20 July 1977 | 215.4L | 12 | 0 |
| | 19 July 1977 | 215.4L | 23 July 1977 | 215.4L | 4 | 0 |
| | 19 July 1977 | 216.3R | 19 July 1977 | 216.3R | 0 | 0 |
| | 2nd Recapture | | 16 Sept. 1977 | 216.3R | 59 | 0 |
| | 20 July 1977 | 215.4L | 23 July 1977 | 215.4L | 3 | 0 |
| | 20 July 1977 | 215.4L | 23 July 1977 | 215.4L | 3 | 0 |
| | 20 July 1977 | 215.4L | 23 July 1977 | 215.4L | 3 | 0 |
| 2nd Recapture | | 7 Sept. 1977 | 212.8Ll | 46 | + 3 | |

continued ...

Table 139. Concluded.

| Species | Tag Releases | | Tag Recaptures | | Elapsed Time (Days) | Distance Travelled ^a (km) |
|---------------------------|----------------|-------------------|----------------|------------------------------------|-------------------------|--------------------------------------|
| | Date | Site ^b | Date | Site ^b | | |
| Northern pike (con't.) | 21 July 1977 | 256.2L | 28 July 1977 | 256.0R | 7 | 0 |
| | 22 July 1977 | 215.4L | 7 Sept. 1977 | 215.4L | 47 | 0 |
| | 2 Sept. 1977 | 247.0R | 15 May 1978 | 27.5 (Poplar River) | 255 | +220 |
| | 22 July 1977 | 215.4L | 10 Oct. 1977 | 215.4L | 80 | 0 |
| | 17 Aug. 1977 | 215.7R | 7 Sept. 1977 | 215.7R | 31 | 0 |
| | 10 Sept. 1977 | 217.0LI | 21 Sept. 1977 | 216.3R | 11 | + 1 |
| | 18 Sept. 1977 | 223.4L | Mar. 1978 | Embarras Portage (km 219.0) | 164 to 194 | + 4 |
| | 29 Sept. 1977 | 223.5R | 22 Oct. 1977 | 168.0 | 23 | + 56 |
| | 1 Oct. 1977 | 223.5LI | 20 Oct. 1977 | 216.0 | 19 | + 8 |
| | Lake whitefish | 10 Aug. 1977 | 222.4L | 8 Sept. 1977 | Grayling Creek (167.4R) | 29 |
| 12 Sept. 1977 | | 223.5LI | Oct. 1977 | 248.0 | 19 to 49 | - 24 |
| 13 Sept. 1977 | | 223.5LI | 5 Oct. 1977 | 81.8R | 22 | +142 |
| 6 Sept. 1977 | | 256.0R | June 1978 | Goose Island ^c | 267 to 297 | - 49 |
| 17 Sept. 1977 | | 223.4L | 22 July 1979 | Jackfish Creek | 308 | - 49 |
| 18 Sept. 1977 | | 223.4L | 31 Oct. 1977 | Jackfish Creek | 43 | - 49 |
| 16 Sept. 1977 | | 223.4LI | 11 Nov. 1978 | Quatre Fourches | 421 | -113 |
| 26 Sept. 1977 | | 223.5LI | 11 Oct. 1977 | 223.4 | 15 | + 0.1 |
| 26 Sept. 1977 | | 223.5LI | Oct. 1977 | 248.0 | 5 to 35 | - 24 |
| 26 Sept. 1977 | | 223.5LI | 14 Oct. 1977 | 168.0 | 18 | + 56 |
| 10 Oct. 1977 | | 223.5LI | 18 Oct. 1977 | 168.0 | 8 | + 56 |
| 10 Oct. 1977 | | 223.4L | June 1978 | Mouth Athabasca River ^c | 234 to 264 | - 77 |
| White sucker | | 5 July 1977 | 217.0RI | 17 Aug. 1977 | 217.6LI | 43 |

^a Distance shown is approximate distance upstream (+) or downstream (-) in the Athabasca River. On occasion movement was upstream or downstream in the Athabasca River and then upstream in a tributary.

^b Distance downstream of Waterways (km 0.0) on the right (R) or left (L) bank. I denotes island site.

^c Lake Athabasca.

7. AOSERP RESEARCH REPORTS

1. AOSERP First Annual Report, 1975
2. AF 4.1.1 Walleye and Goldeye Fisheries Investigations in the Peace-Athabasca Delta--1975
3. HE 1.1.1 Structure of a Traditional Baseline Data System
4. VE 2.2 A Preliminary Vegetation Survey of the Alberta Oil Sands Environmental Research Program Study Area
5. HY 3.1 The Evaluation of Wastewaters from an Oil Sand Extraction Plant
6. Housing for the North--The Stackwall System
7. AF 3.1.1 A Synopsis of the Physical and Biological Limnology and Fisheries Programs within the Alberta Oil Sands Area
8. AF 1.2.1 The Impact of Saline Waters upon Freshwater Biota (A Literature Review and Bibliography)
9. ME 3.3 Preliminary Investigations into the Magnitude of Fog Occurrence and Associated Problems in the Oil Sands Area
10. HE 2.1 Development of a Research Design Related to Archaeological Studies in the Athabasca Oil Sands Area
11. AF 2.2.1 Life Cycles of Some Common Aquatic Insects of the Athabasca River, Alberta
12. ME 1.7 Very High Resolution Meteorological Satellite Study of Oil Sands Weather: "A Feasibility Study"
13. ME 2.3.1 Plume Dispersion Measurements from an Oil Sands Extraction Plant, March 1976
- 14.
15. ME 3.4 A Climatology of Low Level Air Trajectories in the Alberta Oil Sands Area
16. ME 1.6 The Feasibility of a Weather Radar near Fort McMurray, Alberta
17. AF 2.1.1 A Survey of Baseline Levels of Contaminants in Aquatic Biota of the AOSERP Study Area
18. HY 1.1 Interim Compilation of Stream Gauging Data to December 1976 for the Alberta Oil Sands Environmental Research Program
19. ME 4.1 Calculations of Annual Averaged Sulphur Dioxide Concentrations at Ground Level in the AOSERP Study Area
20. HY 3.1.1 Characterization of Organic Constituents in Waters and Wastewaters of the Athabasca Oil Sands Mining Area
21. AOSERP Second Annual Report, 1976-77
22. Alberta Oil Sands Environmental Research Program Interim Report to 1978 covering the period April 1975 to November 1978
23. AF 1.1.2 Acute Lethality of Mine Depressurization Water on Trout Perch and Rainbow Trout
24. ME 1.5.2 Air System Winter Field Study in the AOSERP Study Area, February 1977.
25. ME 3.5.1 Review of Pollutant Transformation Processes Relevant to the Alberta Oil Sands Area

26. AF 4.5.1 Interim Report on an Intensive Study of the Fish Fauna of the Muskeg River Watershed of Northeastern Alberta
27. ME 1.5.1 Meteorology and Air Quality Winter Field Study in the AOSERP Study Area, March 1976
28. VE 2.1 Interim Report on a Soils Inventory in the Athabasca Oil Sands Area
29. ME 2.2 An Inventory System for Atmospheric Emissions in the AOSERP Study Area
30. ME 2.1 Ambient Air Quality in the AOSERP Study Area, 1977
31. VE 2.3 Ecological Habitat Mapping of the AOSERP Study Area: Phase I
32. AOSERP Third Annual Report, 1977-78
33. TF 1.2 Relationships Between Habitats, Forages, and Carrying Capacity of Moose Range in northern Alberta. Part I: Moose Preferences for Habitat Strata and Forages.
34. HY 2.4 Heavy Metals in Bottom Sediments of the Mainstem Athabasca River System in the AOSERP Study Area
35. AF 4.9.1 The Effects of Sedimentation on the Aquatic Biota
36. AF 4.8.1 Fall Fisheries Investigations in the Athabasca and Clearwater Rivers Upstream of Fort McMurray: Volume I
37. HE 2.2.2 Community Studies: Fort McMurray, Anzac, Fort MacKay
38. VE 7.1.1 Techniques for the Control of Small Mammals: A Review
39. ME 1.0 The Climatology of the Alberta Oil Sands Environmental Research Program Study Area
40. WS 3.3 Mixing Characteristics of the Athabasca River below Fort McMurray - Winter Conditions
41. AF 3.5.1 Acute and Chronic Toxicity of Vanadium to Fish
42. TF 1.1.4 Analysis of Fur Production Records for Registered Traplines in the AOSERP Study Area, 1970-75
43. TF 6.1 A Socioeconomic Evaluation of the Recreational Fish and Wildlife Resources in Alberta, with Particular Reference to the AOSERP Study Area. Volume I: Summary and Conclusions
44. VE 3.1 Interim Report on Symptomology and Threshold Levels of Air Pollutant Injury to Vegetation, 1975 to 1978
45. VE 3.3 Interim Report on Physiology and Mechanisms of Air-Borne Pollutant Injury to Vegetation, 1975 to 1978
46. VE 3.4 Interim Report on Ecological Benchmarking and Biomonitoring for Detection of Air-Borne Pollutant Effects on Vegetation and Soils, 1975 to 1978.
47. TF 1.1.1 A Visibility Bias Model for Aerial Surveys for Moose on the AOSERP Study Area
48. HG 1.1 Interim Report on a Hydrogeological Investigation of the Muskeg River Basin, Alberta
49. WS 1.3.3 The Ecology of Macrobenthic Invertebrate Communities in Hartley Creek, Northeastern Alberta
50. ME 3.6 Literature Review on Pollution Deposition Processes
51. HY 1.3 Interim Compilation of 1976 Suspended Sediment Data in the AOSERP Study Area
52. ME 2.3.2 Plume Dispersion Measurements from an Oil Sands Extraction Plan, June 1977

53. HY 3.1.2 Baseline States of Organic Constituents in the Athabasca River System Upstream of Fort McMurray
54. WS 2.3 A Preliminary Study of Chemical and Microbial Characteristics of the Athabasca River in the Athabasca Oil Sands Area of Northeastern Alberta
55. HY 2.6 Microbial Populations in the Athabasca River
56. AF 3.2.1 The Acute Toxicity of Saline Groundwater and of Vanadium to Fish and Aquatic Invertebrates
57. LS 2.3.1 Ecological Habitat Mapping of the AOSERP Study Area (Supplement): Phase I
58. AF 2.0.2 Interim Report on Ecological Studies on the Lower Trophic Levels of Muskeg Rivers Within the Alberta Oil Sands Environmental Research Program Study Area
59. TF 3.1 Semi-Aquatic Mammals: Annotated Bibliography
60. WS 1.1.1 Synthesis of Surface Water Hydrology
61. AF 4.5.2 An Intensive Study of the Fish Fauna of the Steepbank River Watershed of Northeastern Alberta
62. TF 5.1 Amphibians and Reptiles in the AOSERP Study Area
63. ME 3.8.3 Analysis of AOSERP Plume Sigma Data
64. LS 21.6.1 A Review of the Baseline Data Relevant to the Impacts of Oil Sands Development on Large Mammals in the AOSERP Study Area
65. LS 21.6.2 A Review of the Baseline Data Relevant to the Impacts of Oil Sands Development on Black Bears in the AOSERP Study Area
66. AS 4.3.2 An Assessment of the Models LIRAQ and ADPIC for Application to the Athabasca Oil Sands Area
67. WS 1.3.2 Aquatic Biological Investigations of the Muskeg River Watershed
68. AS 1.5.3 Air System Summer Field Study in the AOSERP Study Area, June 1977
68. AS 3.5.2
69. HS 40.1 Native Employment Patterns in Alberta's Athabasca Oil Sands Region
70. LS 28.1.2 An Interim Report on the Insectivorous Animals in the AOSERP Study Area
71. HY 2.2 Lake Acidification Potential in the Alberta Oil Sands Environmental Research Program Study Area
72. LS 7.1.2 The Ecology of Five Major Species of Small Mammals in the AOSERP Study Area: A Review
73. LS 23.2 Distribution, Abundance and Habitat Associations of Beavers, Muskrats, Mink and River Otters in the AOSERP Study Area, Northeastern Alberta
74. AS 4.5 Air Quality Modelling and User Needs
75. WS 1.3.4 Interim Report on a Comparative Study of Benthic Algal Primary Productivity in the AOSERP Study Area
76. AF 4.5.1 An Intensive Study of the Fish Fauna of the Muskeg River Watershed of Northeastern Alberta
77. HS 20.1 Overview of Local Economic Development in the Athabasca Oil Sands Region Since 1961.
78. LS 22.1.1 Habitat Relationships and Management of Terrestrial Birds in Northeastern Alberta

79. AF 3.6.1 The Multiple Toxicity of Vanadium, Nickel, and Phenol to Fish.
80. LS 22.3.1 Biology and Management of Peregrin Falcons (*Falco peregrinus anatum*) in Northeastern Alberta.
81. LS 22.1.2 Species Distribution and Habitat Relationships of Waterfowl in Northeastern Alberta.
82. LS 22.2 Breeding Distribution and Behaviour of the White Pelican in the Athabasca Oil Sands Area.
83. LS 22.2 The Distribution, Foraging Behaviour, and Allied Activities of the White Pelican in the Athabasca Oil Sands Area.
84. WS 1.6.1 Investigations of the Spring Spawning Fish Populations in the Athabasca and Clearwater Rivers Upstream from Fort McMurray; Volume I.
85. HY 2.5 An intensive Surface Water Quality Study of the Muskeg River Watershed. Volume I: Water Chemistry.
86. AS 3.7 An Observational Study of Fog in the AOSERP Study Area.
87. WS 2.2 Hydrogeological Investigation of Muskeg River Basin, Alberta

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