A Survey of the Fish Resources of the Great Bear River, Northwest Territories, 1974

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Fisheries and Marine Service

Manuscript Report 1510

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A SURVEY OF THE FISH RESOURCES OF THE GREAT BEAR RIVER, NORTHWEST TERRITORIES, 1974

by

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A field investigation of the fish fauna of the Great Bear River was conducted from June to September 1974. Data obtained plus information from previous Fisheries and Marine Service surveys between 1971 and 1973 contributed to our existing knowledge of the river's fish populations.

Twenty-five species of fish were recorded in Great Bear River with the greatest diversity occurring at its confluence with the Mackenzie River. Species diversity decreased upstream to a level of only 12-14 species. Arctic grayling, northern pike, longnose sucker and round whitefish were the major fish species throughout the river. Arctic grayling were abundant in most sections of the river while the tributaries upstream of the Brackett River functioned as spawning and nursery areas. Inconnu and Arctic ciscos were only found in the fall as far upstream as St. Charles Rapids. The pre-spawning condition of the Arctic cisco confirmed previous supposition that a portion of the spawning population, migrating annually from the Mackenzie River Delta, utilize the Great Bear River or its tributaries for spawning.

During the post-spawning downstream migration of fish at Wolverine Creek, a small tributary of the Great Bear River, 8973 Arctic grayling, 591 longnose sucker and 68 northern pike were counted (12 June to 8 July 1974). Of 1733 grayling tagged, 22 were recaptured in 1974 and their recapture locations confirmed field observations that the Great Bear outflow and the first 10 km reach of Great Bear River is a major summer habitat.

Arctic grayling (N = 1255) were also tagged in June 1974 at Three Day Lake, a west side Mackenzie River drainage located 78 km downstream from the Great Bear-Mackenzie confluence. Sport and domestic fishermen returned 185 tags. The time, sequence and location of these recaptures confirmed 1972 and 1973 data which showed that this population migrated between Three Day Lake and Great Bear Lake outflow in its annual life cycle. The data would also suggest that other Mackenzie River tributaries in the same region may contribute important segments to the summer population of Arctic grayling in the Great Bear River.

Key words: fishery surveys; check lists; seasonal distributions; grayling, Arctic; life history; population structure; migrations; tagging.

RESUME

Chang-Kue, K. T. J., and R. A. Cameron. 1980. A survey of the fish resources of the Great Bear River, Northwest Territories, 1974. Can. Fish. Mar. Serv. MS Rep. 1510: vi + 59 p.

Nous avons étudié les poissons de la Great Bear River de juin à septembre 1974. Nous données ajoutées à celles d'études menées entre 1971 et 1973 par le Service des pêches et de la mer ont accru nos connaissances des populations des poissons.

Nous avons recensé 25 espèces et, c'est à la confluence de la Mackenzie River que leur diversité était la plus grande. En amont, seules 12 à 14 espèces étaient représentées. La rivière renfermait surtout de l'ombre arctique, du grand brochet, du meunier rouge et du ménomini rond. L'ombre arctique se rencontrait à peu près partout; la fraie et la croissance des jeunes avaient lieu dans les affluents situés en amont de la Brackett River. Ce n'est qu'en automne que nous avons trouvé de l'inconnu et du cisco arctique jusqu'aux St. Charles Rapids. Du fait qu'il présentait les signes d'avant la fraie, le cisco arctique est venu confirmer ce qu'on supposait déjà, soit qu'une fraction de sa population reproductrice qui quitte chaque année le Mackenzie Delta vient frayer dans la Great Bear River ou ses affluents.

Durant la descente après la fraie, nous avons dénombré, dans le Wolverine Creek, petit affluent de la Great Bear River, entre le 12 juin et le 8 juillet 1974, 8973 ombres arctiques, 591 meuniers rouges et 68 grands brochets. Des 1733 ombres marqués, 22 ont été repris en 1974 et les endroits de leur capture viennent confirmer les observations sur le terrain selon lesquelles, l'été, les eaux à l'émissaire du Great Bear Lake et les dix kilomètres en aval constituent un habitat d'importance pour l'espèce.

En juin 1974, nous avons aussi marqué 1255 ombres arctiques au Three Day Lake, situé à l'ouest du Mackenzie, à 78 km en aval de sa confluence avec la Great Bear River. Les pêcheurs sportifs et autochtones nous ont retourné 185 marques. Le moment, l'ordre et le lieu de lear capture sont venus corroborer des données de 1972 et de 1973 qui montraient que cette population migrait, durant son cycle annuel, entre le Three Day Lake et le début de l'émissaire du Great Bear Lake. D'après ces données, l'ombre arctique passant l'été dans la Great Bear River proviendrait pour une part importante d'affluents du Mackenzie de la région.

Mots-clés: inventaires ichtyologiques; listes de contrôle; répartition saisonnière; ombre arctique; cycle évolutif; composition des populations; migrations; marquage.

INTRODUCTION

With the increasing rate of exploitation of the natural resources of the Mackenzie River Valley in the Northwest Territories, the need for detailed information on the fish resources of the Mackenzie River and most of its tributaries became evident. One major tributary is the Great Bear River (Fig. 1) through which flow the waters of Great Bear Lake, on their way to the Mackenzie River. While Fisheries and Marine Service did study the fish populations in the Mackenzie River in the immediate area (Hatfield et al. 1972a, 1972b; Stein et al. 1973a, 1973b; Dryden et al.1973; Jessop et al. 1974; Jessop and Lilley 1975), work on the Great Bear River was limited to occasional visits to a few sites during the summers of 1971, 1972, and 1973.

The significance of Great Bear River as an important Arctic grayling habitat was described by Stein et al. (1973a, 1973b), Jessop et al. (1974), and Jessop and Lilley (1975). These authors presented evidence indicating that the river was a major migration route for Arctic grayling and it was suspected that both inconnu and Arctic cisco also migrate upstream to spawn in the fall. Recognizing that assessment of the impact of any industrial development on the fish fauna may be impending, especially since Northern Canada Power Commission (NCPC) had initiated engineering feasibility studies in 1971 to investigate Great Bear River's hydroelectric power potential (Crippen and Associates 1972), Fisheries and Marine Service conducted a full summer survey of the river in 1974 with the objective of obtaining more information about the fish populations.

Prior to the surveys undertaken by Fisheries and Marine Service from 1971 to 1973 and the brief survey in 1972 by Shotten (1973), the literature contained incidental references to Great Bear River among results of field investigations of Great Bear Lake (Miller 1946; Miller 1947; Miller and Kennedy 1948a, 1948b; Kennedy 1949; Kennedy 1953; Johnson 1966a). This report presents our findings from the 1974 survey and includes summaries of pertinent data from the brief visits made by Fisheries and Marine Service crews in 1971, 1972 and 1973 (Hatfield et al. 1972a, 1972b; Stein et al. 1973a, 1973b; Dryden et al. 1973; Jessop et al. 1974).

DESCRIPTION OF THE STUDY AREA

Great Bear River (64°54'N 125°35'W) flows from the southwest arm (Keith Arm) of Great Bear Lake for 122 river kilometers to its confluence with the Mackenzie River at Fort Norman (Fig. 2). The gradient varies from 0.57 m/km to 1.90 m/km, the total vertical drop between the lake and the Mackenzie River being 107 m (Crippen and Associates 1972). The river width varies from 150 to 600 m while the general cross-sectional profile shows the river to be shallow except for a narrow sinuous channel, 60 to 150 m wide and from 1.5 to 6 m deep. The river bed is predominantly composed of cobbles and boulders with some extensive beds of coarse gravel. Northern Transportation Company Limited operates barges (0.9 m maximum draft) on Great Bear River which is navigable except for the 12 km stretch at St. Charles Rapids. A gravel road on the south bank, on which any cargo is portaged by truck, completes the freight transportation system.

The river is the only outflow for Great Bear Lake, the fourth largest and fourth deepest lake in North America with a water surface area of 31,153 km^2, a maximum depth of 452 m and a mean depth of 76 m (Johnson 1966b). The lake has a relatively small drainage area of 145,817 km^2 and has no major inflow river system; consequently the annual lake level fluctuation is seldom greater than 0.2 to 0.3 m and the water residence time, as estimated by Johnson (1975a), is 124 years. The Great Bear River's discharge is well regulated; the minimum and maximum recorded in 1974 was 493 and 578 m^3/sec respectively while the annual mean discharge was 535 m^3/sec. Water survey records show that the average annual mean discharge between 1963 and 1974 was 564 m^3/sec (Anon. 1976).

Major tributaries to the Great Bear River include the Brackett River, St. Charles Creek, Wolverine Creek, Stick Creek, Rosalie Creek, Porcupine River and an unnamed stream designated in this report as Mountain Creek (Fig. 2).

The crystal clear waters of Great Bear River provide a remarkable contrast at the confluence with the Mackenzie River where a distinct zonation of silty Mackenzie water and clear Bear River water is visible for many kilometers downstream on the Mackenzie. While the visual zonation may be apparent for up to 10 km, a temperature zonation has been measured as far as 600 km downstream (Mackay 1972).

Freeze-up occurs between mid-October and late November while break-up begins in mid-May. The ice pack is heaviest at St. Charles Rapids where ice accumulations up to 7 m thick are not uncommon. The vegetation trim line caused by ice along the river bank at the Mountain Creek confluence was observed to be about 15-25 m above the summer water level of Great Bear River. While the river is generally ice-free by mid-June, large quantities of ice, carried by the current, may appear in July as a result of Great Bear Lake's break-up, which in some years is not complete until late July.

The river valley is bordered through the greatest part of its length by steep banks which are from 10 to 40 m above the waters. Mature stands of black spruce and a dense ground cover of lichen and moss cover the slopes. Active slumps and landslides are prominent features in some areas below St. Charles Rapids. Details of the river valley physiography and geology are described by Crippen and Associates (1972) and Thurlow and Associates (1973).

Fort Norman and Fort Franklin are the two nearest settlements with populations of 282 and 404 persons respectively. Domestic fishing by Fort Norman residents is conducted at the mouth of the Great Bear River during the ice-free period. Fort Franklin residents prefer to fish in Great Bear Lake and until recently, only a few individuals fished Porcupine River during the Arctic grayling spawning runs. Residents from Fort Franklin provide guide services to sport fishermen seeking Arctic grayling at the lake outflow and in the first 10 km reach of Great Bear River.

METHODS AND MATERIALS

SAMPLING LOCATIONS

Great Bear River and Great Bear Lake outflow were sampled at 22 different locations or reaches (Fig. 3) between June 12 and September 20, 1974. The uniformity of the shoreline in most areas, and particularly the fast waters and shallow depth of water, limited both access to shore and the choice of suitable sampling sites. Generally from one to four locations were sampled in each reach during the season and, because of their proximity and similarity, were given the common location (loc.) number assigned to that particular reach. Suitable gill net sampling sites were generally in areas behind a large boulder or in back-eddies with a minimum depth of two meters. Nets were effective in Great Bear River only when set parallel to the stream flow in the transition zone between fast and slower waters. Netting in each tributary was done at its confluence with Great Bear River where it was possible to orient the gill nets perpendicular to the tributary's current. The field crew was based at a campsite on the north bank about 3.2 m above St. Charles Rapids (Fig. 3).

Location numbers in each tributary were prefixed by the appropriate initial letter and began with number one at the confluence with Great Bear River (e.g. Wolverine Creek confluence was designated as location W1).

The Great Bear River had been sampled in previous years at eight of the locations shown in Fig. 3 by the Fisheries and Marine Service crew based in Norman Wells. In 1971, Fort Norman and B1 were sampled regularly (Hatfield et al. 1972a). In 1972, Fort Norman, B1, 22 and C1 were included in the season's sampling schedule while W1, S1, P1 and 6 were visited in the fall when helicopter support was available (Stein et al. 1973a, 1973b). Fort Norman was the only location sampled in 1973 (Jessop et al. 1974). Additional fish samples were collected from B1, C1 and P1 in 1971 (Hatfield et al. 1972b) and from C1, S1 and P1 (Dryden et al. 1973). Shotten (1973) also sampled locations B1 and the lake outflow (loc. 6) in 1972.

CAPTURE TECHNIQUES

During 1971 to 1973 a variety of gill nets was used to capture fish for detailed analysis (1971) and for tagging (1972-73). The gill nets used were 18 m gangs (3 m panels of 3.8, 5.1, 7.6, 10.2, 12.7 and 14 cm stretched mesh); 22.9 m gill nets of 7.6 or 10.2 cm stretched mesh were occasionally used to capture fish for tagging. All nets were 1.8 m deep. Beach seines were used to capture juveniles and small fish species.

Fish capture gear in 1974 included the following:

(a) Downstream fence and trap on Wolverine Creek,

(b) Gill net gangs as described in the previous paragraph,

(c) Beach seine (12 m x 3.7 m; 20 mm oval delta mesh,

(d) Minnow traps, and

(e) Fry traps.

Early in the 1974 season, between June 12 and July 19, a downstream fish counting fence and trap was constructed on Wolverine Creek, about 100 m upstream from its confluence with Great Bear River. The objectives were to obtain an actual count of Arctic grayling in the post-spawning run and to tag as many of these downstream migrants as possible to determine their subsequent distribution in the Great Bear River drainage.

Gill nets were used for index fishing for adult fish in the Great Bear River and tributary mouths. An attempt was made to sample each location at least once every two weeks in an effort to determine species composition, distribution, relative abundance, migration routes and times of migration.

Possible nursery areas were located using beach seines and minnow traps while fry traps and minnow traps were used to determine the period of downstream movement of small fish in Porcupine, Rosalie, Stick, Wolverine and Mountain creeks.

TAGGING PROGRAM

In order to evaluate the summer distribution of Arctic grayling after a spawning run in a tributary, a sub-sample of each day's downstream post-spawners was tagged at Wolverine Creek between June 12 and July 19, 1974. Fish larger than 15 cm in fork length were tagged at the posterior base of the dorsal fin with a coded, fluorescent orange Floy-type tag. Fork length and a scale sample were taken from each fish which was immediately released below the fence after tag insertion.

Between 1972 and 1974, the Fisheries and Marine Service crew in Norman Wells conducted a tagging study on the post-spawning run of Arctic grayling in Three Day Lake, a west side Mackenzie tributary drainage near Norman Wells (Fig. 1). Results of each year are summarized in Stein et al. (1973a, 1973b), Jessop et al. (1974) and Jessop and Lilley (1975). Grayling from this population have been recaptured in the Great Bear River each year by sport and domestic fishermen and efforts were made in 1974 to detect the time of arrival of these Three Day Lake migrants in our index gill net catches.

CATCH ANALYSIS - FIELD

Fish from gill nets and a daily sub-sample from the fish fence were sampled for weight (g), fork length (mm), sex and maturity. A scale sample from the area above the lateral line beside the dorsal fin was taken for age determination. Otoliths were also taken from Arctic grayling and lake trout and were stored in a 50% glycerin solution. Stomachs were taken from gill net caught fish and preserved in 10% formalin for further analysis.

Small fish caught in beach seines, fry traps and minnow traps were preserved in 10% formalin and brought back to Winnipeg for further analysis.

CATCH ANALYSIS - LABORATORY

Specimens from seine catches were identified using the taxonomic keys in McPhail and Lindsey (1970) and Scott and Crossman (1973). Several specimens were sent to the Canadian Museum of Natural Science for verification of our identifications. An alphabetical list of common names and associated generic names for fish species encountered is given in Appendix 1.

Ages were determined by placing scales between glass slides and counting annuli on the magnified image (50-80x) projected in a Leitz trichinoscope. Otoliths were read directly under a dissecting microscope after charring in a bunsen flame to enhance contrast. Arctic grayling otoliths were aged without reference to the corresponding scale age so that a comparison between the two methods of ageing could be made.

Stomach samples were examined to identify and record the occurrence of all food items.

Length-weight relationships were calculated according to the equation:

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

where W = weight in grams (g)

a = y-intercept

b = slope of the regression line

L = length in millimeters (mm)

S_b = standard deviation of b

Data collected during the study were analysed using a Hewlett-Packard Model 9810-A programmable calculator and computer facilities based at the University of Manitoba.

Tag returns from field crews, sport and domestic fishermen were analysed to determine migration routes and fish movements. Data for the 1974 post-spawning dispersal of Arctic grayling from Three Day Lake near Norman Wells have already been included in the 1974 report on the Mackenzie River fish resource study (Jessop and Lilley 1975).

WATER CHEMISTRY AND TEMPERATURE

A Hach kit (Model AL 36B) was used to measure the dissolved oxygen, pH, alkalinity, total hardness, acidity and dissolved carbon dioxide at selected locations. Conductivity was measured with a Yellow Springs Instrument Company conductivity meter (YSI Model 33 S-C-T). On site temperatures were measured with an Ertco pocket thermometer while Taylor maximum and minimum thermometers were maintained at camp to measure the daily air and water temperature range at that location on Great Bear River. A Ryan recording thermometer (Model D 15) was also installed in Wolverine Creek at the fish fence site to provide a continuous record of water temperature.

RESULTS AND DISCUSSION

PHYSICAL AND CHEMICAL CONDITIONS

Table 1 summarizes the results of on-site water chemistry determinations at tributary and Great Bear River locations. Oxygen saturation ranged ranged from 85 to 108% and pH readings were between 7.5 and 9.0. The ranges of chemical parameters in Great Bear River (loc. 1 and 21) appear consistent with those from other systems subject to partial shield drainage, as summarized by Armstrong and Schindler (1971).

The levels of readings at location 23 on Great Bear River would suggest that Brackett River water was actually sampled and that the waters of the two rivers had not fully mixed as far as 5 km from the confluence. When viewed from an aircraft, the relatively dark, silty water of Brackett River was seen to flow along the north bank of Great Bear River contrasting with the Great Bear River's clear waters. This lateral zonation is maintained almost until the confluence of Great Bear and the Mackenzie rivers.

Air and water temperatures recorded during the survey (mid-June to late September, 1974) are shown in Fig. 4. The maximum air temperature of 30°C occurred on 3 August and the minimum of -5°C on 11 September. Water temperatures in Great Bear River ranged from 14.4°C on 13 July to 1.7°C on 13 September. The water temperature in Wolverine Creek reached its highest on 17 June with 18°C, while a low of 3.5°C was recorded on 11 September.

SPECIES DISTRIBUTION

The distribution of fish species caught by Fisheries and Marine Service between 1971 and 1974 is presented in Figs. 5 to 13. Twenty-five species were recorded. Table 2 is a checklist of species recorded at major locations, moving upstream from Fort Norman to Great Bear Lake.

It is apparent from Table 2 that the diversity of species decreases upstream. Johnson (1975b) described 16 species as having been recorded in Great Bear Lake while as many as 29 species have been identified in the adjacent Mackenzie River (Hatfield et al. 1973a, 1973b; Stein et al. 1973a, 1973b; Dryden et al. 1973; Jessop et al. 1974). Broad whitefish, least cisco, white sucker, yellow walleye, flathead chub, goldeye and Arctic lamprey were only found in the lower reach below the Brackett River confluence (loc. B1) and may be considered as Mackenzie River species. Arctic cisco, inconnu, longnose dace and trout-perch were found only as far upstream as St. Charles Creek or St. Charles Rapids. The latter presumably constitutes a barrier to the upstream distribution of these species. An employee of Northern Transportation Company Limited claimed to have caught Arctic cisco by angling above the rapids in August of previous years; however, his identification of the species has not been substantiated.

Specimens of mountain whitefish, Arctic cisco, least cisco, white sucker, longnose dace and spottail shiner were the first reported from the Great Bear River. Shotten (1973) reported catching least cisco at Brackett River and spottail shiner at Great Bear Lake outflow. He also caught northern pike, burbot and lake chub at the outflow (Table 2). Except for mountain whitefish, all species identified were within their known geographical range.

All the species recorded for Great Bear Lake (Johnson 1975b), except for chum salmon, *Oncorhynchus keta* (Walbaum) and deepwater sculpin, *Myoxocephalus quadricornis* (Linnaeus), were also captured in Great Bear River. The latter species, although widely distributed in the lake, almost exclusively inhabits waters deeper than 3 m (Johnson 1975b).

SPECIES COMPOSITION AND NUMERICAL ABUNDANCE

Eleven species were captured in the gill netting program in 1974 (Table 3). Access to locations below St. Charles Rapids was limited and consequently were not given equal sampling frequency (Table 4). A few observations, however, can be made from the catch. The dominant species was Arctic grayling, which constituted 40.1% of the catch, followed by northern pike (19.5%), longnose sucker (13.4%), and round whitefish (8.4%). Lake trout and lake cisco were caught in the fall at the lake stations (loc. 1 to 5) while Arctic cisco, inconnu and humpback whitefish were captured at St. Charles Creek in September. One specimen, identified in the field as an Arctic char or Dolly Varden, was taken at Stick Creek (loc. S1); however, the specimen was not kept so that its proper identification remains unconfirmed.

A summary of the numbers and size range of fish caught in 1971 to 1973 in gill nets at Fort Norman and the Brackett River confluence (loc. B1) is shown in Table 5. Fish caught upstream of the Brackett River confluence in 1972 are shown in Table 6. Sampling methods were not standardized, as a variety of gill nets were used to capture fish, primarily for tagging; however, the information was useful in determining the species distribution in Great Bear River prior to the 1974 survey.

Juveniles of six large species and six small fish species were taken with beach seines and minnow traps during 1974 (Table 7). Most sampling sites were at suitable gravel or sand bars found at the confluence of tributaries. Arctic grayling was numerically the most dominant (986) of the larger species, followed by longnose sucker (319) and round whitefish (184). No juvenile northern pike were caught at these locations.

Catches of small fish taken in fry or minnow traps set upstream in selected tributaries are listed in Table 8. Fry traps were not very successful at catching Arctic grayling fry; the relatively large numbers at location M1 were caught only in minnow traps. Slimy sculpin were taken in large numbers at Wolverine, Stick, Rosalie and Porcupine creeks in mid-August.

Table 9 shows the numbers of fish captured with beach seines in the Brackett River, St. Charles and Porcupine Creek locations in 1971 and 1972. The large numbers of fish sampled at Brackett River relative to the other locations is primarily an artifact resulting from greater sampling frequency; however, greater species diversity in this area and the presence of a larger shallow, backwater habitat at Brackett River were invariably reflected in each catch. Lake chub and longnose suckers were the most numerous of all species caught at Brackett River. The only mountain whitefish juvenile recorded in Great Bear River was also caught here in 1972 (Stein et al. 1973a).

WOLVERINE CREEK COUNTING FENCE

The total number of fish released at the fish fence between 12 June and 8 July included 8,973 Arctic grayling (Fig. 14), 591 longnose sucker and 68 northern pike (Fig. 15). Counts were usually made between 1000 and 1800 hours, the peak downstream movement usually occurring at approximately 1300 hours, when daily water temperatures reached maximum. Although the trap was closed off after a day's work, the fence was damaged almost every night up till 25 June by black bears, thereby allowing fish to escape downstream until our return the next morning. The proportion of Arctic grayling that moved downstream during our absence is unknown. The fence was removed in early July when no more fish movements down the river were observed.

Arctic grayling actively moved downstream between 12 and 27 June, with the peak occurring on 17 June (Fig. 14), when the highest maximum stream temperature of 18°C was recorded. The range of maximum water temperature during this period was 14 to 18°C and the minimum ranged from 11.5 to 14°C (Fig. 4). A total of 1,733 grayling or 19.3% of the count of live fish were tagged. An additional 96 fish were randomly taken from the trap and sampled while 169 fish found dead on the fence constituted fence mortalities; most of the latter, however, were badly decomposed and had apparently perished upstream.

Longnose suckers comprised only 6.2% of the total number of fish counted. The two peaks in Fig. 15 correspond with the two periods of greatest grayling counts (Fig. 14) suggesting that the post-spawning run of both species was concurrent. Fence mortality of suckers was low, numbering only ten fish.

Northern pike suffered the greatest mortality at the fence. Unlike Arctic grayling or longnose suckers, this species could not swim away once entrapped by the current against the fence. From one to eleven fish per day suffered mortality during each night, totalling 57 fish. Any northern pike encountered during the day were released downstream without any further handling. Most were immature fish in the 330 to 420 mm fork length range.

TAGGING PROGRAM

A total of 1,928 fish, including 1,733 Arctic grayling and 185 longnose suckers were tagged by the Great Bear River crew in 1974. While most of the tagged fish were released at Wolverine Creek in June, 10 of the Arctic grayling, caught by angling, were tagged in Great Bear River on 9 and 10 June, at location 11 (Fig. 3).

While none of the above tagged fish were recaptured in our survey gill nets, sport and domestic fishermen were successful in recapturing 22 fish (Table 10). All fish were recaptured either at Great Bear Lake outflow (loc. 6) or within the first 10 km reach of the river (loc. 7). The earliest recapture occurred at loc. 6 on 25 June, 12 days after its release at Wolverine Creek, while the rest of the fish were recaptured 14 to 88 days later.

The lake outflow is acknowledged as one of the best angling locations for Arctic grayling and its sport fishery potential is utilized only by a limited number of local and non-resident anglers. Miller (1946) observed the greatest numbers of grayling in this location during his 1945 survey of Great Bear Lake. Although none were caught in our gill nets or angling efforts, tagged Arctic grayling from Wolverine Creek, easily spotted with their attached fluorescent orange tags, were occasionally seen by the field crew at various locations along the first 10 km reach of the river (loc. 7) (R. A. Cameron, personal observations).

Arctic grayling - Thymallus arcticus (Pallas)

Length-frequency distribution: The percent frequency distribution of length of Arctic grayling caught during 1974 in gill nets is shown in Fig. 16. The size range sampled was 160 to 460 mm fork length with the modal fork length group, 401 to 420 mm, comprising 29.7% of the sample. Fish greater than 421 mm in length constituted 24.1% of the population.

The length-frequency distribution of a subsample (20.4%) of the post-spawning run at Wolverine Creek is also shown in Fig. 16. Except for one small fish (138 mm), all fish successfully trapped at the fence ranged from 200 to 460 mm in fork length. A major mode in the 401 to 420 mm class was also evident. In addition, there was a smaller mode in the 281 to 300 mm class. The dominant length class made up 31.5% of the sample and only 8.6% were equal to or greater than 421 mm.

Length-weight relationship: The length-weight relationship for 143 Arctic grayling from gill net catches in Great Bear River between 29 June and 20 September 1974 was as follows:

$$\log_{10}W = -4.864 + 2.961(\log_{10}L)$$

$$S_b = 0.042$$

$$95\% \text{ C.I. of } b = 2.878 \text{ to } 3.044$$

The relationship is also illustrated in Fig. 17 where the scatter diagram of the actual data is plotted.

The length-weight relationship for 96 Arctic grayling sampled between 12 June and 10 July 1974 from the Wolverine Creek post-spawning run was:

$$\log_{10}W = -3.992 + 2.614(\log_{10}L)$$

$$S_b = 0.135$$

$$95\% \text{ C.I. of } b = 2.348 \text{ to } 2.882$$

For both groups the length-weight relationship of males did not differ significantly ($p > 0.05$) from that of females in slope or elevation; therefore data for both sexes were combined. A comparison of the relationships between the fish gill netted in Great Bear River and those taken at the Wolverine counting fence showed a significant difference ($p > 0.05$) in slope and elevation. The former was expected since many of the fish taken from Wolverine Creek downstream run in the spring, especially those fish in a spent condition, were noticeably emaciated.

Age and growth: The scales and otoliths of 99 Arctic grayling were examined separately by the same person and the results are shown in Fig. 18, where for each scale-read age class, the mean and range of otolith-read age for the same fish are shown. The scale age structure encompassed 9 years, while otolith ageing showed the oldest fish to be 11 years. For scale age five or older, the corresponding otolith reading was extremely variable, both exceeding and falling below the scale age. Tripp and McCart (1974) presented a similar analysis of data from Vermilion Creek, a tributary of the Mackenzie River located about 80 km from our upper study area. Although good agreement between the two methods occurred up to age 10, a distinct difference was evident for older fish which tended to be underaged because of crowded scale annuli. The oldest age read from scales for Vermilion Creek was 13 years whereas otolith ages ranged up to 21 years. Because of this effect, also described by McCart et al. (1972) for Arctic grayling in the Alaskan North Slope, other authors have preferred otolith based age determination (Craig and Poulin 1974; deBruyn and McCart 1974; Tripp and McCart 1974). Because no such apparent dichotomy of ageing results appeared in our sample, we did not consider this particular aspect to be a problem.

A comparison of growth in length for each age class from both methods did seem to show that scale ages generally differ from those determined from otoliths for a particular fork length by about one year (Fig. 19). The one year discrepancy can also be inferred from Fig. 18. This strongly suggested that a consistent error was being made by the scale reader, especially in recognizing the first annulus between the scale and otolith; however, both scales and otoliths from several 0+ and 1+ year fish had been concurrently examined initially to facilitate his detection of the first annulus. Identifying the first annulus is a problem that cannot be ignored especially since Kruse(1959) observed how the first annulus may fail to appear in certain years when the growth season is retarded by prolonged ice conditions.

Otoliths were generally difficult to read as only 76% of the sample of 136 were readable. Because the otolith sample size was relatively small (N = 99) compared to the total scale sample from 374 fish, and since detection of the first annulus on scales from our study was not a problem, we decided that scale readings were more reliable and thus were used as the basis of age determination for this report.

The percent-frequency age distribution for grayling taken in 1974 is shown in Fig. 20. The distribution of the subsample (N = 224) from Wolverine Creek and the sample (N = 150) taken from Great Bear River are each superimposed on the combined distribution (N = 374). Of the ten age classes recorded, age 6 was predominant, comprising 22.7% of the total sample. Older fish made up 31.3% of the Great Bear River sample and only 22.2% of the post-spawners at Wolverine Creek.

The age distribution patterns between the two samples are generally similar, except for age class 1 for Great Bear River and age 3 in Wolverine Creek. Age 3 class was the second most dominant one in Wolverine Creek and the mean fork length for this class, 272.0 ± 32.96 mm (Table 11), show that this age class accounts for the second mode in the length-frequency summary for Wolverine Creek (Fig. 16).

Since fish smaller than 201 mm fork length were not trapped by the fence at Wolverine Creek, a poor representation of the 1 year and younger age class was expected. The relatively greater percentage of 1 year olds sampled in the Great Bear River, represented by 13 fish, is misleading, since 4 fish caught with gear other than gill nets were included. These 4 notwithstanding, the smaller mesh sizes in the gill net gangs enabled us to capture these smaller individuals from the population.

Grayling fry were first collected at Wolverine Creek (N = 10) on 26 June at a mean fork length of 23.0 ± 2.3 mm (± standard deviation). By mid-July, fry measured 43.3 ± 3.6 mm (N = 50) while four fish captured on 29 August measured 58.0 ± 10.8 mm (Fig. 21). Fry from Stick Creek generally exhibited slower growth during late spring and early summer; fry taken from 6 to 9 September measured 69.0 ± 5.4 mm (N = 5). The latest date that juveniles were sampled occurred on 16 to 20 September at Mountain Creek, where grayling had attained a mean fork length of 73.2 ± 18.1 mm (N = 39). Water temperatures had not yet reached 0°C (Fig. 4) at the end of sampling and presumably the season for growth had not yet ended. Mean lengths corresponded to results obtained from other drainages in the same geographical area. Collections by Tripp and McCart (1974) of grayling fry in several east side tributaries of the Mackenzie (viz. Donnelly, Hanna, Prohibition, Vermilion and Jungle Ridge) showed that by the fall of 1973, fry had attained mean lengths ranging from 57.4 mm in Vermilion Creek to 84.9 mm in Donnelly River.

Combinations of a variety of habitat conditions among different tributaries can influence the relative growth rate of resident grayling fry. Tripp and McCart (1974) found that growth rates differed significantly even among areas within the Donelly River drainage and related these observations to measurable differences in mean water temperatures and benthic invertebrate densities.

Growth in length and weight for Arctic grayling (N = 374) sampled from Great Bear River and Wolverine Creek are summarized in Table 11 and the growth in length is illustrated in Fig. 22. The early phase of rapid growth takes place up to about age 6 and is followed by a gradual decline. The growth curve of the Great Bear River population is compared with that of other grayling populations from Great Bear Lake, Mackenzie River and Great Slave Lake in Fig. 23. Also included is the growth curve (otolith age) for the resident population of Hodgson Creek which, according to Tripp and McCart (1974), was the slowest growing population reported to date. The growth of Great Bear River grayling, up to about age 7, is similar to that of the population in Great Slave Lake east and Great Bear Lake as reported by Bishop (1967) and Falk and Dahlke (1974). Great Slave grayling appear to attain the greatest length per age class, especially for older fish, and may represent the upper limit of recorded growth curves for this species in the Northwest Territories.

The growth curve for grayling from the adjacent Mackenzie River (Stein et al. 1973b) is also very similar to that of the Great Bear River. Stein et al. (1973b) obtained the curve from their 1972 sample, 60% of which were taken in the spring in Three Day Lake (Fig. 1). The similarity in growth would be expected if these populations inhabit similar or identical habitats in the same geographical area during the season of growth. This notion is supported by results from the tagging program conducted by Fisheries and Marine Service since 1972 and will be discussed further under *Movements and migration*.

Sex and maturity: For a total sample of 226 fish from Wolverine Creek and Great Bear River in 1974, the average sex ratio was 1.38M:1F (Table 12). The ratio for the Wolverine Creek sample, 1.49M:1F (N = 92), was slightly higher than the sex ratio of 1.31M:1F, for the Great Bear River sample (N = 134). Except for ages 3 and 4 years, males generally outnumbered females with the ratio of male to female increasing with age.

Age at first maturity differed between sexes. The youngest males with maturing gonads were at age 2 while the first maturing females were at age 3 (Table 12). All males were mature by age 8 and all females by age 7. Miller (1946) observed that some grayling from his Great Bear Lake collection reached sexual maturity during their fourth summer (35% of the 3 year old fish). A summary of the gonad maturity of 92 grayling sampled from the post-spawning run at Wolverine Creek (Table 13) showed that sexual maturity, as evidenced by spent gonad condition, was attained as early as 4 years by females. For ages 5, 6 and 7 years, the percentage that had spawned was 54%, 73% and 81% respectively.

Food habits: A total of 138 stomachs from Arctic grayling were examined. Dipteran adults, plecopterans, chironomid larvae and corixids were the most common aquatic food items (Table 14). Terrestrial insects occurred in 58% of the stomachs.

The data displayed the opportunistic feeding nature of this species. A wide assortment of food items is almost the rule, with the dominant items reflecting both local and seasonal abundance and availability. Miller's (1946) samples from Great Bear Lake had a high percentage (93%) of terrestrial insects. Amphipods and corixids were the major organisms in grayling feeding at Chick Lake outflow on the Donnelly River, a major Arctic grayling summer habitat in the same geographical area (Tripp and McCart 1974). Spawners and post-spawners in Three Day Lake near Norman Wells (Fig. 1 and 24) were feeding on chironomid larvae (91% occurrence) and amphipods (64% occurrence) when examined in June 1974.

Movements and migrations: The distribution of tagged grayling released at Wolverine Creek during the post-spawning migration was discussed in the section : TAGGING PROGRAM. During the summer, tagged Arctic grayling from outside the Great Bear River drainage, viz. Three Day Lake near Norman Wells (Fig. 24), were recaptured by sport and domestic fishermen as well as by our field crew. The recaptures in 1974 (Jessop and Lilley 1975) followed the same pattern as in previous years, as described by Stein et al. (1973a, 1973b) and Jessop et al. (1974). Since the data are pertinent to the Great Bear River, a summary of all the information is useful here.

During the summer of 1972, 1973 and 1974, 1130, 1045 and 1255 Arctic grayling respectively, were tagged by the Fisheries and Marine Service crew based in Norman Wells. During May and June of each year 861, 818 and 1142 in the respective years, were tagged in Three Day Lake (Fig. 24, loc. 26) during the annual post-spawning run out of the lake and its headwater drainage. Almost all tag returns came from this population. Domestic fishermen fishing at Stewart Creek mouth (loc. 25), Bluefish Creek (loc. 24) and Fort Norman (loc. 23) caught appreciable numbers of these tagged fish in late June and July while both sport and domestic fishermen captured additional tagged fish in Great Bear River in late summer and fall. The following paragraphs describe each year's tag returns.

A. Arctic grayling recaptured in 1972. In the first year of the study, the temporal and locational sequence of recaptures corresponded with increasing distance from the release site in Three Day Lake (Table 15). This movement and ultimate dispersal out of Three Day Lake is illustrated in Fig. 25. There were some recaptures within 3 days during a visit to Three Day Lake in September to tag the immature grayling still present in the lake in the fall.

B. Arctic grayling recaptured in 1973. During 1973, domestic fishermen at Stewart Creek, Bluefish Creek and Fort Norman recaptured Three Day Lake fish tagged both in 1972 and 1973. A greater number were also recaptured in Great Bear River that year. Recaptures made in 1973 are summarized in Table 16, and illustrated in Fig.'s 26 and 27.

C. Arctic grayling recaptured in 1974. During 1974, 271 Arctic grayling from Three Day Lake were recaptured; 42 were fish tagged in 1972, 44 were tagged in 1973 and 185 in 1974. A summary of these recaptures is given in Table 17 and the movements are illustrated in Fig.'s 28, 29 and 30. In addition one grayling tagged at St. Charles Creek in August 1972 was caught at Bluefish Creek (loc. 25) in late June 1974.

Recaptures in the Great Bear River did not involve fish exclusively from Three Day Lake. Among tags returned to us were some from Arctic grayling tagged in the Donnelly System by Aquatic Environments Ltd. in June and July 1972. These recaptured fish were caught during 1972 and 1973 in Great Bear River and at three other locations (Fig. 31) in the Norman Wells study area (Tripp and McCart 1974).

The recapture of Three Day Lake tagged fish in 1972, 1973 and in 1974 provides evidence of an annual progressive movement of post-spawners from Three Day Lake toward the Great Bear River. The general movement pattern observed is: (a) from Three Day Lake (Fig. 24, loc. 26) down Stewart Creek to its confluence with the Mackenzie (loc. 25) by mid to late June; (b) upstream to Bluefish Creek area (loc. 24) by late June; (c) upstream to the confluence to Great Bear and Mackenzie rivers (loc. 23) by late June, and (d) upstream on Great Bear River as far as the outflow of Great Bear Lake (loc. 6) during July, August and September. These observations would seem to indicate that a major portion of the Three Day Lake spawning population migrated to and remains in the Great Bear River during summer and fall. It is very likely that the Great Bear River is the major overwintering area for this population.

Further inspection of the 1974 results (Table 17) show that the sequence, timing and location of recaptures, as well as the concurrent capture of fish tagged in 1972, 1973 and 1974 are noteworthy. Not only does it emphasize the post-spawning migration pattern, but is also suggests that grayling return annually to the same spawning areas in the Three Day Lake drainage. During the June tagging operation in Three Day Lake, the recaptures of grayling, initially tagged and released there one and two years previously, demonstrated an annual return of grayling after ice breakup in May. Moreover, a survey of winter conditions in Three Day Lake in February 1974 indicated that suitable overwintering conditions did not exist in the lake. Its outflow stream, Stewart Creek, has significantly reduced flows by mid-summer besides being blocked by numerous beaver dams. Thus it seems likely that these fish spend a summer and winter in more suitable areas and then only return to Three Day Lake as part of the spawning run. Whether these observations are proof of reproductive homing or not has not been conclusively shown since the gonad condition of live tagged fish cannot be determined accurately. Tripp and McCart (1974) also encountered a similar situation for the Donnelly River grayling population.

The dispersal of fish from Three Day Lake may not be entirely upstream on the Mackenzie River since one grayling was recaptured in the Donnelly River in the spring, one year after its release in Three Day Lake (Fig. 2). Also, our capture of one grayling, tagged in Three Day Lake in June 1973, among the post-spawning run at Wolverine Creek in June 1974 indicates that a minor dispersal to other spawning areas occurs. It is not likely then, that adjacent river systems other than the Great Bear River which are rarely or never fished by sport or domestic fishermen, may well be utilized in the summer by some of the Three Day Lake fish.

It is also possible that Arctic grayling from adjacent river systems undergo similar migration patterns to and from the Great Bear River even though each river provides a suitable habitat for a resident population throughout the year. Recaptures of Donnelly River fish (tagged by Aquatic Environments Ltd.) in Great Bear River (Fig. 31) would seem to support this suggestion. Other rivers which would fit this category include the Keele and Redstone rivers (Fig. 1) and the Carcajou, Mountain, Oscar and Hanna rivers (Fig. 24).

There are also small streams which have appreciable flows in the spring and summer and are almost dry in the fall. Many are suitable as spawning and nursery streams and, in some cases, possess the capability to maintain overwintering pools for juveniles (McCart 1974). The adult spawning population may thus reside in these streams only in the spring and may need to spend the remainder of the year in a suitable summer feeding area and overwintering site. Unlike the Fort Simpson area, the Mackenzie River in the Norman Wells-Fort Norman reach does not appear to provide suitable summer habitat, as observed in the Fisheries and Marine Service surveys between 1971 and 1974. It is therefore feasible that post-spawning adult grayling from small tributaries spend the summer and winter in the Great Bear River as is the case for the Three Day Lake population. Examples of these minor streams include Canyon, Jungle Ridge, Prohibition, Vermilion, Nota and Bluefish Creek located on the east bank of the Mackenzie between Norman Wells and Fort Norman (Fig. 24).

Northern pike - Esox lucius (Linnaeus)

Seventy northern pike were caught in 1974 in Great Bear River with gill nets Table 18; most were caught in the mouths of tributaries such as Porcupine River, Stick Creek and Brackett River (Fig. 2). Backwater and reduced flow conditions, expecially at Porcupine River, provided the most suitable summer habitat for this species.

Northern pike ranged in size from 335 to 738 mm fork length , 54% of which were in the 520 to 620 mm size range (Fig. 32). Up to 17 northern pike per day were counted incidentally among grayling and longnose suckers moving downstream at Wolverine Creek in June and early July (Fig. 15). As previously mentioned, these were immature fish in the 330 to 420 mm fork length range.

Sixty percent of the pike taken in gill nets were in the 5, 6 and 7 year age groups (Table 18); the maximum age in the population was 10 years. The maximum age reported for pike in the adjacent Mackenzie River was 17 years (Stein et al. 1973b) with about 80% being in the 5 to 7 age groups. The oldest fish found in Great Bear Lake by Miller and Kennedy (1948b) was 18 years. The minimum age at maturity was 2 to 3 years while the female to male sex ratio was 1:1.

The length-weight relationship for northern pike (N = 70) was:

$$\log_{10}W = -4.920 + 2.926(\log_{10}L)$$

$$S_b = 0.094$$

95% C.I. of b = 2.739 to 3.113

A comparison of length-weight relationships indicated no significant differences ($P > 0.05$) between males and females in slope or elevation and therefore the data for the two sexes were combined for the calculation.

Comparisons of length-age relationships (Fig. 33) show that the relative size of Great Bear River northern pike, up to 7 years of age, is greater than that of the population from the adjacent Mackenzie River (Hatfield et al. 1972b; Stein et al. 1973b) or Great Bear Lake (Miller and Kennedy 1948b); however, recent length-age statistics from Great Bear Lake (Falk and Dahlke 1974) are consistent with the data for Great Bear River.

Forty-six percent of the northern pike had empty stomachs. The rest had fed almost exclusively on fish, with sculpins being the most frequent species identified. Other fish species among the stomach contents included Arctic grayling, humpback whitefish, lake cisco and Arctic cisco (Table 19).

Longnose sucker - Catostomus catostomus (Forster)

Longnose sucker was the third most frequently caught species with gill nets in Great Bear River in 1974 (Table 3). Adults have been found throughout the study area (Table 2, Fig. 10) while juveniles and fry were caught in most of the tributaries, especially at Stick, St. Charles, Wolverine Creek (Table 7) and the Brackett River (Table 9).

The fork length of adults caught in 1974 ranged from 324 to 491 mm (Fig. 32) and is consistent with the size ranges sampled in St. Charles and Brackett River area in previous years (Table 5 and 6). The 421-460 mm length class was dominant, making up 25% of the sample. The sex ratio was 2.1 females:1 male. No age determinations were made. Longnose sucker in this fork length range in the adjacent Mackenzie River were 10 to 18 years old (Stein et al. 1973b).

Over half of the 34 longnose suckers examined had empty stomachs. The most frequent identifiable food item were chironomidae (Table 20).

Adult longnose suckers migrated out of Wolverine Creek during June. The peak numbers of the post-spawning run occurred at the same time as the Arctic grayling post-spawning run (Fig. 15). Spawning of longnose suckers generally occurs after ice break-up on the tributaries, usually between mid-May to early June. Fry moved out of tributaries by mid-July and young-of-the-year were found in tributary confluences and location 15 on Great Bear River (Table 7) during August and September.

Round whitefish - Prosopium cylindraceum (Pallas)

Adult round whitefish were found along the length of Great Bear River (Table 2, Fig. 9) and juveniles, while abundant at St. Charles and Wolverine creeks, were also taken at lobation 11, 15, Porcupine River and Stick Creek (Table 7).

Adults ranged from 280 to 480 mm in fork length (Fig. 32) while the 440-460 mm length class constituted 35.5% of the sample. Ages ranged from 3 to 12 years with the 10 year age group comprising 30% of the sample (Table 21). Round whitefish caught in 1972 (Table 6) were also between 3 and 12 years old (Stein et al. 1973b). Minimum age at first sexual maturity was 6 to 8 years. Stein et al. (1973b) reported the minimum age to be about 8 years for the Mackenzie River, slightly higher than the 6 to 7 years reported by Kennedy (1949) for Great Slave Lake specimens. The sex ratio was 1.2 females:1 male.

The length-weight relationship of males ($N = 13$) did not differ significantly ($P > 0.05$) from that of females ($N = 16$) in slope or elevation. Therefore, the length-weight relationship of round whitefish ($N = 29$) was:

$$\log_{10}W = -5.759 + 3.299(\log_{10}L)$$

$$S_b = 0.285$$

95% C.I. of b = 2.692 to 2.905

Diptera and chironomid larvae were the identifiable food items in round whitefish stomachs (Table 20). Fish remains occurred in 3 fish. Stein et al. (1973b) found, in addition to the 2 types of invertebrates, trichoptera, plecoptera and plant debris in fish taken in the Mackenzie River during 1972.

Round whitefish fry were first caught on 26 June at Wolverine Creek confluence, where specimens measured 25-33 mm in fork length. By mid-September the juveniles at St. Charles Creek were 41 to 63 mm long. Since no fry or juveniles were caught upstream on the tributaries (Table 8) it cannot be established if spawning took place in tributaries in the previous fall. It is not unlikely that this species spawns in Great Bear River itself since the required gravel spawning substrate is quite common through most of the upper half of the river.

Arctic cisco - Coregonus autumnalis (Pallas)

Seventeen Arctic cisco were caught in 1974 in the reach between locations 21 and 15 on Great Bear River (Fig. 3). No fry or juveniles have ever been taken in the study area.

Arctic cisco were between 344 to 425 mm in fork length (Fig. 32) and were almost all in the 7 to 9 year age classes (Table 22). The minimum age at sexual maturity, based only on one specimen in the sample, was 4 years; however, 7 years appears to be the general minimum age at maturity for the Mackenzie River fish (Stein et al 1973b). Thirteen of the 7 to 9 year old fish, or 76.5% of the total sample, were ripe males or females. The sex ratio was 1.4 females:1 male.

The length-weight relationship of this small sample size ($N = 17$) was:

$$\log_{10}W = -5.759 + 3.299(\log_{10}L)$$

$$S_b = 0.289$$

95% C.I. of b = 2.682 to 3.915

All Arctic ciscos had empty stomachs. Hatfield et al. (1972a) and Stein et al. (1972b) made similar observations for all specimens taken in the Aklavik, Arctic Red River and Norman Wells areas, thereby indicating that adults on spawning migrations up the Mackenzie River rarely feed.

The upstream migration pattern of Arctic cisco from the lower Mackenzie delta and the coast has been described by Fisheries and Marine Service (Hatfield et al. 1972a; Stein et al. 1973b; Jessop et al. 1974; Jessop and Lilley 1975). Migrants appear in the delta in July, reach Arctic Red River and Fort Good Hope by late July and early August, while smaller numbers reach Norman Wells and Fort Norman by early and mid-August. The apppearance of schools of ripe, uniformly sized Arctic cisco, signified by catches in domestic gill nets, is awaited as an annual event. The occurrence of ripe Arctic cisco in Great Bear River after 13 September 1974 confirms a previous supposition that the Great Bear River system serves as a secondary migration route for this species and also possibly provides spawning habitat. Our observations also support the conclusion of Percy (1976) that juvenile and mature non-spawning fish which are present along the coast throughout the summer and fall generally remain there rather than accompany the spawning migration up the Mackenzie River.

Lake trout - Salvelinus namaycush (Walbaum)

Thirty-six lake trout were captured in 1974 (Table 23). Except for one fish taken at location 9 on Great Bear River (Fig. 3), all were captured in August in Great Bear Lake near the outflow (Fig. 3; loc. 1, 2, 3, 4 and 5). No juveniles were found in the river although Stein et al. (1973a, 1973b) recorded juvenile lake trout at the Brackett River confluence. Great Bear River presents less preferable habitat than Great Bear Lake and only the occasional stray lake trout is captured.

The length frequency distribution is shown in Fig. 32. The average fork length was 603 mm (range 236-736 mm) with the majority being in the 580 to 620 mm range. The ages of 32 fish (range 474-736 mm) ranged from 6 to 37 years, 34% of which were aged 19-21 years (Table 23). Falk et al. (1974) found that the modal age class for 1777 lake trout from Great Bear Lake was 20 years, the oldest fish recorded being 53.

A general comparison of both the length-weight and age-length relationship showed that the lake trout from this area (Smith Arm) were similar to that of lake trout from other sections of Great Bear Lake (Falk et al. 1973). A comparison of length-weight relationships showed no significant difference ($P > 0.05$) between male and female lake trout in slope or elevation. Therefore, the data were combined to calculate the equation:

$$\log_{10}W = -5.048 + 3.045(\log_{10}L)$$

$$S_b = 0.096$$

95% C.I. for b = 2.848 to 3.242

On 27 and 28 August, 2 of 9 females (22%) and 14 of 17 males (82%) were ripe and, since no spent fish were caught, it was believed that spawning had not yet commenced. The water temperature in the lake at that time was 7 to 8°C. In his 1963 to 1965 study of Great Bear Lake, Johnson (1975b) observed that spawning took place between 5 and 13 m depth at temperatures between 4.5 and 6°C from 18 August to 4 September.

Ninespine stickleback and lake cisco, plus unidentified fish remains, were recorded in lake trout stomachs (Table 19). Over half of the stomachs examined were empty, an observation similar to that made by Miller and Kennedy (1948a).

Miscellaneous species

Adult lake cisco were only found in Great Bear Lake (Fig. 7) when locations 1, 2 and 4 were sampled in August 1974; however, specimens have been taken in previous years at the Great Bear-Mackenzie River confluence (Table 5). The sample of 8 fish ranged from 186 to 252 mm in fork length and were 3 to 5 years old (Table 24). All fish were immature with a female to male sex ratio of 0.75:1.

Three lake cisco juveniles were taken in the Great Bear River (Table 7, Fig. 7), one upstream in Porcupine Creek (30 mm fork length) in August and 2 at the confluence of St. Charles Creek in September (50-52 mm fork length). The diet of adult lake cisco consisted primarily of adult diptera and terrestrial insects (Table 20).

One male and one female inconnu were caught on 19 September at St. Charles Creek. Both fish were immature, the male being 6 years old and the female 4 years (Table 24). Inconnu were taken at St. Charles Creek and location 22 in the fall of 1972 (Table 6) while many were caught in the Great Bear River mouth at Fort Norman in 1971, 1972 and 1973 (Table 5). No fry or juveniles have been found in the study area.

Catch summaries and tag returns by Stein et al. (1973a, 1973b) and Jessop et al. (1974) revealed that mature inconnu, originating in the Beaufort Sea, migrate up the Mackenzie River. Ripe fish reach the Fort Good Hope and Norman Wells area in August. As with Arctic cisco, the appearance of large, ripe inconnu in August in domestic catches at Fort Norman occurs annually and it was suspected that this species utilized the Great Bear River for migrations and spawning. The absence of significant catches in Great Bear River during the 1971 to 1974 surveys does not support this notion.

Two humpback whitefish, 4 and 6 years old respectively (Table 24), were caught in late September at St. Charles Creek. Both fish were immature. Ripe specimens have been caught in previous years at the Brackett River confluence in 1971(Table 5) and at location 22 in 1972 (Table 6), thus suggesting that some spawning may occur upstream in Great Bear River.

One mountain whitefish (381 mm in fork length) was caught at location 11 (Fig. 3 and 9). This 10 year old fish (Table 24) is the first adult of the species reported for the Great Bear River drainage. The northern extension of range for this species was first reported by Stein et al. (1973a, 1973b) from adults and juveniles taken in the Rabbitskin River (Fig. 1) and juveniles from Oscar and Brackett rivers (Fig. 24).

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Table 1. Water chemistry data for the Great Bear River and tributary locations, 1974.

Station	1	P_1	R_1	S_1	W_1	M_1	C_1	21	B_1	23
Sampling dates	10/9	28/6 3/9	3/7 3/9	29/6 4/9	26/6 4/9	11/9	11/9	18/9	18/9	19/9
Temperature °C	6	17 10	15 10	17 10	15 9	6	8	7	10	10
Dissolved O_2 (ppm)	12	8 11	10 11	9 10	11 10	12	11	11	12	12
% saturation O_2	95	82 97	98 97	92 87	108 85	95	92	90	105	105
pH	7.5	8.5 8.5	8.5 8.5	8.5 8.5	8.5 7.5	8.0	8.5	8.5	9.0	8.5
Conductivity (μmhos)	n.t.	85 75	95 105	135 122	50 148	168	162	95	352	320
Total hardness (mg/ℓ $CaCO_3$)	68	86 103	86 86	103 103	103 103	171	120	86	171	154
Alkalinity - methyl orange (mg/ℓ $CaCO_3$)	51	86 103	86 103	34 86	17 68	86	120	68	140	120
Alkalinity - phenopthalein (mg/ℓ $CaCO_3$)	0	0 0	0 0	0 0	0 0	0	0	0	0	0
Total acidity (mg/ℓ $CaCO_3$)	17	17 34	17 34	34 17	6 17	34	34	17	34	34
Free acidity (mg/ℓ $CaCO_3$)	0	0 0	0 103	0 0	0 0	120	0	0	0	0
Dissolved CO_2 (ppm)	10	5 10	5 10	10 10	10 10	10	10	10	10	10

Table 2. List of fish species recorded by Fisheries and Marine Service at nine locations on the Great Bear River, 1971-1974.

SPECIES	LOCATIONS								
	Fort Norman	Brackett R. (B)	St. Charles Ck. (C)	Mountain Ck (M)	Wolverine Ck (W)	Stick Ck (S)	Rosalie Ck (R)	Porcupine Ck (P)	Gt. Bear Lake (6)
Arctic grayling	√	√*	√	√	√	√	√	√	√*
Arctic char - Dolly Varden	√	-	-	-	-	√	-	-	-
lake trout	-	√	-	-	-	√	-	-	-
inconnu	√	√	√	-	-	-	-	-	-
humpback whitefish	√	√	√	-	-	-	-	-	√
broad whitefish	√	-	-	-	-	-	-	-	-
round whitefish	√	√*	√	-	√	√	-	√	√
mountain whitefish	-	√	-	-	-	-	-	-	-
Arctic cisco	√	√	√	-	-	-	-	-	-
lake cisco	√	√	√	-	-	-	-	√	-
least cisco	√	*	-	-	-	-	-	-	-
northern pike	√	√*	√	-	√	√	-	√	-*
burbot	√	√	-	-	-	-	-	√	-*
yellow walleye	√	√	-	-	-	-	-	-	-
longnose sucker	√	√*	√	√	√	√	-	-	√*
white sucker	√	√	-	-	-	-	-	-	-
flathead chub	√	-	-	-	-	-	-	-	-
lake chub	-	√*	√	-	√	-	-	√	-*
longnose dace	√	√	√	-	-	-	-	-	-
spottail shiner	√	√	-	-	-	-	-	-	-*
goldeye	√	-	-	-	-	-	-	-	-
slimy sculpin	-	√*	√	√	√	√	√	√	√*
trout perch	-	√*	√	-	-	-	-	-	-
Arctic lamprey	√	√	-	-	-	-	-	-	-
ninespine stickleback	-	-	-	√	√	√	-	√	√

* Species recorded by Shotten (1973).

Table 3. Species composition and numbers of fish captured in gill nets in the Great Bear River, 1974.

SPECIES	CATCH PER BIWEEKLY PERIOD							TOTAL
	17 June to 30 June	1 July to 14 July	15 July to 28 July	29 July to 11 Aug.	12 Aug. to 25 Aug.	26 Aug. to 8 Sept.	9 Sept. to 22 Sept.	
Arctic grayling	1	5	5	62	39	19	13	144
northern pike	7	11	11	15	11	1	14	70
longnose sucker	2	6	7	11	12	8	2	48
lake trout	-	-	-	3	6	27	-	36
round whitefish	2	2	2	6	8	10	-	30
Arctic cisco	-	-	-	-	-	-	17	17
lake cisco	-	-	-	-	4	4	-	8
inconnu	-	-	-	-	-	-	2	2
humpback whitefish	-	-	-	-	-	-	2	2
mountain whitefish	-	-	1	-	-	-	-	1
Arctic char-Dolly Varden	1	-	-	-	-	-	-	1
TOTAL	13	24	26	97	80	69	50	359

Table 4. Frequency of sampling (per weekly interval) with standard gill nets at Great Bear River locations, 1974.

WEEK	LOCATIONS																											
	1	2	3	4	5	6	7	P_1	8	9	S_1	10	W_1	11	12	13	M_1	14	15	16	17	18	19	C_1	20	21	22	B_1
9 June - 15 June														1														
16 June - 22 June																												
23 June - 29 June								1			1																	
20 June - 6 July								1			1																	
7 July - 13 July																				1								
14 July - 20 July								1						3														
21 July - 27 July																						1	1	1	1		1	
28 July - 3 Aug.							2		1		1																	
4 Aug. - 10 Aug.			1			1			2		1	1		2														
11 Aug. - 17 Aug.		1		1	1		4		1		1																	
18 Aug. - 24 Aug.								1	2	1	1																	
25 Aug. - 31 Aug.	1	1	1	1	1	1																						
1 Sept.- 7 Sept.							2					1		2														
8 Sept.- 14 Sept.																			2	1		2					1	
15 Sept.- 21 Sept.															1				1				3	2			3	1

Table 5. Number and size range (fork length in millimeters) of fish caught in gill nets at Fort Norman and Brackett River locations on the Great Bear River, 1971-1973.

Species	Locations									
	Fort Norman						Brackett River Bl			
	1971 July - Sept.		1972 June - Aug.		1973 July - Aug.		1971 Sept.		1972 June - Oct.	
	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length
Arctic grayling	3	227-338	5	277-440	1	210	1	373	1	405
inconnu	6	231-442	38	174-324	61	229-646	-	-	-	-
humpback whitefish	39	158-352	12	148-422	70	185-285	1	423	-	-
broad whitefish	1	284	16	160-278	2	243-515	-	-	-	-
round whitefish	-	-	-	-	1	375	-	-	1	360
Arctic cisco	70	286-495	5	220-440	5	212-390	2	354-379	1	338
lake cisco	2	147-240	4	260-394	1	390	-	-	-	-
least cisco	-	-	2	272-376	3	368-402	-	-	-	-
northern pike	1	433	1	295	8	345-570	8	221-580	11	335-575
burbot	4	604-832	4	241-683	3	540-670	-	-	1	845
longnose sucker	19	210-486	25	165-400	42	210-475	-	-	7	352-455
white sucker	-	-	1	192	-	-	-	-	-	-
yellow walleye	2	338-346	2	216-335	6	251-350	-	-	-	-
flathead chub	16	142-290	-	-	4	232-255	-	-	-	-

Table 6. Number and size range (fork length in millimeters) of fish caught in gill nets at upstream locations on Great Bear River, 1972.

Species	Stations											
	22 - 1972 July - Oct.		C1 St. Charles Ck. 1972 Aug. - Oct.		W1 Wolverine Ck. 1972 Sept. - Oct.		S1 Stick Ck. 1972 Sept. - Oct.		P1 Porcupine Ck. 1972 Sept. - Oct.		6 - 1972 Oct.	
	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length
Arctic grayling	68	279-515	9	295-377	23	152-445	5	178-430	6	320-450	15	241-425
inconnu	1	282	2	480-653	-	-	-	-	-	-	-	-
humpback whitefish	5	365-448	3	299-334	-	-	-	-	-	-	-	-
round whitefish	-	-	8	358-432	-	-	-	-	-	-	8	430-480
Arctic cisco	1	293	-	-	-	-	-	-	-	-	-	-
northern pike	10	345-720	25	405-911	4	542-660	47	430-680	28	442-810	-	-
burbot	-	-	-	-	-	-	-	-	2	*	-	-
longnose sucker	10	320-445	8	310-448	-	-	-	-	-	-	-	-
whitefish	-	-	-	-	-	-	-	-	1	374	-	-

* = no length data

Table 7. Numbers of each fish species caught with beach seines and minnow traps at tributary confluences and other locations on the Great Bear River, 1974.

Species	Location										Total
	4	6	P_1	R_1	S_1	W_1	11	C_1	15	B_1	
Arctic grayling	12	-	195	132	285	121	24	201	16	-	986
Round whitefish	-	-	7	-	1	64	1	108	3	-	184
Lake cisco	-	-	1	-	-	-	-	2	-	-	3
Northern pike	-	-	-	-	-	-	-	-	-	-	0
Burbot	-	-	-	-	-	-	-	-	2	-	2
Longnose sucker	-	-	-	-	154	18	2	99	30	16	319
White sucker	-	-	-	-	-	-	-	-	-	1	1
Lake chub	-	-	-	-	-	2	-	383	4	49	438
Longnose dace	-	-	-	-	-	-	-	12	-	-	12
Spottail shiner	-	-	-	-	-	-	-	-	-	11	11
Slimy sculpin	-	10	15	22	24	10	30	14	1	2	128
Trout perch	-	-	-	-	-	-	-	39	-	1	40
Ninespine stickleback	5	-	2	-	1	-	1	-	44	-	53
TOTAL	17	10	220	154	465	215	58	858	100	80	2177

Table 8. Numbers of each fish species caught with fry and minnow traps at upstream locations on tributaries of the Great Bear River, 1974.

Species	Locations						Total
	P_2	R_2	S_2	W_2	M_2	B_2	
Arctic grayling	1	4	13	8	133	-	159
Round whitefish	-	-	-	-	-	-	-
Lake cisco	-	-	-	-	-	-	-
Northern pike	-	-	4	-	-	-	4
Burbot	-	-	-	-	-	-	-
Longnose sucker	-	-	-	15	11	-	26
White sucker	-	-	-	-	-	-	-
Lake chub	-	-	-	-	-	1	1
Longnose dace	-	-	-	-	-	-	-
Spottail shiner	-	-	-	-	-	-	-
Slimy sculpin	70	412	76	222	8	-	788
Trout perch	-	-	-	-	-	1	1
Ninespine stickleback	1	-	11	2	124	-	138
TOTAL	72	416	104	247	276	2	1117

Table 9. Numbers of each species captured with beach seines in the Brackett River, St. Charles and Porcupine Creek locations on the Great Bear River, 1971-1972.

Species	Brackett R. (B1) 1971 July-Sept.	Brackett R. (B1) 1972 June-Aug.	St. Charles Ck. (C1) 1971 July-Sept.	St. Charles Ck. (C1) 1972 June-Sept.	Porcupine Ck. (P1) 1971 July-Sept.	Porcupine Ck. (P1) 1972 June-Sept.
Arctic grayling	27	3	-	9	11	-
round whitefish	4	1	-	-	-	-
mountain whitefish	-	1	-	-	-	-
northern pike	7	-	-	1	1	-
longnose sucker	328	125	72	-	-	-
white sucker	-	1	-	-	-	-
yellow walleye	1	-	-	-	-	-
flathead chub	6	-	-	-	-	-
lake chub	270	586	82	46	-	-
longnose dace	7	-	-	1	-	-
spottail shiner	41	3	-	-	-	-
slimy sculpin	6	14	-	4	-	-
trout perch	19	2	-	8	-	-
ninespine stickleback	-	-	-	-	3	1
(subfamily Coregoninae)	7	1	-	-	-	-
(subfamily Salmoninae)	1	-	-	-	-	-

Table 10. Location and date of recapture by domestic and sport fishermen of Arctic grayling tagged and released at Wolverine Creek, 1974.

Tag No.	Date Tagged	Date Recaptured	Recapture location	Distance from (km)	Time (days)
C00262	13-06-74	25-06-74	6	56	12
C00939	17-06-74	01-07-74	6	56	14
C00074	14-06-74	04-07-74	6	56	20
C00141	13-06-74	04-07-74	6	56	21
C01160	17-06-74	04-07-74	6	56	17
C00554	14-06-74	14-07-74	6	56	30
C00655	14-06-74	14-07-74	6	56	30
C00762	15-06-74	14-07-74	6	56	29
C01272	17-06-74	14-07-74	6	56	27
C01200	17-06-74	15-07-74	6	56	29
C01537	24-06-74	15-07-74	6	56	21
C00068	13-06-74	20-07-74	6	56	37
C00962	17-06-74	01-08-74	7	46	45
C00683	14-06-74	07-08-74	7	51	54
C00286	13-06-74	23-08-74	6	56	71
C00890	16-06-74	23-08-74	6	56	68
C00937	17-06-74	23-08-74	6	56	67
C00504	14-06-74	30-08-74	6	56	77
C00529	14-06-74	05-09-74	7	52	83
C01737	26-06-74	05-09-74	7	52	71
C00670	14-06-74	10-09-74	6	56	88
C00644	14-06-74	*	*	*	*

* = no recapture information given.

Table 11. Mean fork length and mean weight by age for Arctic grayling caught in the Great Bear River, 1974.

Scale Annuli	No. of fish	Fork Length (mm) Mean	Range	S.D.	Weight (gm) Mean	Range	S.D.
1	14	164.2	98-225	35.52	56.1	9-140	35.61
2	28	240.2	203-286	23.31	174.3	100-270	50.12
3	59	272.0	186-339	32.96	269.1	60-520	95.52
4	40	323.3	237-400	43.82	420.5	170-760	143.72
5	51	364.5	290-417	31.52	570.6	290-800	122.20
6	85	403.7	324-456	21.53	716.1	440-940	108.19
7	71	413.0	376-452	15.94	749.1	500-1050	111.54
8	20	421.1	397-448	14.82	756.5	480-980	121.75
9	5	437.0	427-442	6.16	898.0	780-980	79.50
10	1	420.0	-	-	900.0	-	-
Total	374						

Table 12. Sex ratio and maturity by age class of Arctic grayling from Wolverine Creek and the Great Bear River, 1974.

		Percent				
Scale Age	No. Sexed	Males	Mature Males	Females	Mature Females	Total Mature
1	8	50.0	0	50	0	0
2	21	66.7	14	33.3	0	9.5
3	20	45.0	33	55.0	18	25.0
4	19	31.6	33	68.4	85	68.4
5	26	61.5	87	38.5	90	88.5
6	55	56.4	90	43.6	96	92.7
7	54	63.0	88	37.0	100	92.6
8	17	70.6	100	29.4	100	100.0
9	5	80.0	100	20.0	100	100.0
10	1	100.0	100			
TOTAL:	226	58.0%		42%		

Table 13. Maturity of gonads of Arctic grayling by age class from the post-spawning downstream migrants at Wolverine Creek, 12 June to 10 July 1974.

Scale Age	Number Examined	Frequency of Gonad Condition							
		Immature		Maturing and Mature		Ripe		Spent	
		Male	Female	Male	Female	Male	Female	Male	Female
2	16	10	4	2	0	0	0	0	0
3	10	3	2	3	2	0	0	0	0
4	7	0	1	2	3	0	0	0	1
5	13	4	0	1	1	0	0	4	3
6	22	1	0	0	4	1	0	7	9
7	16	0	0	0	1	2	0	8	5
8	6	0	0	1	0	0	1	3	1
9	2	0	0	1	0	0	0	1	0
Total	92								

Table 14. Frequency and percent occurrence of food items in 138 Arctic grayling from the Great Bear River, 1974.

Food Item	N	%
Tricoptera (L)	1	0.7
Plecoptera (L)	50	36.2
Ephemeroptera (L)	18	13.0
Diptera (A)	84	60.9
Diptera (L)	25	18.1
Chironimidae (L)	40	29.0
Hemiptera (Corixidae) (A)	34	24.6
Aquatic Coleoptera (A)	3	2.2
Terrestrial Insects	80	58.0
Odonata (N)	1	0.7
Amphipoda	5	3.6
Nematoda	4	2.9
Conchostraca	2	1.4
Amostraca	2	1.4
Arachnida	4	2.9
Unidentified Invertebrates	72	52.2
Sculpin	1	0.7
Unidentified fish remains	2	1.4
Debris	44	31.9
Empty	4	2.9

(L) = larva

(A) = adult

(N) = nymph

Table 15. Summary of recaptures in 1972 of tagged Arctic grayling released in 1972 in Three Day Lake.

No.	Recapture Location	Recapture Date	Days After Release
5	Three Day Lake	June	1 - 4
2	Stewart Ck (loc. 25)	28 June	6
2	Bluefish Ck. (loc. 24)	30 June - 21 July	6 - 23
2	Ft. Norman (loc. 23)	30 June - 2 July	25 - 26
2	St. Charles Rapids (loc. 16)	15 to 24 July	18 - 29
3	Bear Lake outflow (loc. 6)	31 July - 27 Aug	39 - 60
7	Three Day Lake	September	1 - 3

Table 16. Summary of recaptures in 1973 of tagged Arctic grayling released in 1972 and 1973 in Three Day Lake.

Arctic grayling tagged in 1972

No.	Recapture Location	Recapture Date	Days After Release
9	Three Day Lake	7 - 15 June	334 - 356
5	Stewart Ck. (loc. 25)	14 - 24 June	354 - 372
11	Bluefish Ck. (loc. 24)	18 - 20 June	356 - 365
2	Fort Norman (loc. 23)	26 June	363 - 365
1	St. Charles Rapids (loc. 16)	25 June	365
5	Bear Lake outflow (loc. 6)	15 July - 4 Sept.	384 - 433
1	Donnelly River (loc. 27)	17 June	364

Arctic grayling tagged in 1973

No.	Recapture Location	Recapture Date	Days After Release
8	Three Day Lake	8 - 19 June	1 - 21
7	Stewart Ck. (loc. 25)	19 - 23 June	1 - 13
11	Bluefish Ck. (loc. 24)	9 - 18 June	2 - 15
5	Fort Norman (loc. 23)	18 June - 1 July	12 - 23
2	St. Charles Rapids (loc. 16)	15 July - 15 Aug.	39 - 83
9	Bear Lake outflow (loc. 6)	30 July - 6 Sept.	45 - 93

Table 17. Summary of recaptures in 1974 of tagged Arctic grayling released in 1972, 1973 and 1974 in Three Day Lake.

Arctic grayling released in 1972

No.	Recapture Location	Recapture Date	Days After Release
15	Three Day Lake	May 30 - June 21	715 - 735
6	Stewart Creek (loc. 25)	June 15 - June 28	722 - 742
18	Bluefish Creek (loc. 24)	June 15 - 28	691 - 751
1	Stick Creek (loc. S1)	Sept. 20	814
3	Bear Lake Outflow (loc. 6)	June 20 - Aug. 23	730 - 762

Arctic grayling released in 1973

No.	Recapture Location	Recapture Date	Days After Release
12	Three Day Lake	June 3 - 21	363 - 390
8	Stewart Creek (loc. 25)	June 15 - 28	369 - 379
21	Bluefish Creek (loc. 24)	June 20 - 30*	366 - 387
1	Wolverine Creek (loc. W2)	June 18	370
2	Bear Lake Outflow	July 15 - Sept 10	405 - 452

Arctic grayling released in 1974

No.	Recapture Location	Recapture Date	Days After Release
14	Three Day Lake	June 1 - 23	1 - 22
28	Stewart Creek (loc. 25)	June 4 - 28	1 - 31
136	Bluefish Creek (loc. 24)	June 20 - 28*	4 - 28
1	Fort Norman (loc. 23)	August 29	73
2	Stick Creek (loc. S1)	August 22	64 - 70
1	St. Charles (loc. C1)	August 20	92
3	Bear Lake Outflow	Aug. 22 - Sept. 6	64 - 101

*approximate dates

Table 18. Mean fork length and mean weight by age for northern pike caught in the Great Bear River, 1974.

Scale Annuli	No. of fish	Fork Length (mm) Mean	Range	S.D.	Weight (gm) Mean	Range	S.D.
2	4	383.0	335-420	35.5	440.0	320- 580	109.5
3	4	480.3	405-525	56.1	925.0	560-1200	325.9
4	7	449.1	413-489	28.4	702.1	550- 925	127.5
5	16	558.6	449-641	57.1	1348.1	650-1850	376.4
6	12	568.2	459-667	64.8	1365.4	660-2500	487.9
7	14	592.0	531-711	48.5	1560.7	1000-2900	504.3
8	11	593.3	536-725	53.5	1697.7	1100-2850	641.5
9	-	-	-	-	-	-	-
10	2	701.5	665-738	51.6	2950.0	2800-3100	212.1

Table 19. Frequency and percent occurrence of food items in northern pike, lake trout and Arctic char-Dolly Varden from Great Bear River, 1974.

Food Item	Northern Pike N	%
Arctic grayling	5	8.2
Humpback whitefish	2	3.3
Lake cisco	2	3.3
Arctic cisco	2	3.3
Sculpin	11	18.0
Unidentified fish	14	23.0
Ephemeroptera	1	1.6
Debris	1	1.6
Empty	32	52.6

	Lake trout N	%
Ninespine stickleback	1	10
Lake cisco	1	10
Unidentified fish	2	20
Debris	1	10
Empty	6	60

	Arctic char-Dolly Varden N	%
Sculpin	1	100

Table 20. Frequency and percent occurrence of food items in humpback whitefish, lake cisco, round whitefish and longnose sucker from the Great Bear River, 1974.

Food Item	Round whitefish N	Round whitefish %
Diptera (L)	2	11.8
Chironomidae (L)	3	17.6
Unidentified invertebrates	3	17.6
Unidentified fish	2	11.8
Debris	2	11.8
Empty	10	58.8

	Lake cisco N	Lake cisco %
Diptera (A)	2	40.0
Terrestrial insects	2	40.0
Unidentified invertebrates	3	60.0
Empty	2	40.0

	Humpback whitefish N	Humpback whitefish %
Diptera (L)	2	100

	Longnose sucker N	Longnose sucker %
Chironomidae (L)	5	16.7
Nematoda	1	3.3
Unidentified invertebrates	1	3.3
Debris	11	36.7
Empty	16	53.3

(L) = larva
(A) = adult

Table 21. Mean fork length and mean weight by age for round whitefish caught in the Great Bear River, 1974.

Scale Annuli	No. of fish	Fork Length (mm) Mean	Range	S.D.	Weight (gm) Mean	Range	S.D.
3	1	104.0	-	-	90.0	-	-
4	-	-	-	-	-	-	-
5	2	308.0	305-311	4.2	280.0	240- 320	56.6
6	3	391.7	293-450	85.9	806.7	220-1150	510.5
7	1	337.0	-	-	360.0	-	-
8	2	442.5	431-454	16.3	1062.5	975-1150	123.7
9	6	437.8	342-491	50.1	1100.0	1050-1350	100.0
10	9	433.9	391-455	22.5	958.9	580-1100	194.8
11	3	453.0	411-483	37.47	1083.3	900-1300	202.1
12	3	462.3	448-474	16.86	1283.3	1000-1500	256.6

Table 22. Mean fork length and mean weight by age for Arctic cisco caught in the Great Bear River, 1974.

Scale Annuli	No. of fish	Fork Length (mm) Mean	Range	S.D.	Weight (gm) Mean	Range	S.D.
4	1	353.0	-	-	400.0	-	-
5	-	-	-	-	-	-	-
6	1	357.0	-	-	460.0	-	-
7	4	358.5	344-373	12.0	475.0	440-500	25.2
8	7	390.0	368-425	18.6	615.7	500-850	116.3
9	4	400.5	392-412	8.7	685.0	600-740	61.9

Table 23. Mean fork length and mean weight by age for lake trout caught in Great Bear Lake, above the outflow of Great Bear River, 1974.

Otolith Annuli	No. of fish	Fork Length (mm) Mean	Range	S.D.	Weight (gm) Mean	Range	S.D.
6	1	474.0	-	-	1250.0	-	-
7	-	-	-	-	-	-	-
8	1	500.0	-	-	1600.0	-	-
9	1	555.0	-	-	1750.0	-	-
12	2	615.0	569-661	65.1	2600.0	2050-3150	777.8
13	1	481.0	-	-	1125.0	-	-
14	-	-	-	-	-	-	-
15	3	595.0	582-606	12.1	2616.7	2500-2700	104.1
16	2	649.0	567-731	116.0	3625.0	2500-4750	1591.0
17	3	586.7	576-602	13.6	2466.7	2300-2650	175.6
18	2	618.5	600-637	26.2	3050.0	2500-3600	777.8
19	5	655.6	615-736	52.3	3335.0	2800-3875	474.2
20	2	665.0	597-733	96.2	3525.0	2550-4500	1378.9
21	4	612.3	602-636	16.0	2850.0	2450-3350	406.2
22	1	588.0	-	-	2650.0	-	-
23	1	583.0	-	-	2150.0	-	-
24	1	565.0	-	-	2650.0	-	-
31	1	680.0	-	-	3550.0	-	-
37	1	630.0	-	-	3400.0	-	-

Table 24. Mean fork length and mean weight by age for lake cisco, inconnu, humpback whitefish and mountain whitefish caught in the Great Bear River, 1974.

Scale Annuli	No. of fish	Fork Length (mm) Mean	Range	S.D.	Weight (gm) Mean	Range	S.D.
Lake cisco							
3	3	202.3	190-224	18.8	70.0	40-100	30.0
4	4	227.8	186-252	28.8	120.0	60-160	52.9
5	1	228.0	-	-	110.0	-	-
Inconnu							
5	1	504.0	-	-	1400.0	-	-
6	1	528.0	-	-	1700.0	-	-
Humpback whitefish							
4	1	249.0	-	-	200.0	-	-
6	1	273.0	-	-	230.0	-	-
Mountain whitefish							
10	1	381.0	-	-	740.0	-	-

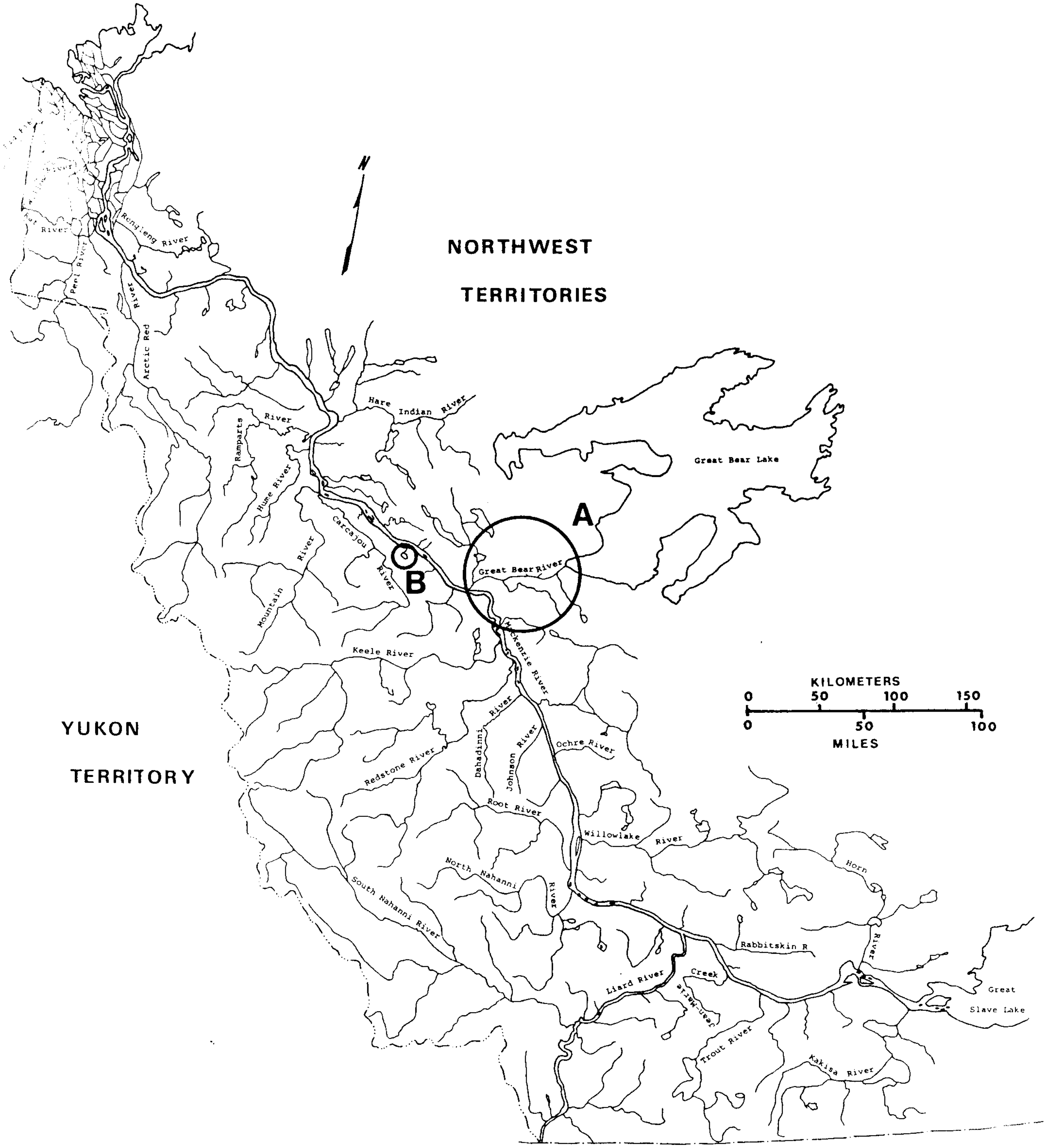

Fig. 1. Map of the Mackenzie River Valley showing the location of the Great Bear River (A) and Three Day Lake (B).

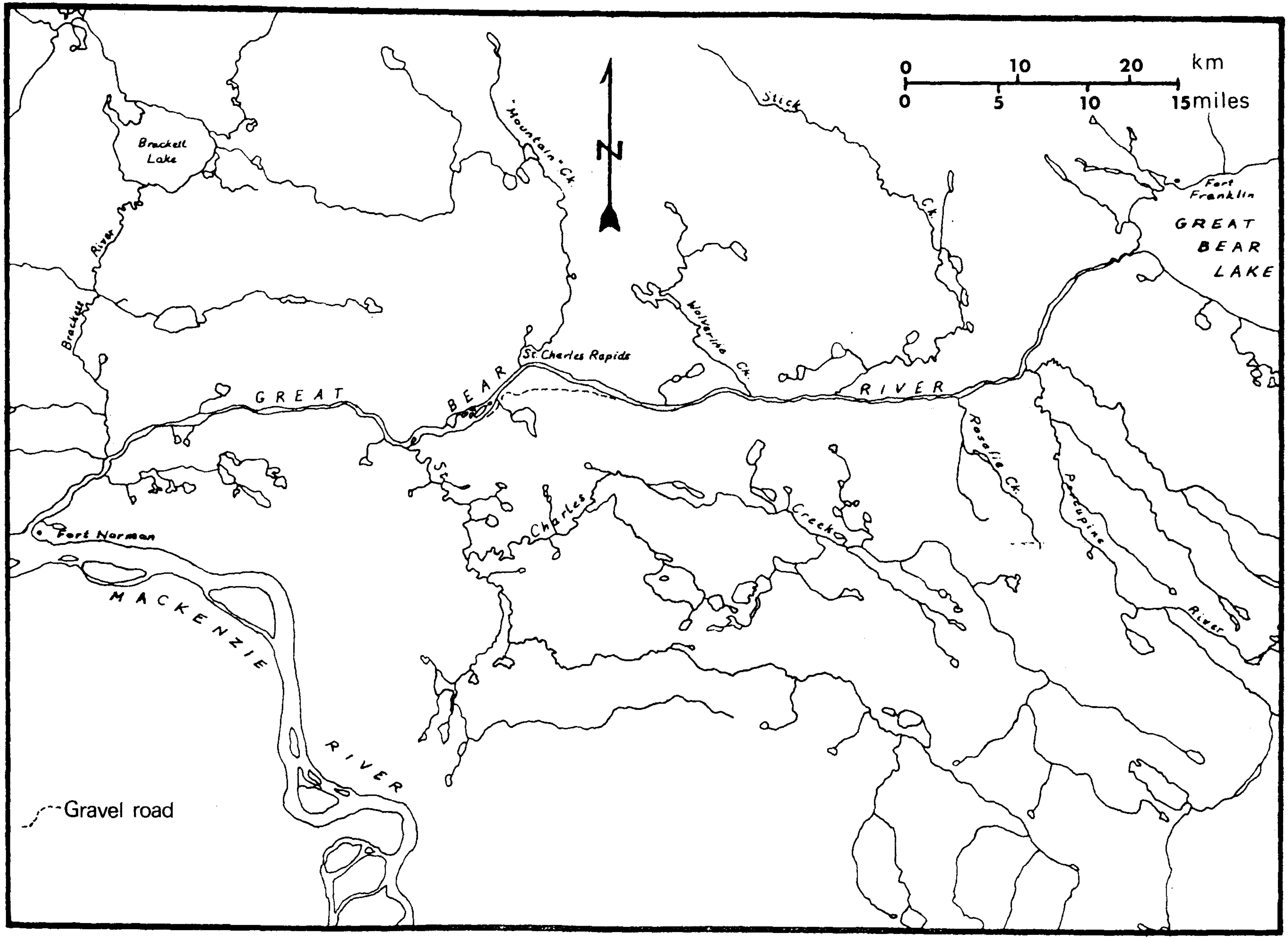

Fig. 2. Map of the Great Bear River showing major tributaries.

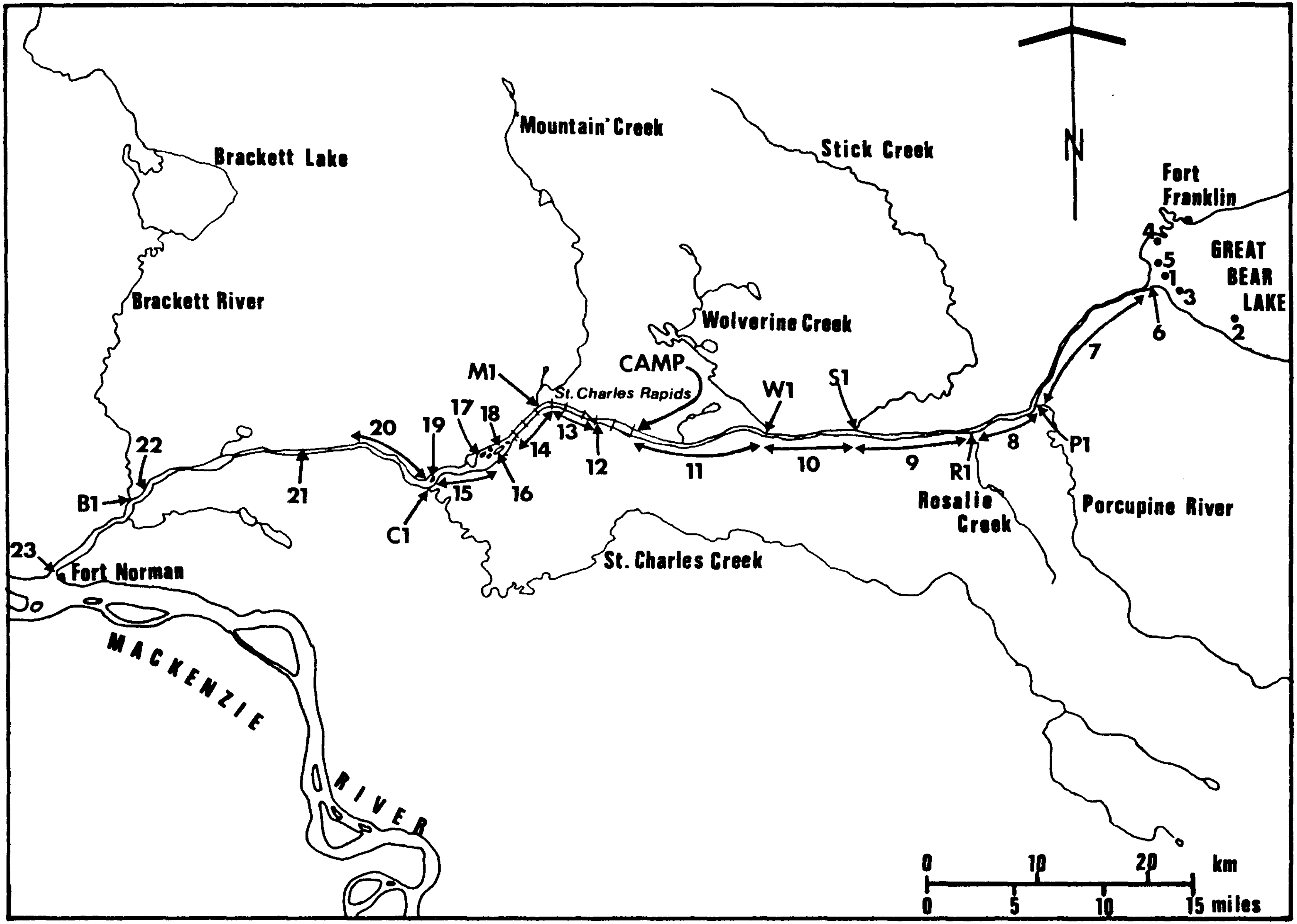

Fig. 3. Map of the Great Bear River showing sampling locations, 1974.

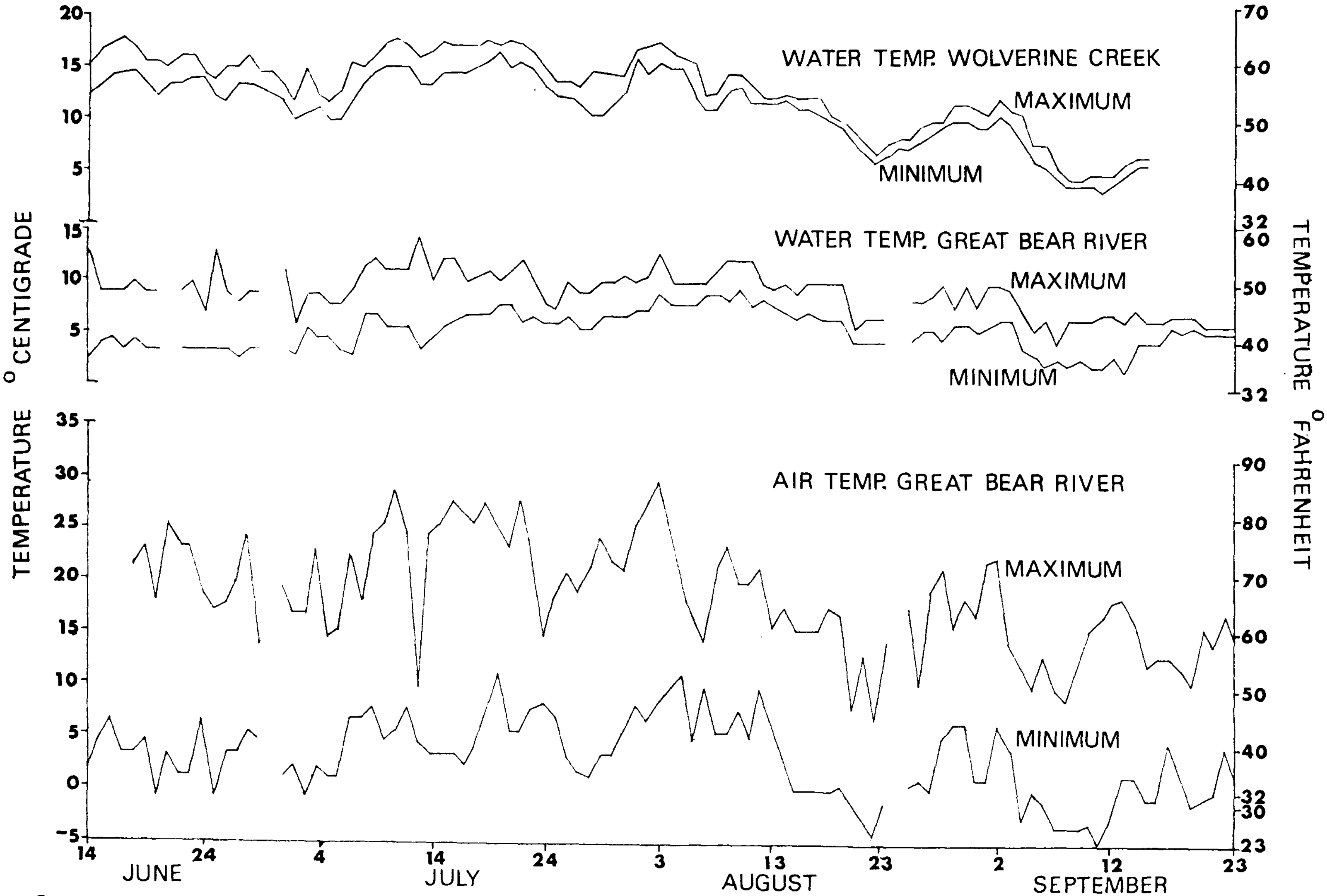

Fig. 4. Maximum and minimum temperature records for Great Bear River campsite and Wolverine Creek, June-September, 1974.

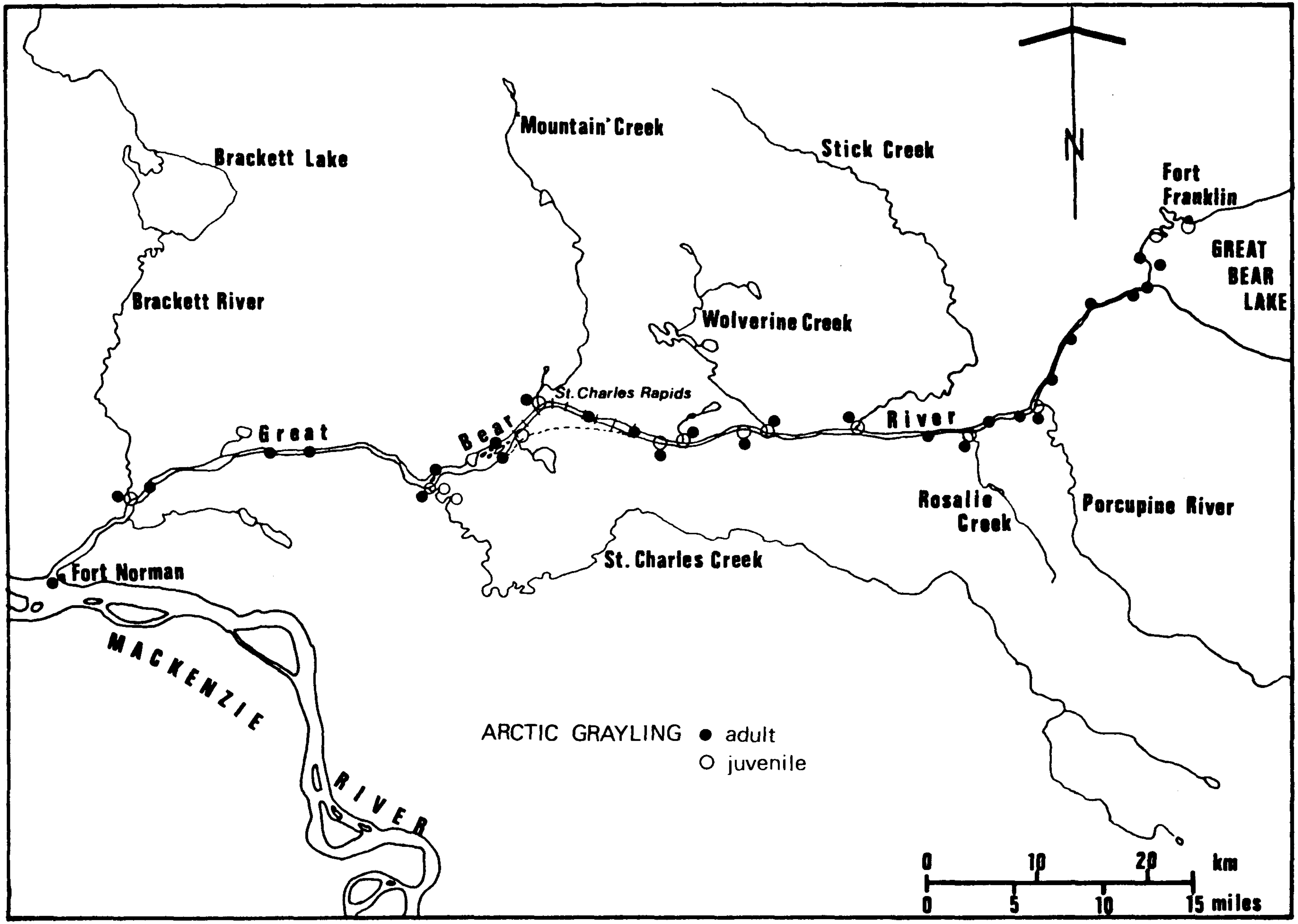

Fig. 5. Distribution of Arctic grayling, *Thymallus arcticus* (Pallas), in the Great Bear River, 1971-1974.

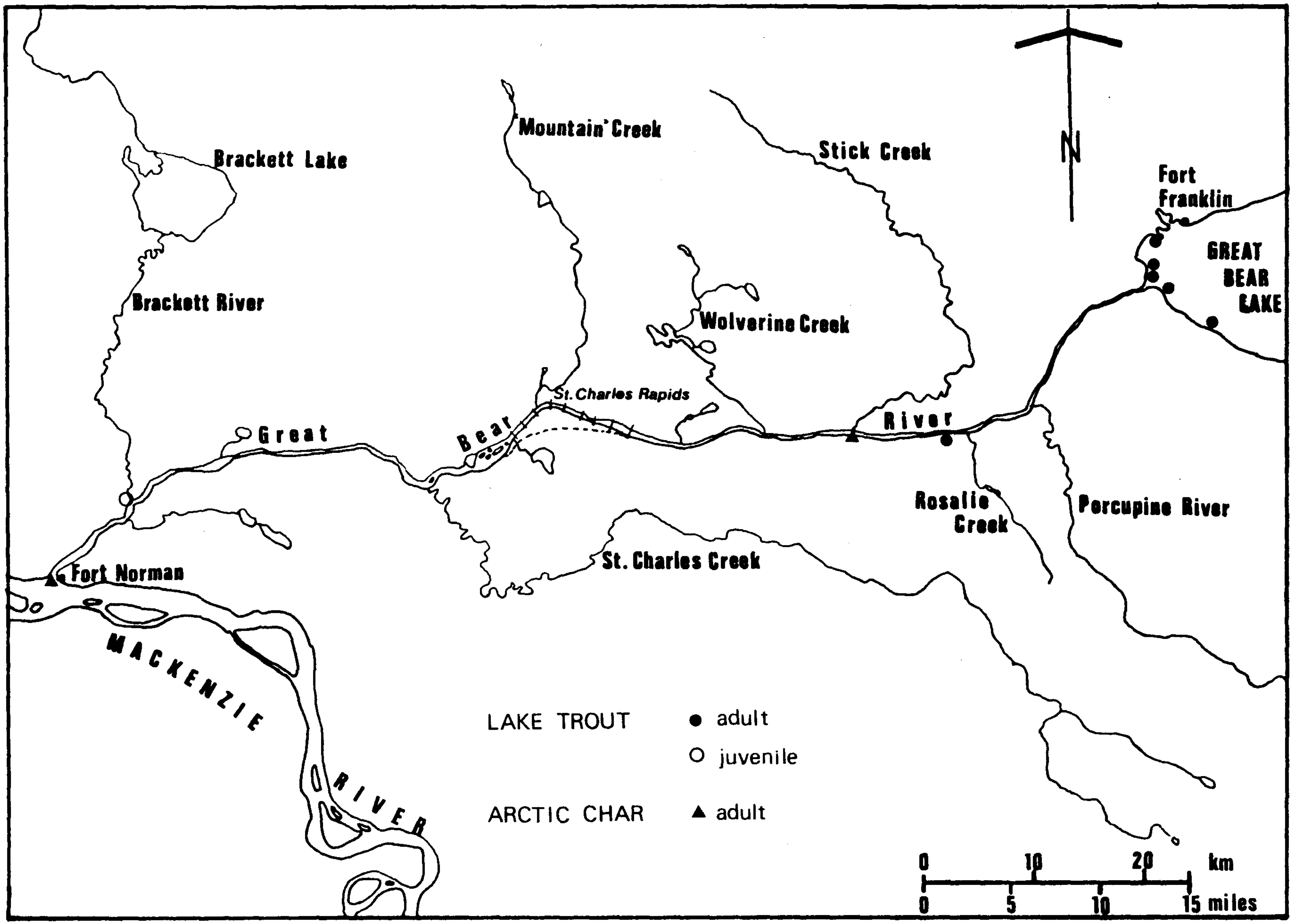

Fig. 6. Distribution of lake trout, *Salvelinus namaycush* (Walbaum) and Arctic char, *Salvelinus alpinus* (Linnaeus), in the Great Bear River, 1971-1974.

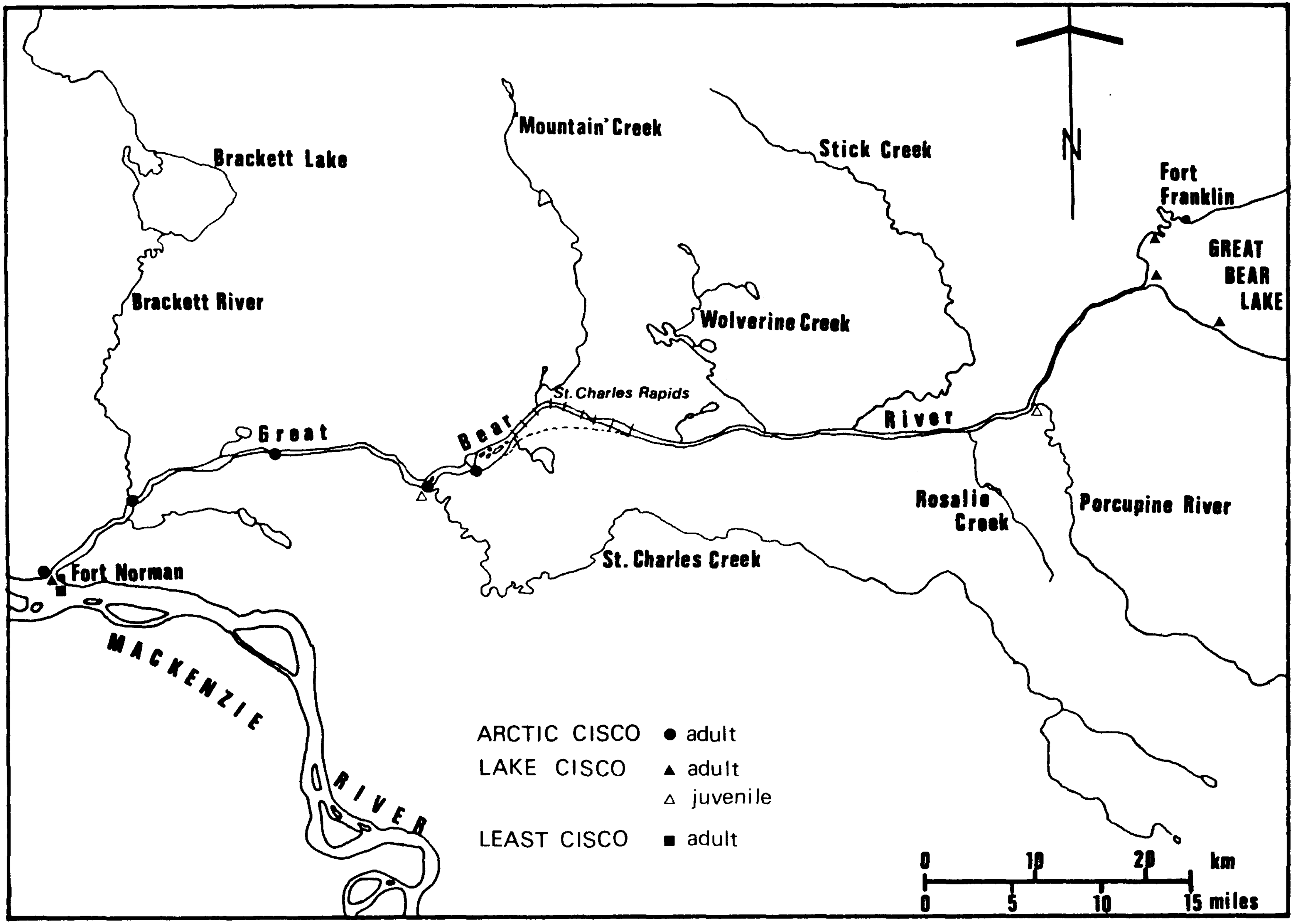

Fig. 7. Distribution of Arctic cisco, *Coregonus autumnalis* (Pallas), lake cisco, *Coregonus artedii* (Le Sueur) and least cisco, *Coregonus sardinella* (Valenciennes), in the Great Bear River, 1971-1974.

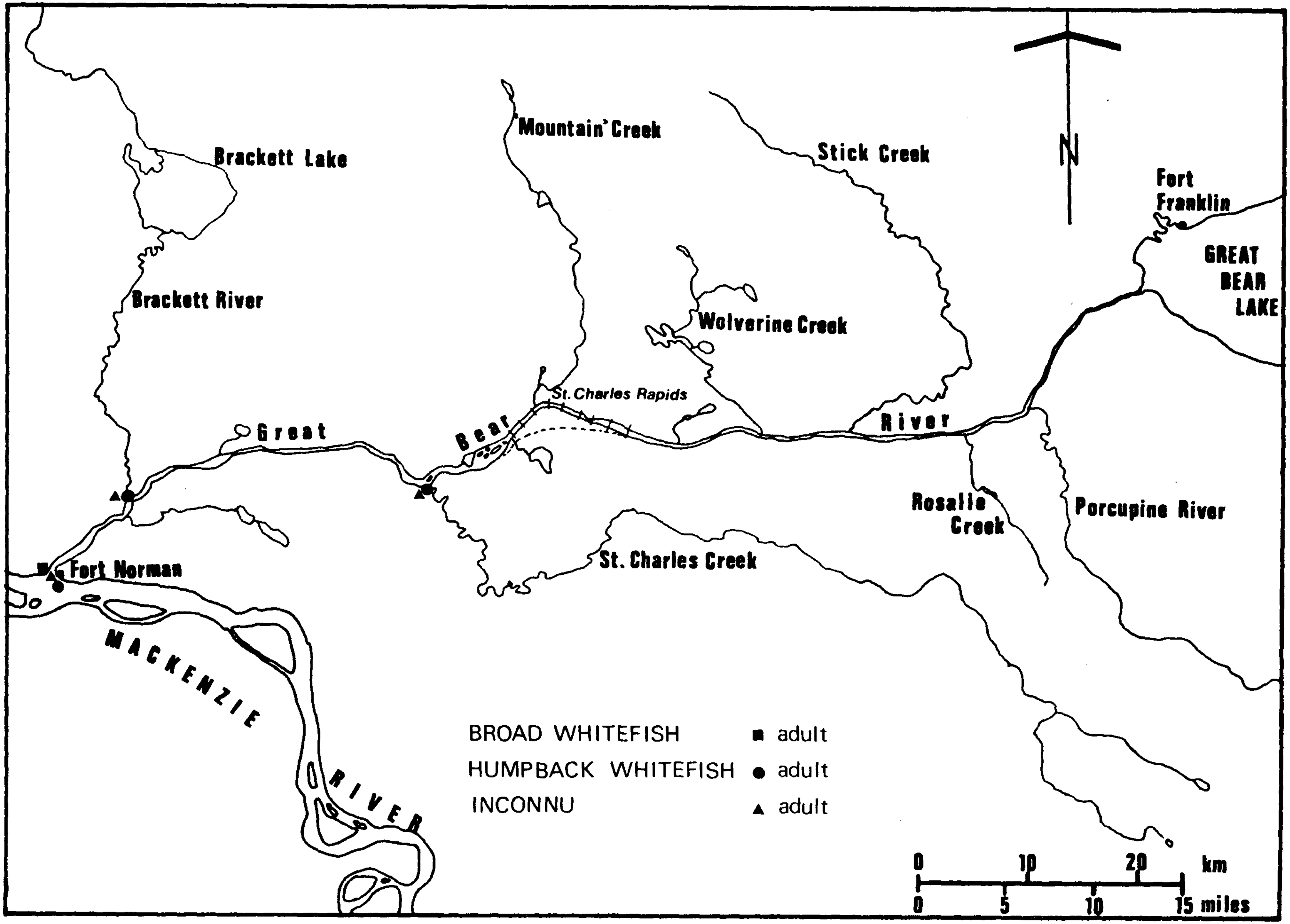

Fig. 8. Distribution of broad whitefish, *Coregonus nasus* (Pallas), humpback whitefish, *Coregonus clupeaformis* (Mitchill) and inconnu, *Stenodus leucichthys nelma* (Pallas), in the Great Bear River, 1971-1974.

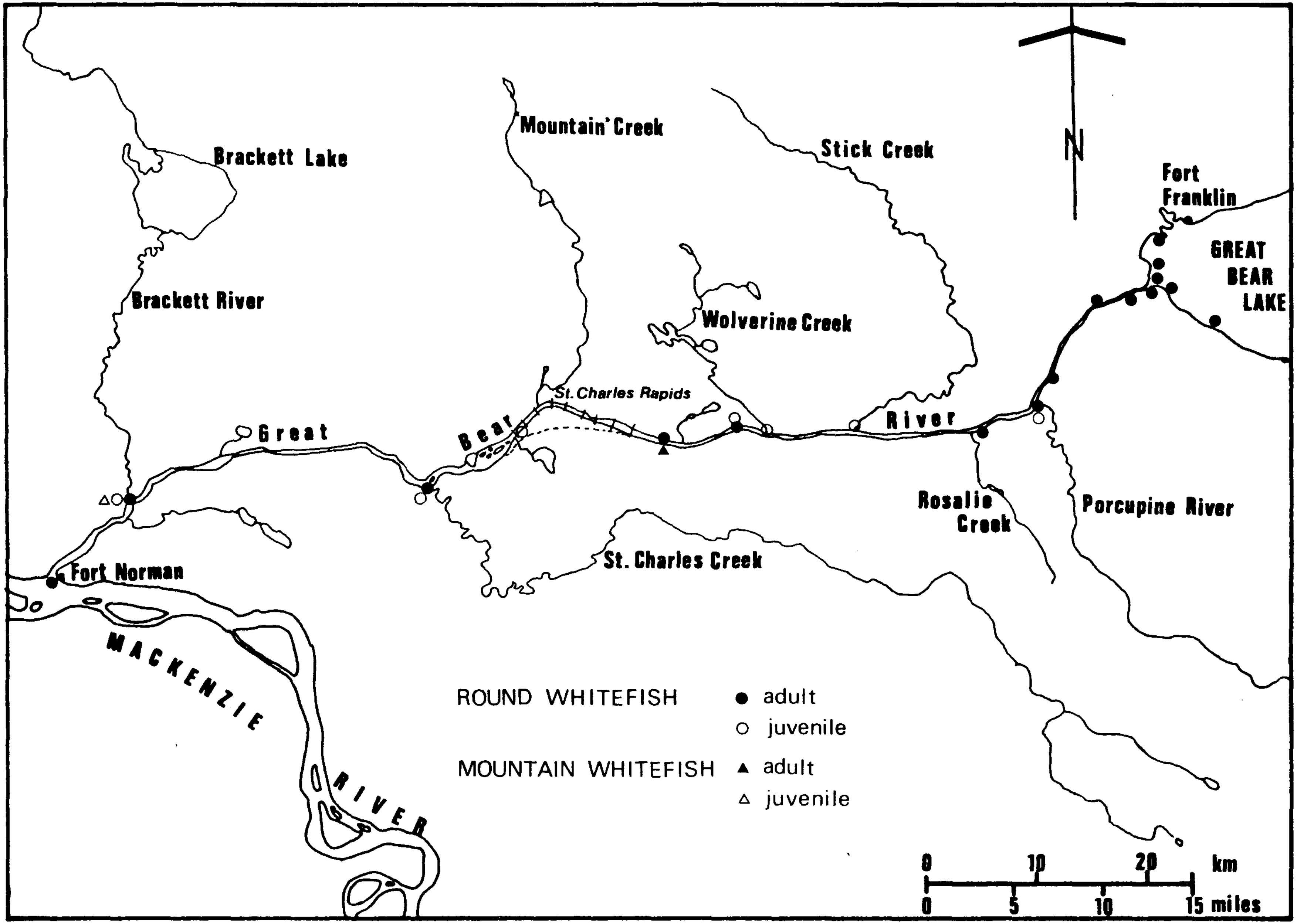

Fig. 9. Distribution of round whitefish, *Prosopium cylindraceum* (Pallas) and mountain whitefish, *Prosopium williamsoni* (Girard), in the Great Bear River, 1971-1974.

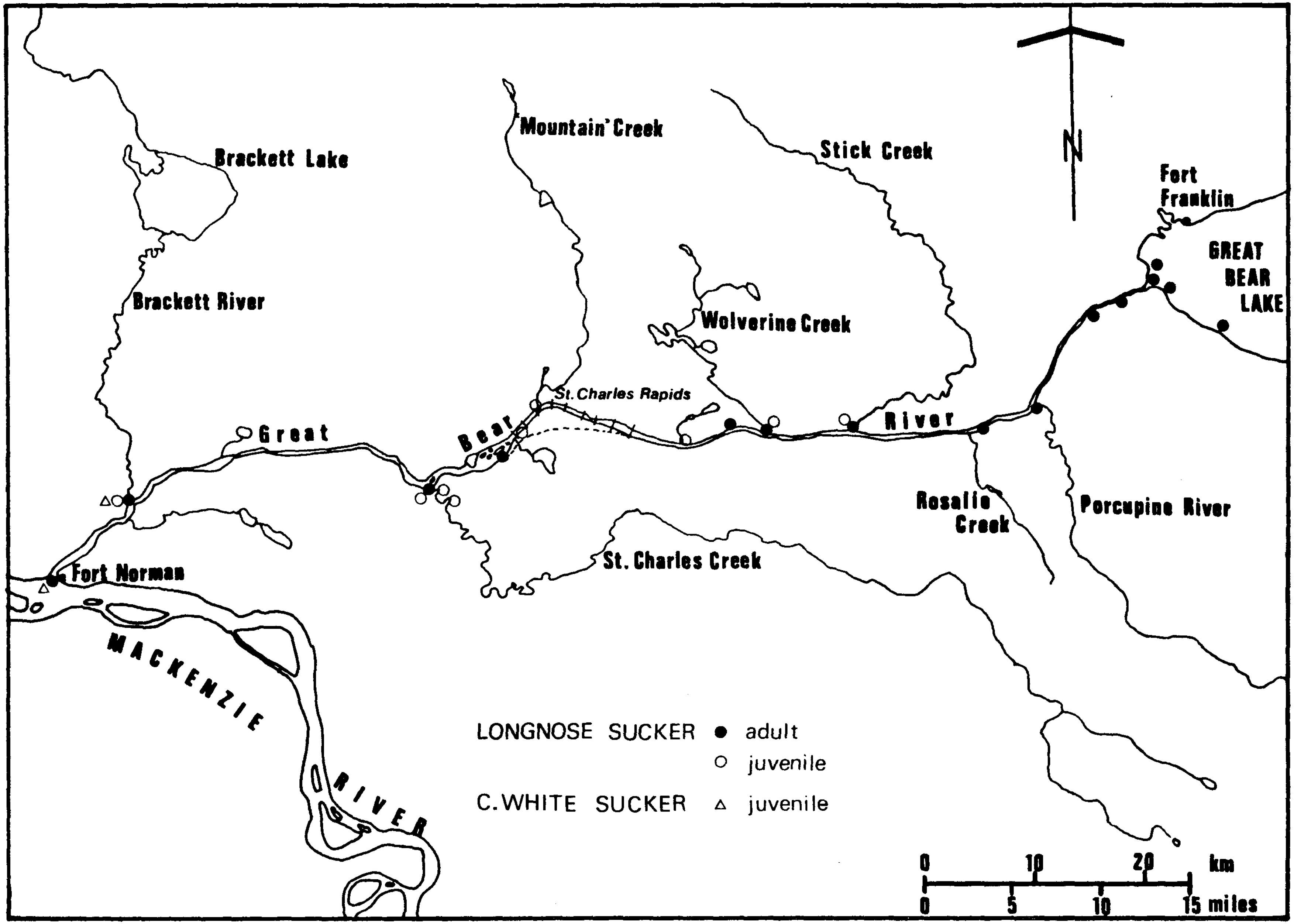

Fig. 10. Distribution of longnose sucker, *Catostomus catostomus* (Forster) and white sucker, *Catostomus commersoni* (Lacépède), in the Great Bear River, 1971-1974.

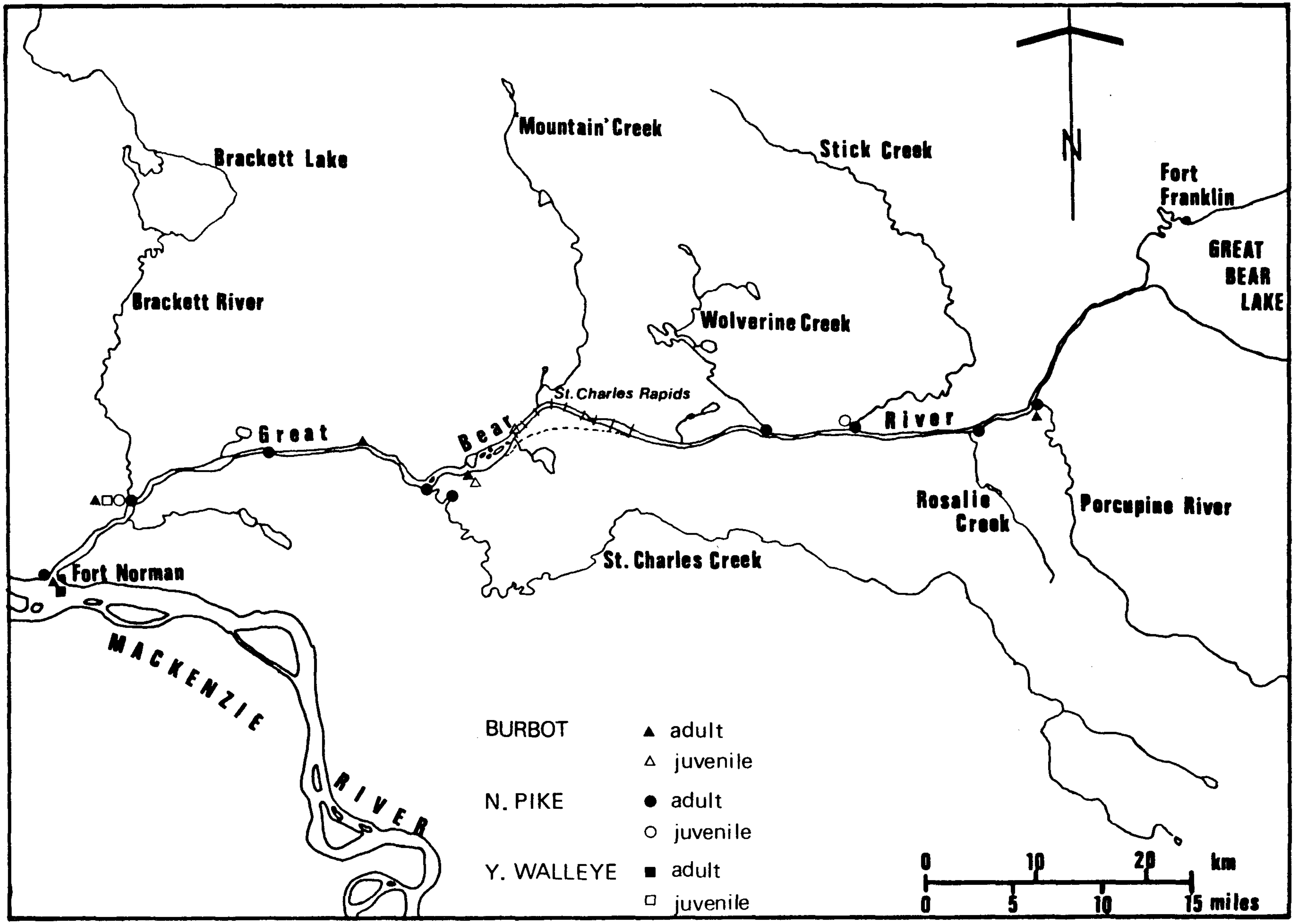

Fig. 11. Distribution of burbot, *Lota lota* (Linnaeus), northern pike, *Esox lucius* (Linnaeus) and yellow walleye, *Stizostedion vitreum vitreum* (Mitchill) in the Great Bear River, 1971-1974.

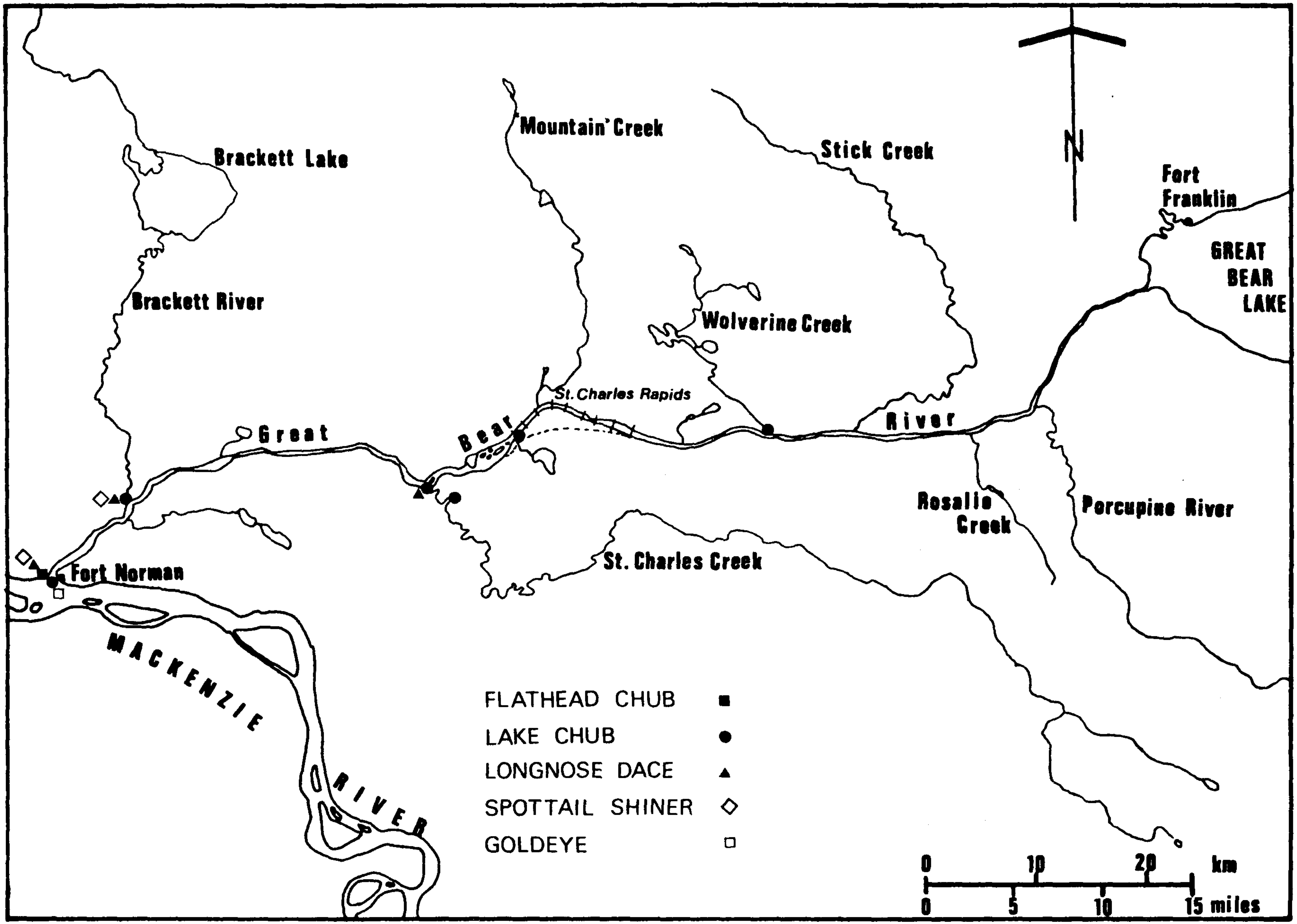

Fig. 12. Distribution of flathead chub, *Platygobio gracilis* (Richardson), lake chub, *Couesius plumbeus* (Agassiz), longnose dace, *Rhinichthys cataractae* (Valenciennes), spottail shiner, *Notropis hudsonius* (Clinton) and goldeye, *Hiodon alosoides* (Rafinesque), in the Great Bear River, 1971-1974.

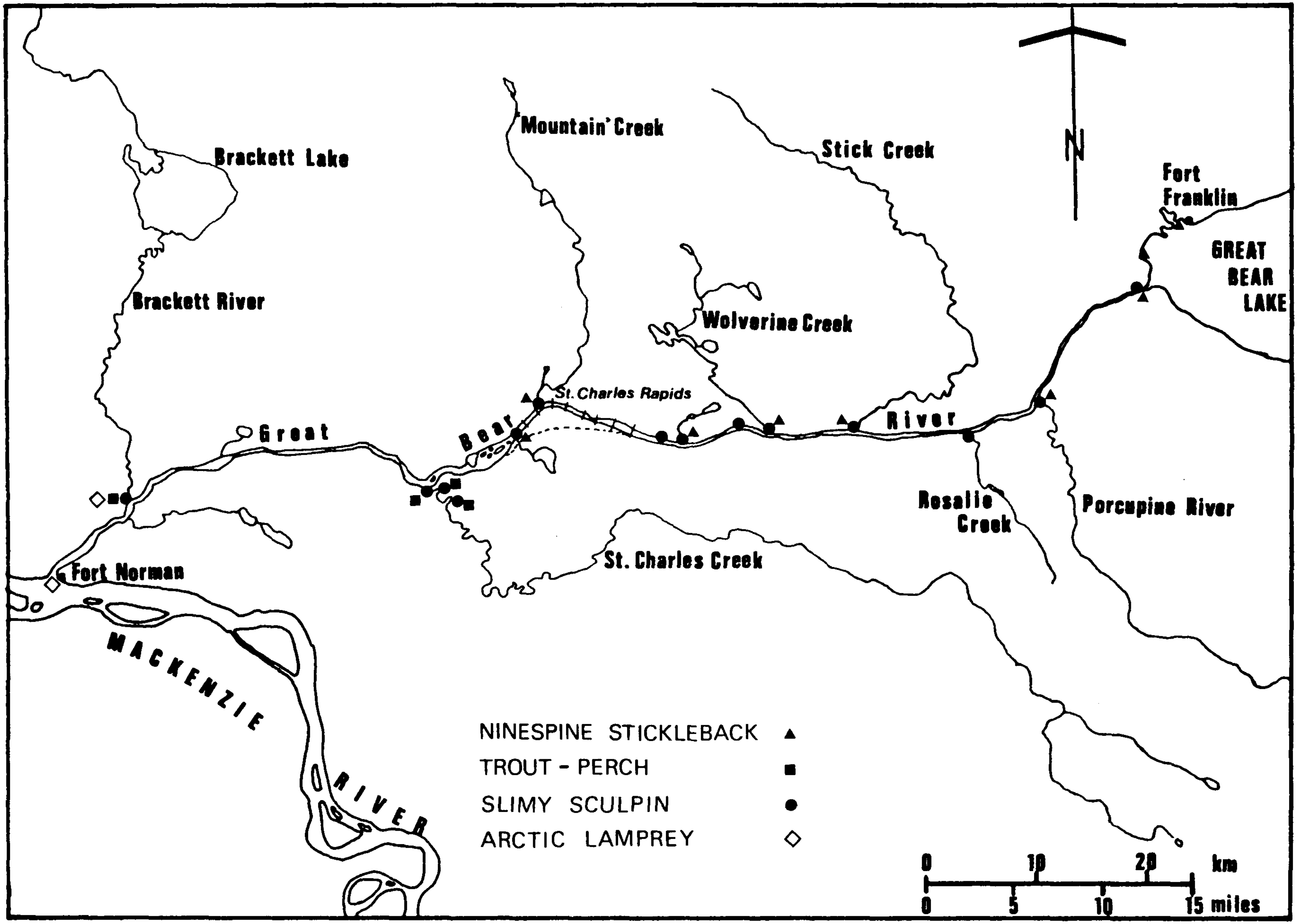

Fig. 13. Distribution of ninespine stickleback, *Pungitius pungitius* (Linnaeus), trout-perch, *Percopsis omiscomaycus* (Walbaum), slimy sculpin, *Cottus cognatus* (Richardson) and Arctic lamprey, *Lampetra japonica* (Martens), in the Great Bear River, 1971-1974.

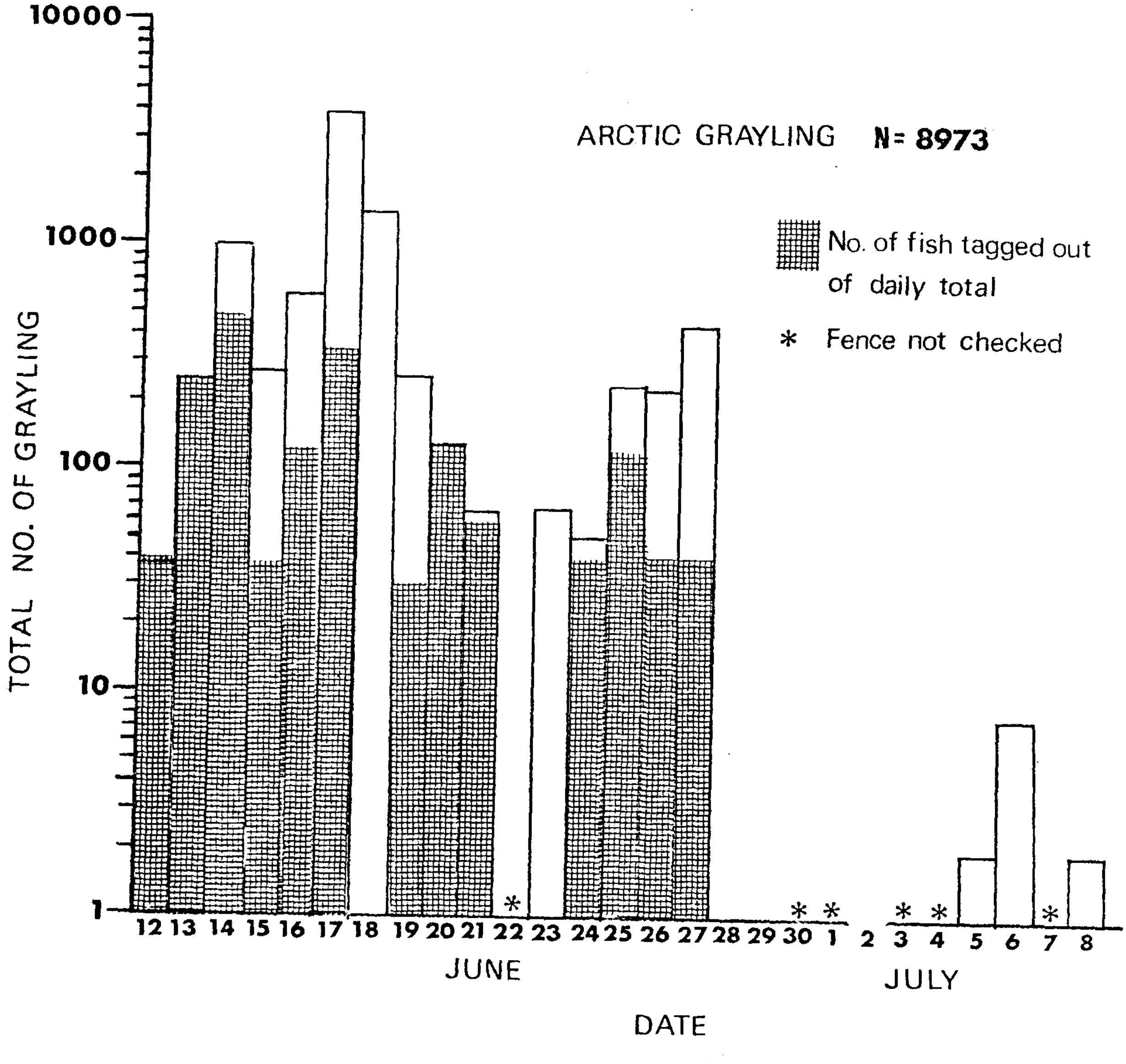

Fig. 14. Daily counts of Arctic grayling released downstream of the counting fence at Wolverine Creek during the post-spawning migration, June-July, 1974.

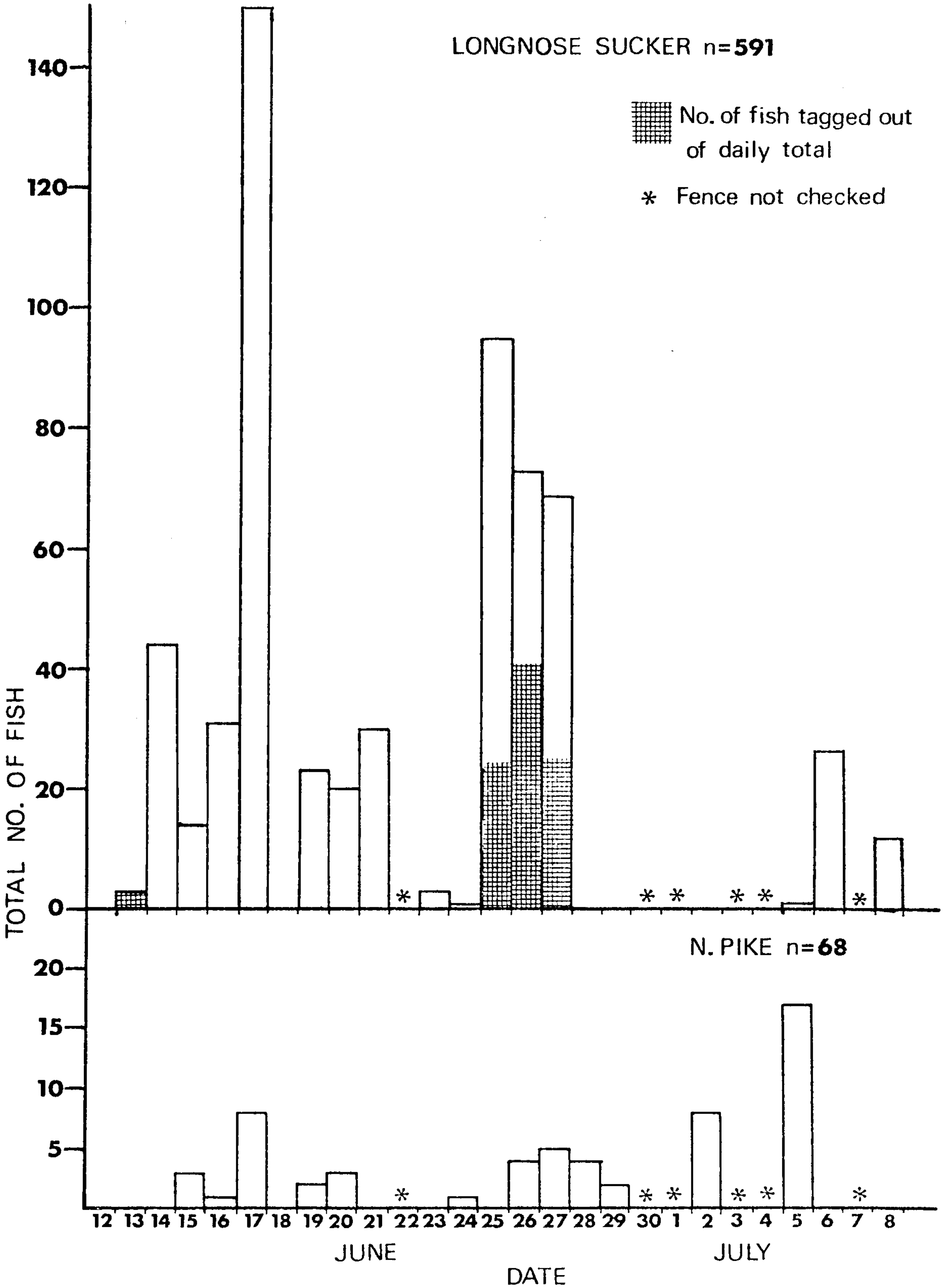

Fig. 15. Daily count of longnose sucker and northern pike released alive downstream of the counting fence at Wolverine Creek, June-July, 1974.

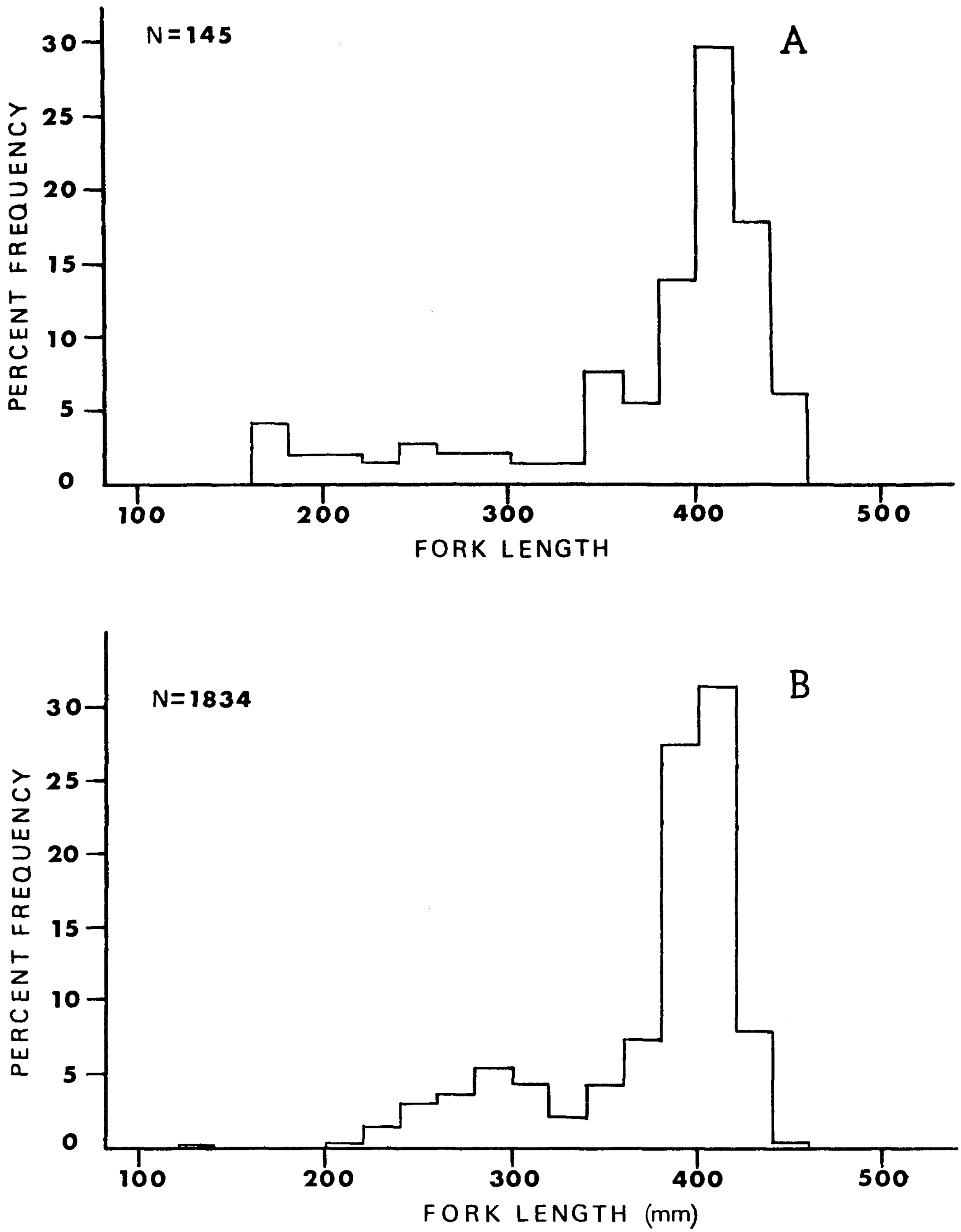

Fig. 16. Length-frequency distributions of Arctic grayling from (A) gill net catches on Great Bear River, 1974 and (B) a sub-sample (N = 1834) of the downstream migrants in Wolverine Creek (12 June to 14 July, 1978).

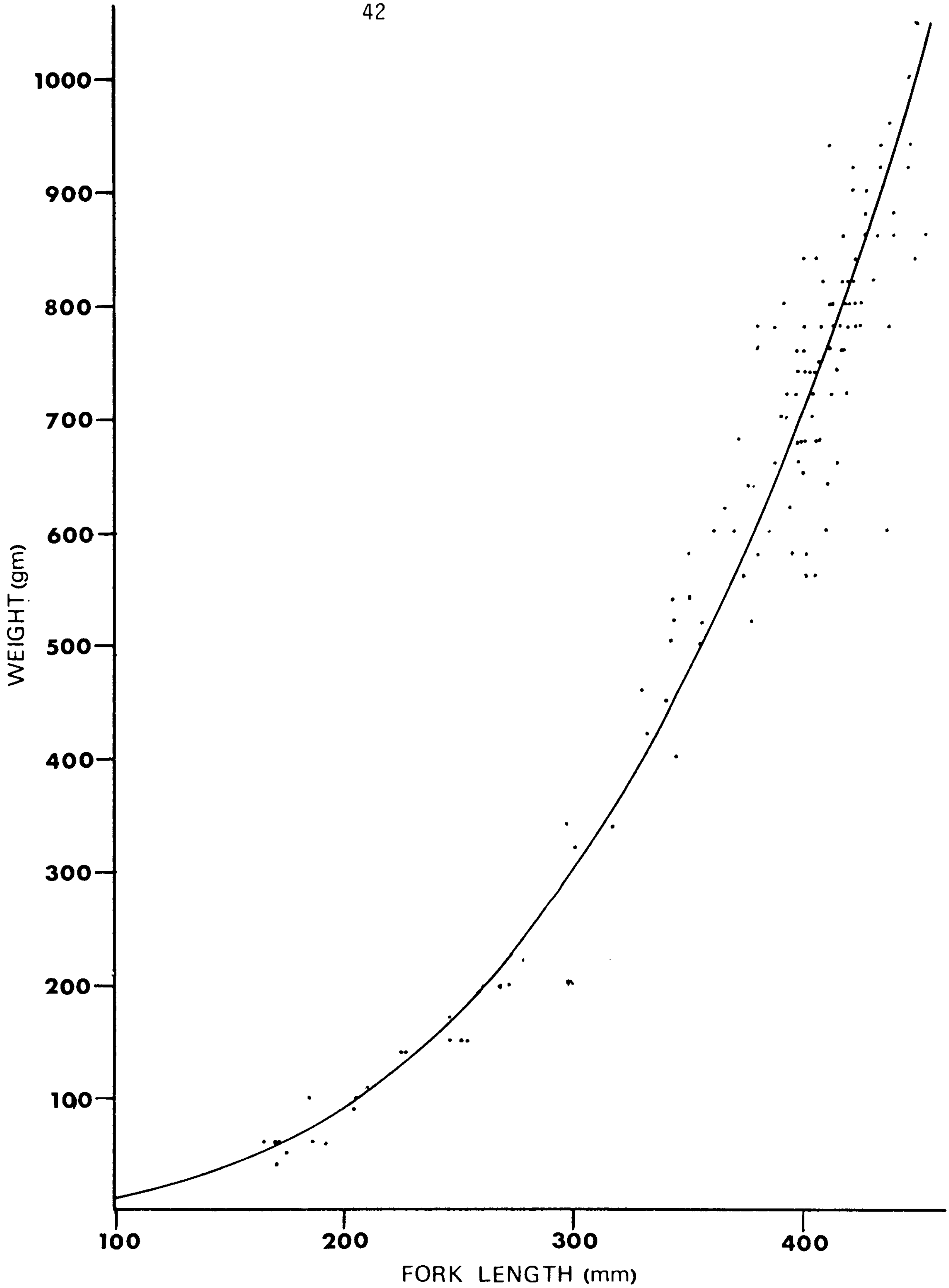

Fig. 17. Length-weight relationship of Arctic grayling caught in gill nets in Great Bear River, 1974.

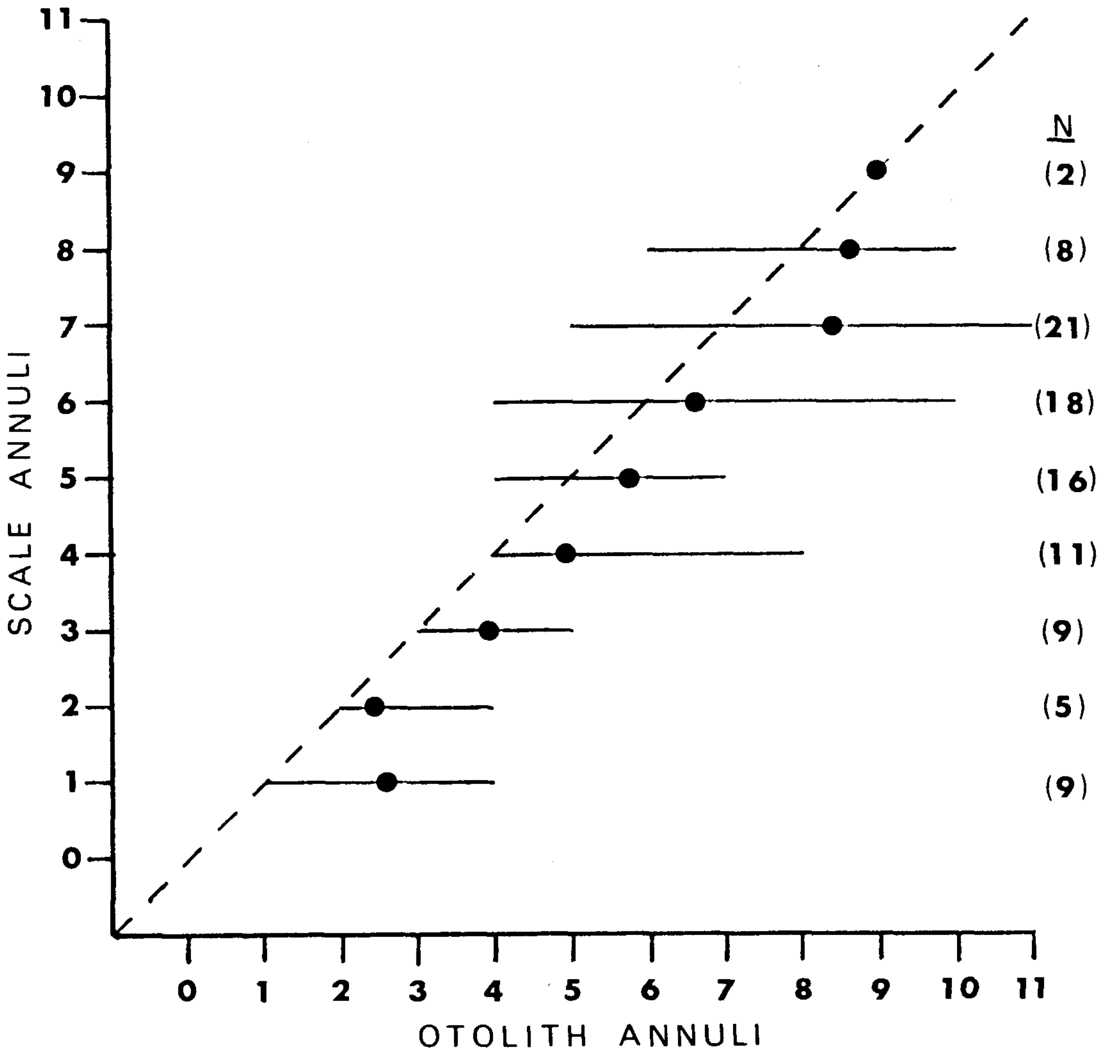

Fig. 18. Comparison of scale and otolith methods for ageing 99 Arctic grayling from the Great Bear River, 1974.

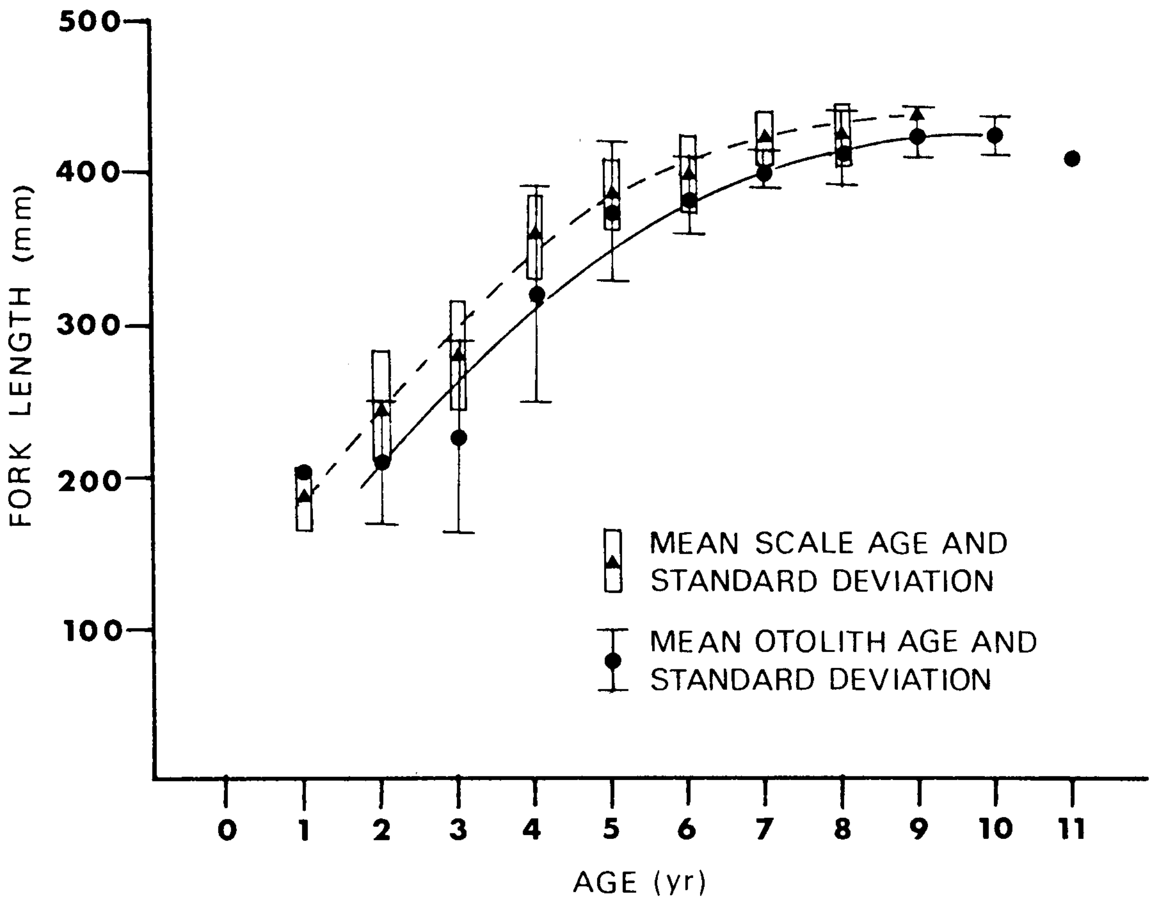

Fig. 19. Comparison of length-age relationship determined from both scales and otoliths for Arctic grayling from Great Bear River, 1974.

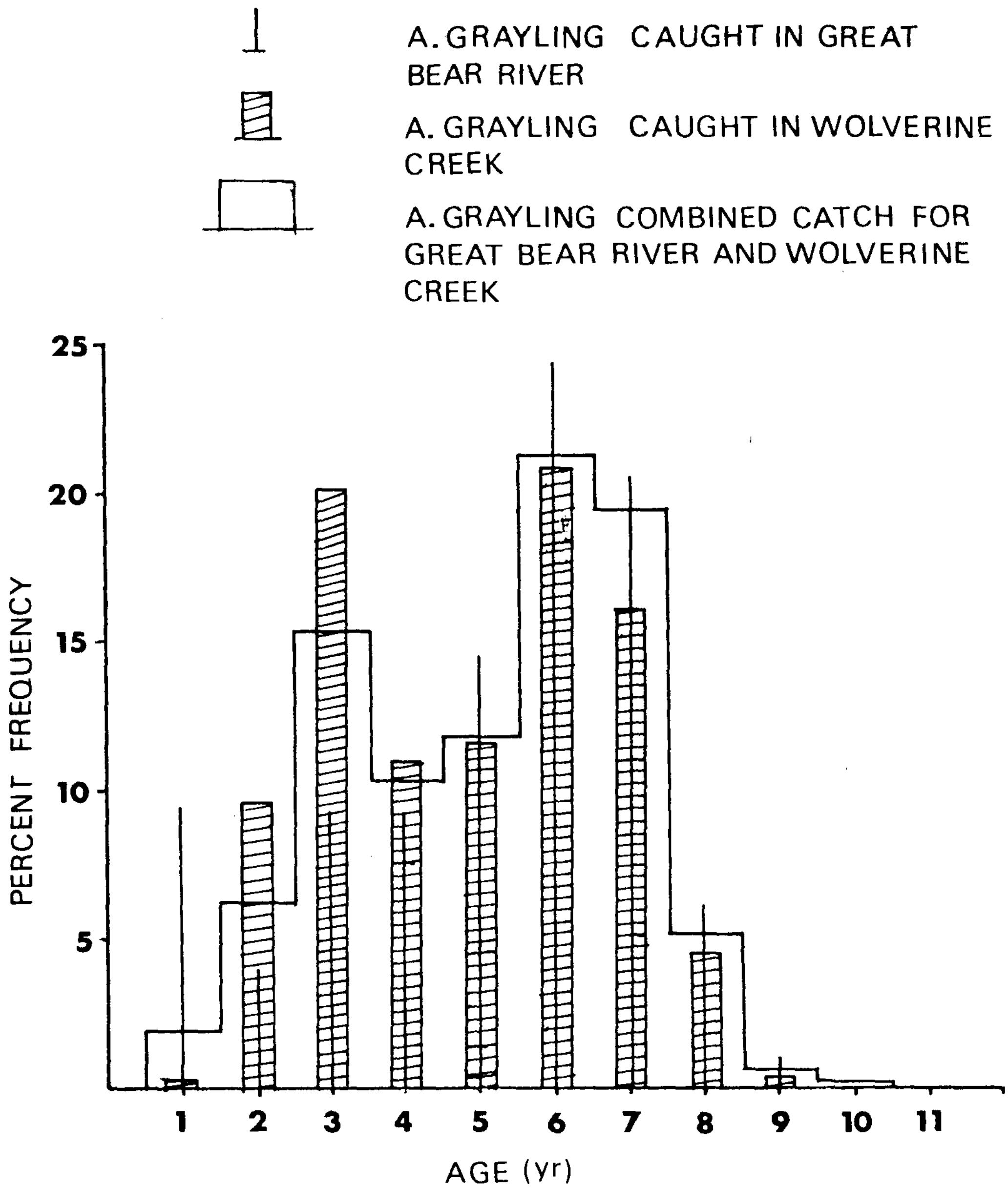

Fig. 20. Percent frequency distribution of age for Arctic grayling from Wolverine Creek and Great Bear River, 1974. The distribution of fish (N = 224) analysed from Wolverine Creek and the sample (N = 150) taken in Great Bear River are each superimposed on the combined distribution (N = 374).

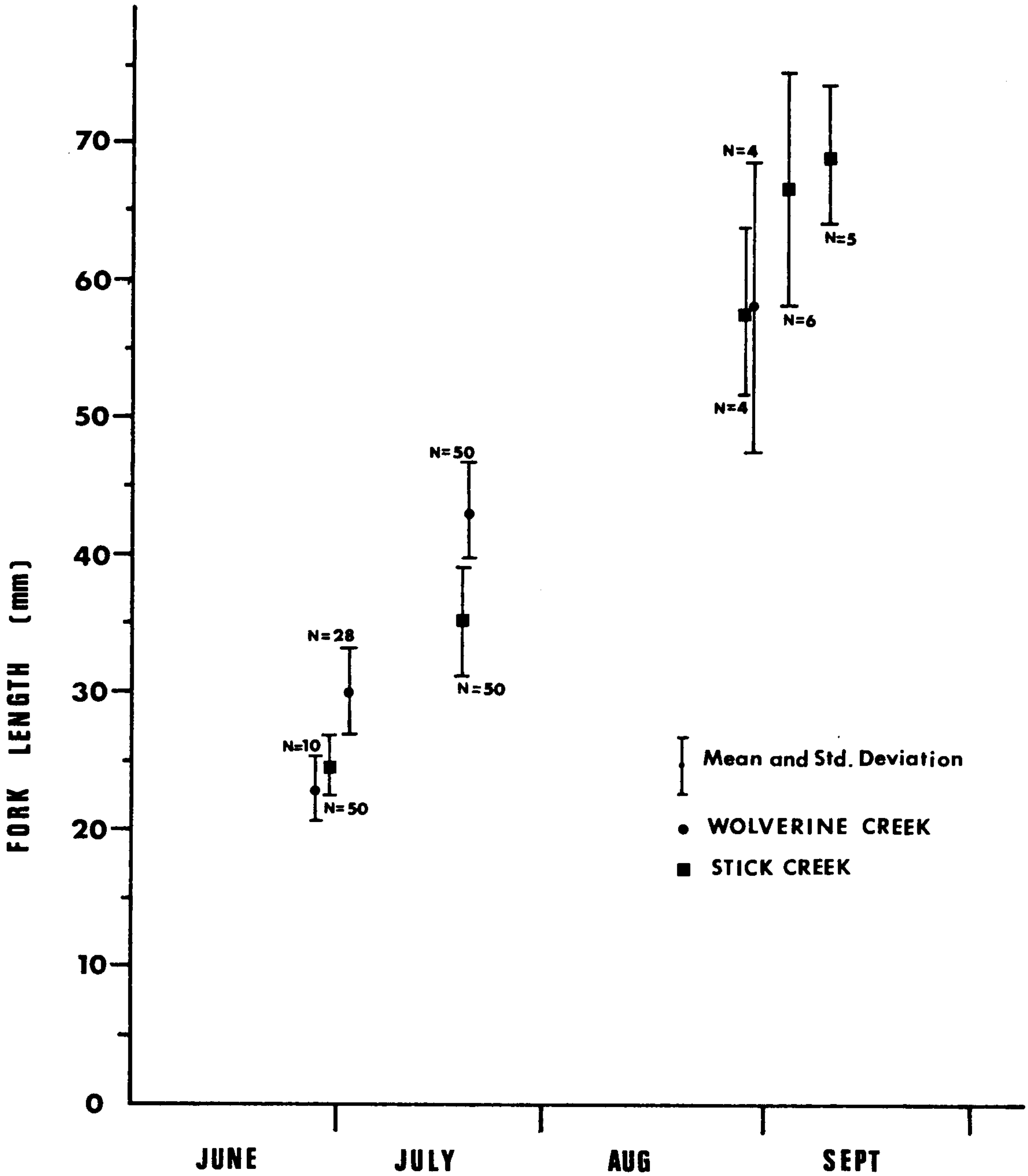

Fig. 21. Growth in length of Arctic grayling fry from Wolverine and Stick Creek, June-September 1974.

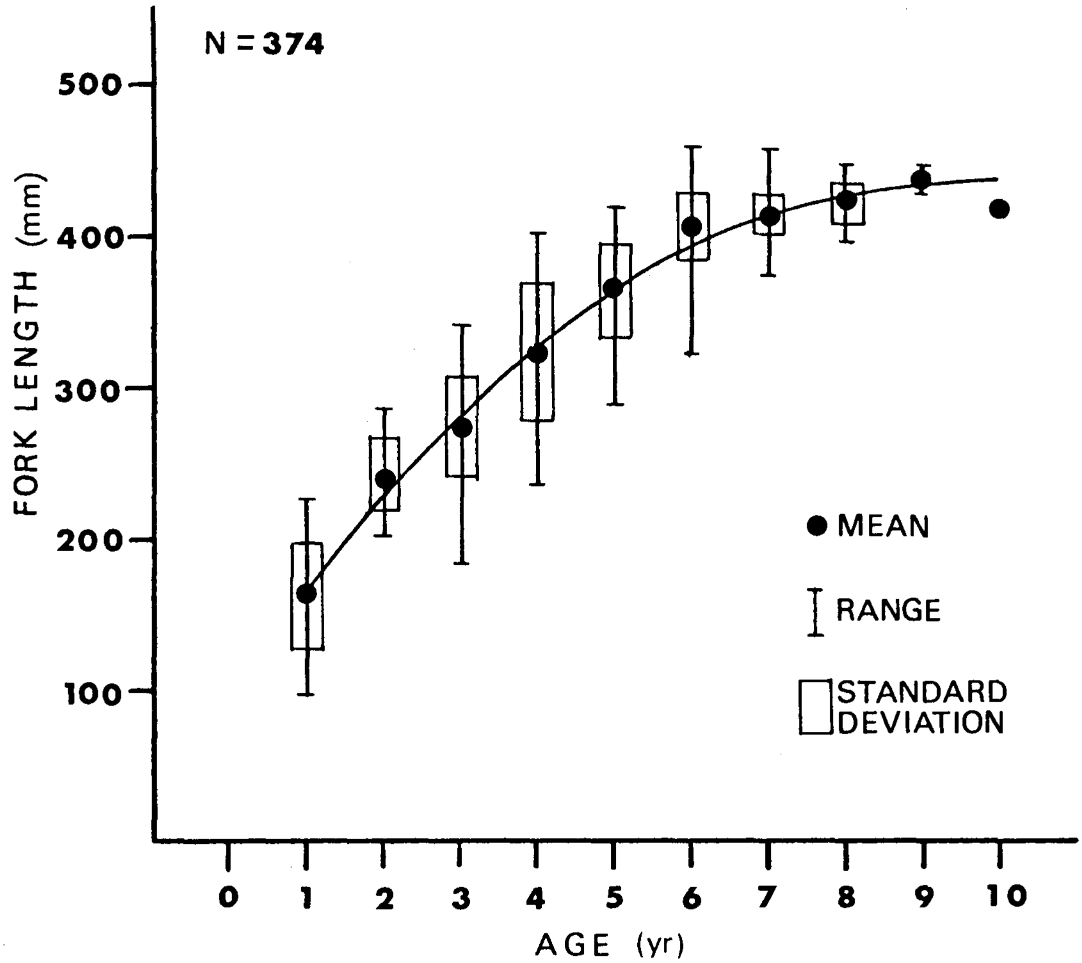

Fig. 22. Age-length relationship, based on scale annuli, of Arctic grayling from Great Bear River, 1974.

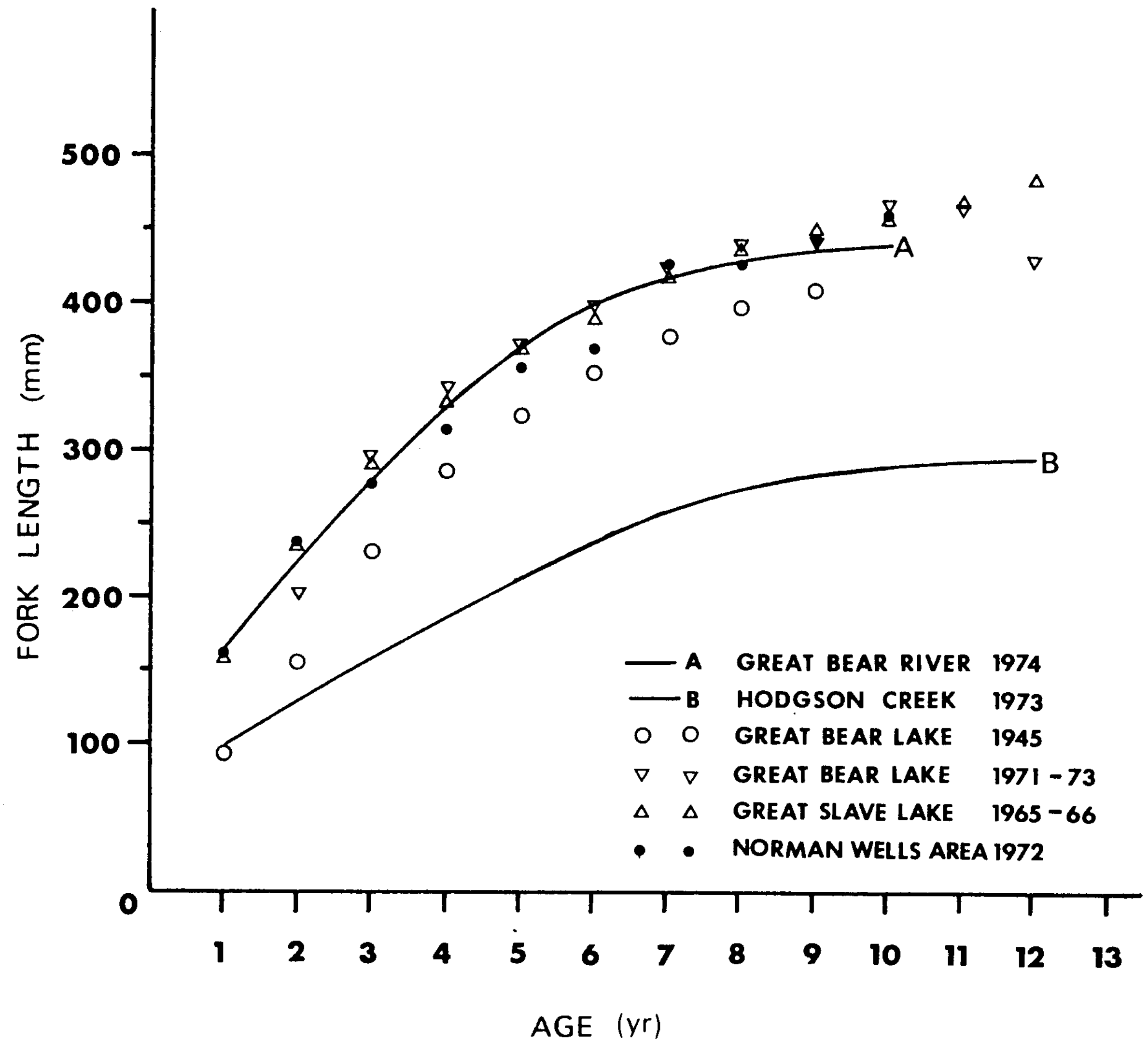

Fig. 23. Comparison of age-length relationship of Arctic grayling in the Great Bear River with the population in Hodgson Creek (Tripp and McCart 1974), Great Bear Lake (Miller 1946; Falk and Dahlke 1974), east Great Slave Lake (Bishop 1967) and the Mackenzie River in the Norman Wells area (Stein et al. 1973a).

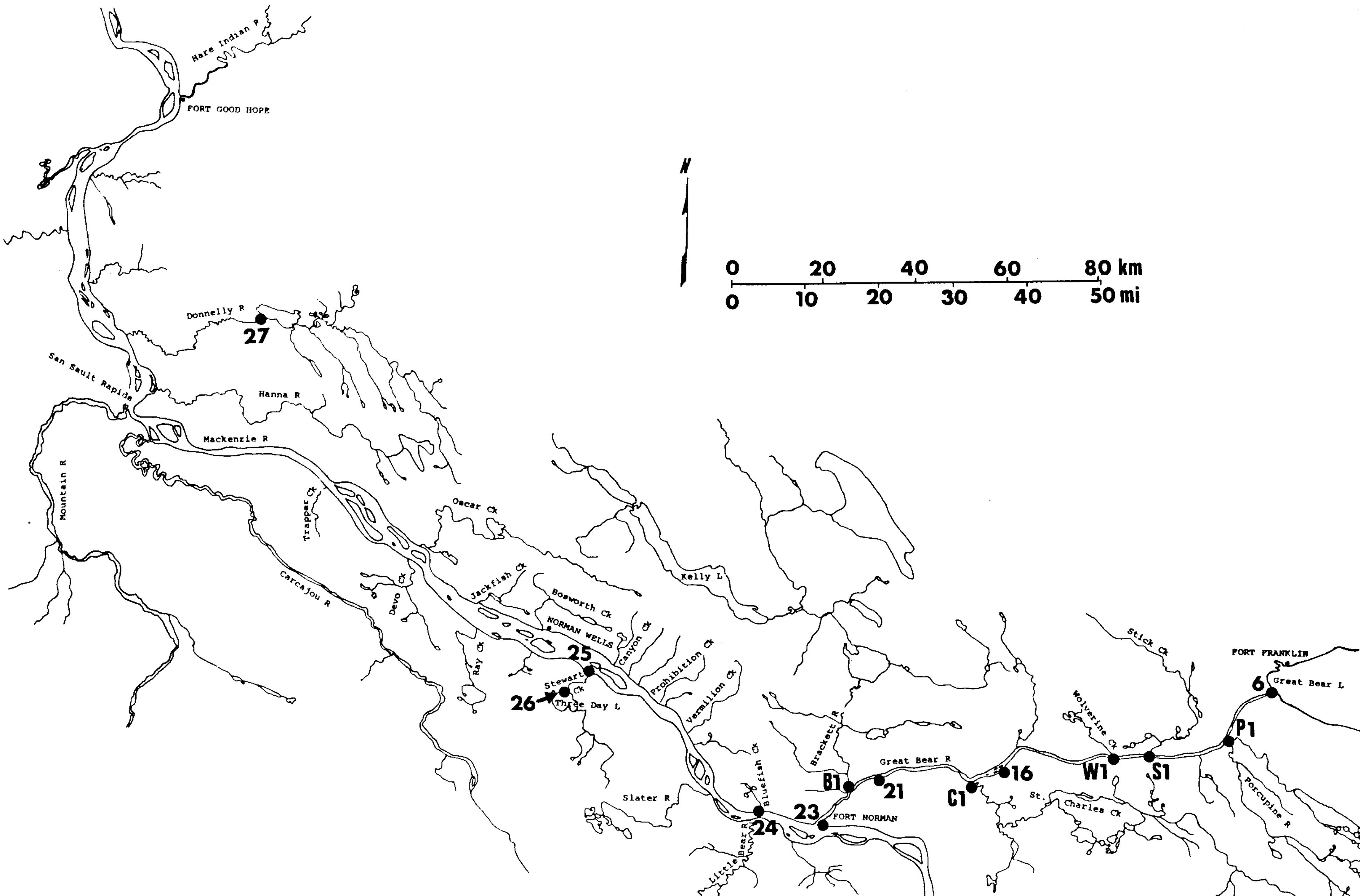

Fig. 24. Map of Norman Wells study area showing major recapture locations of tagged Arctic grayling from Three Day Lake in 1972, 1973 and 1974. Stations on Great Bear River are consistent with locations shown in Fig. 3.

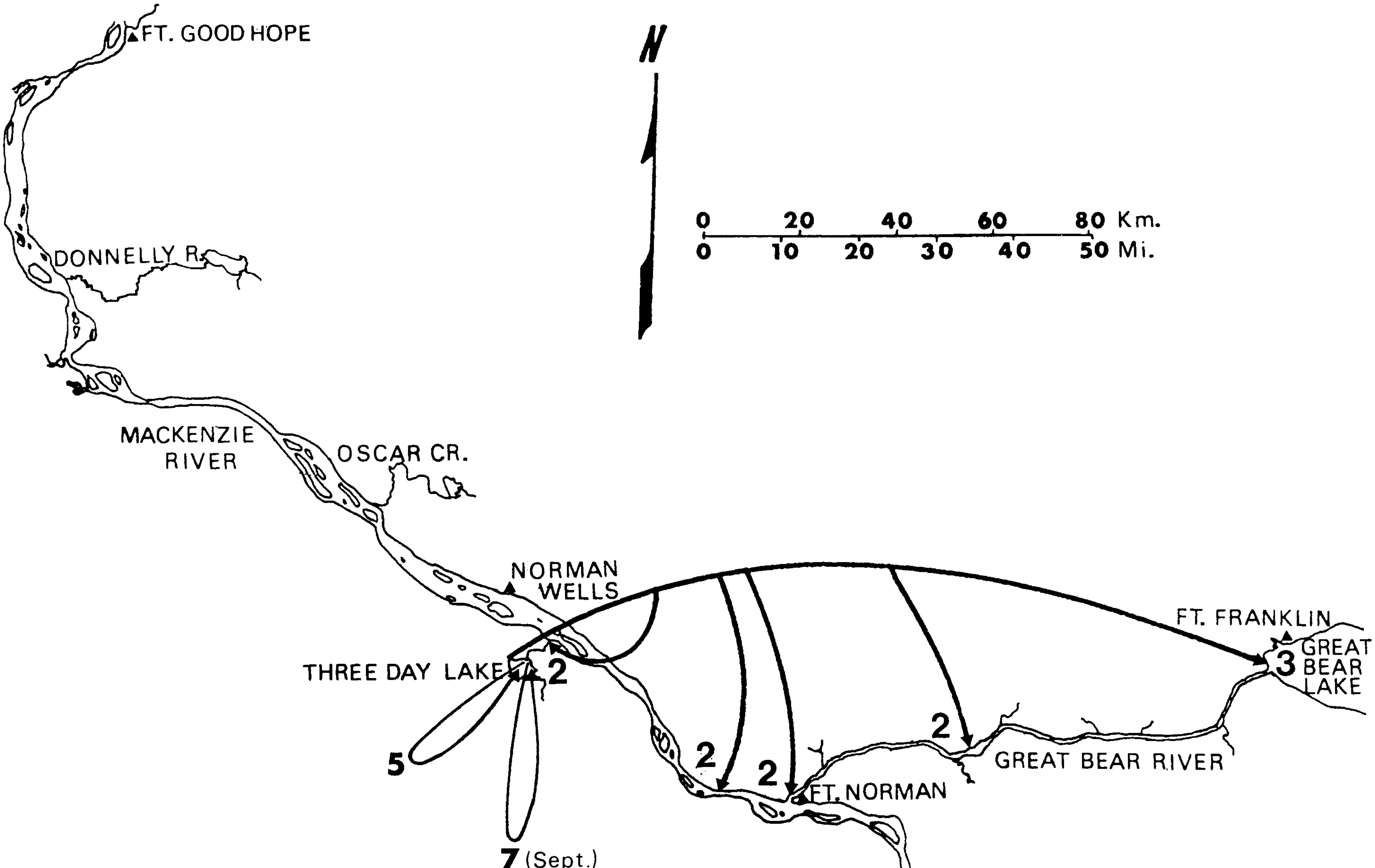

Fig. 25. The site and number of recaptures in 1972 of Arctic grayling released in Three Day Lake in June 1972.

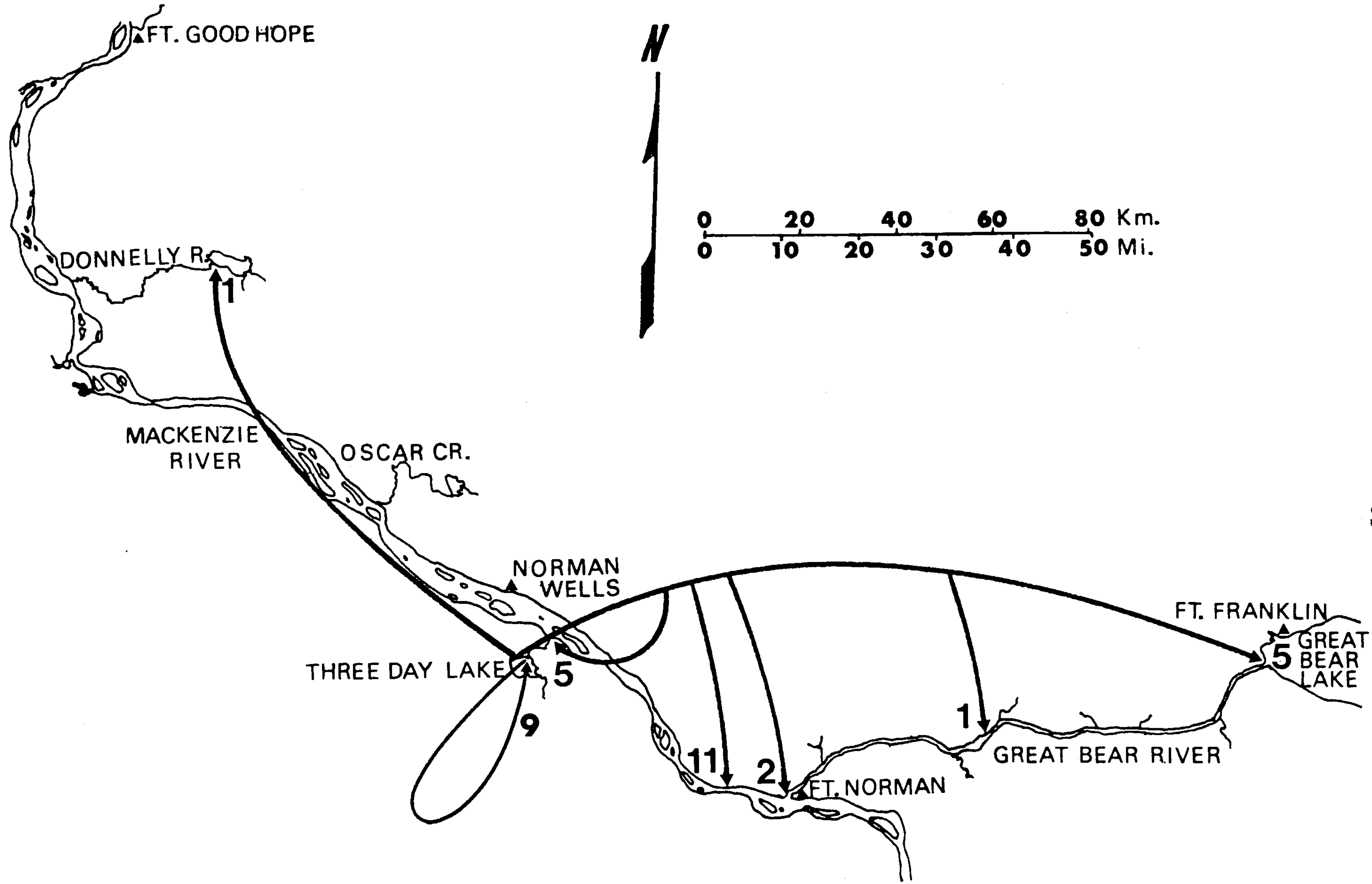

Fig. 26. The site and number of recaptures in 1973 of Arctic grayling released in Three Day Lake in June 1972.

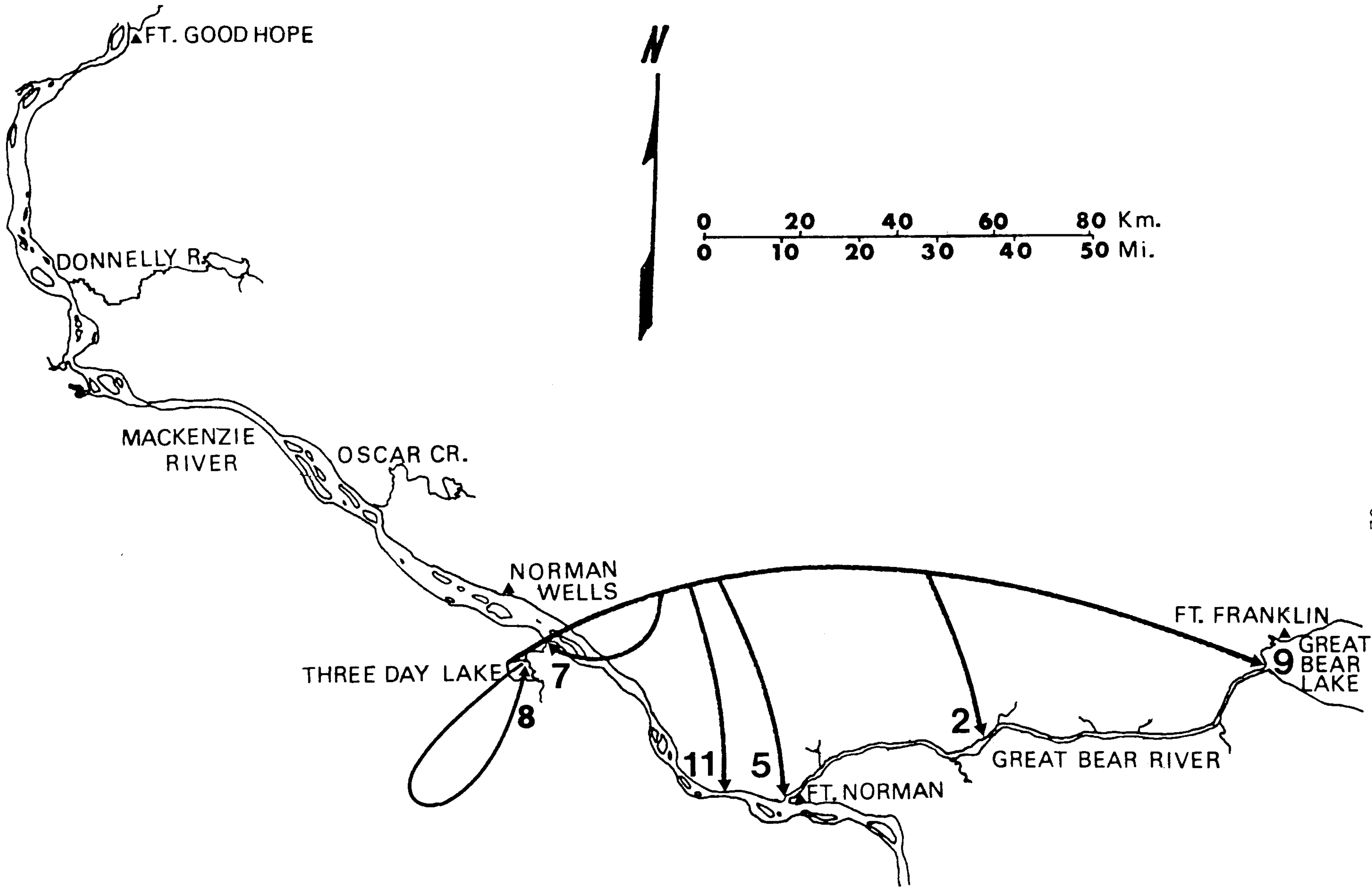

Fig. 27. The site and number of recaptures in 1973 of Arctic grayling released in Three Day Lake in May-June, 1973.

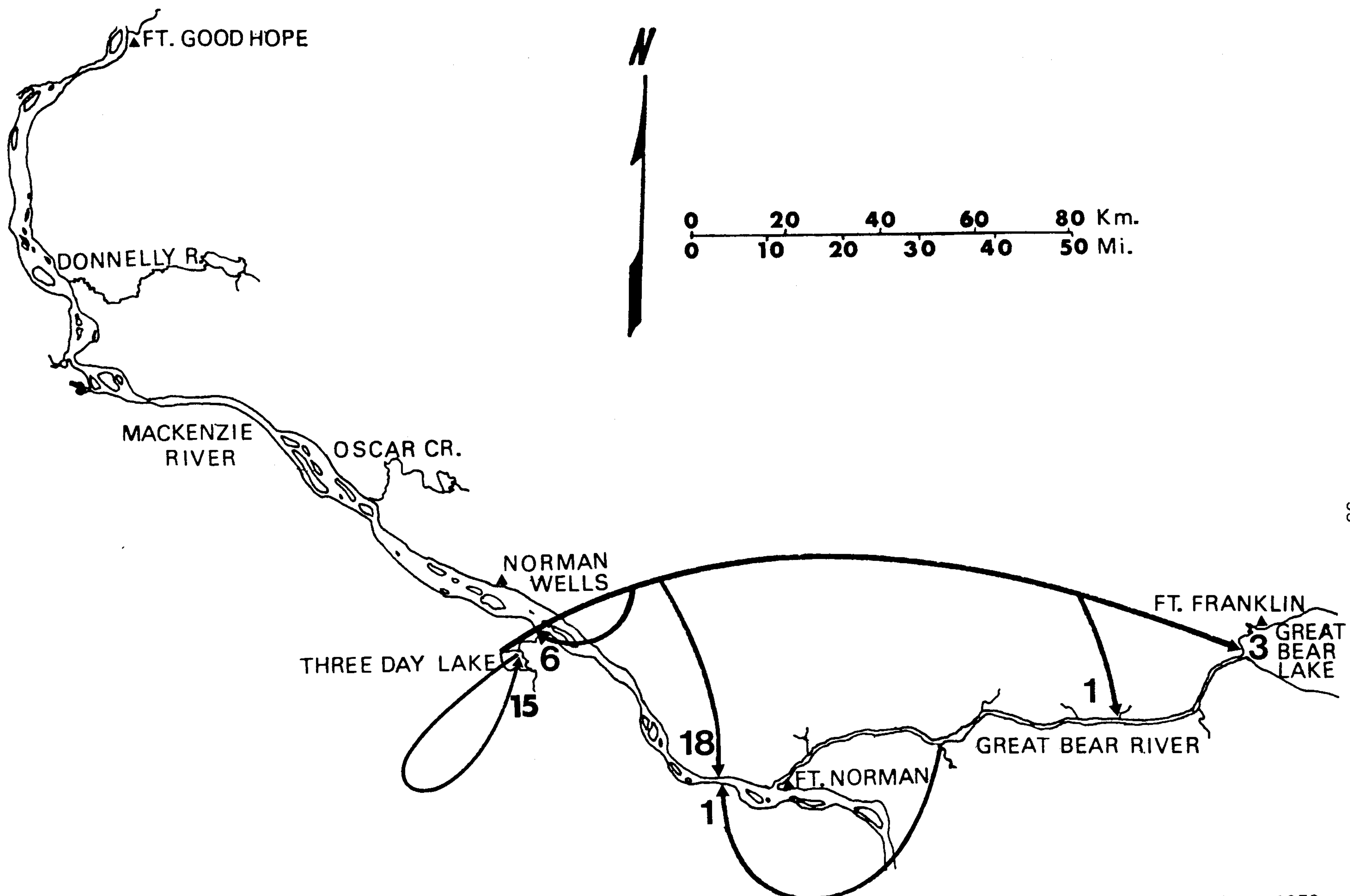

Fig. 28. The site and number of recaptures in 1974 of Arctic grayling released in Three Day Lake in June 1972.

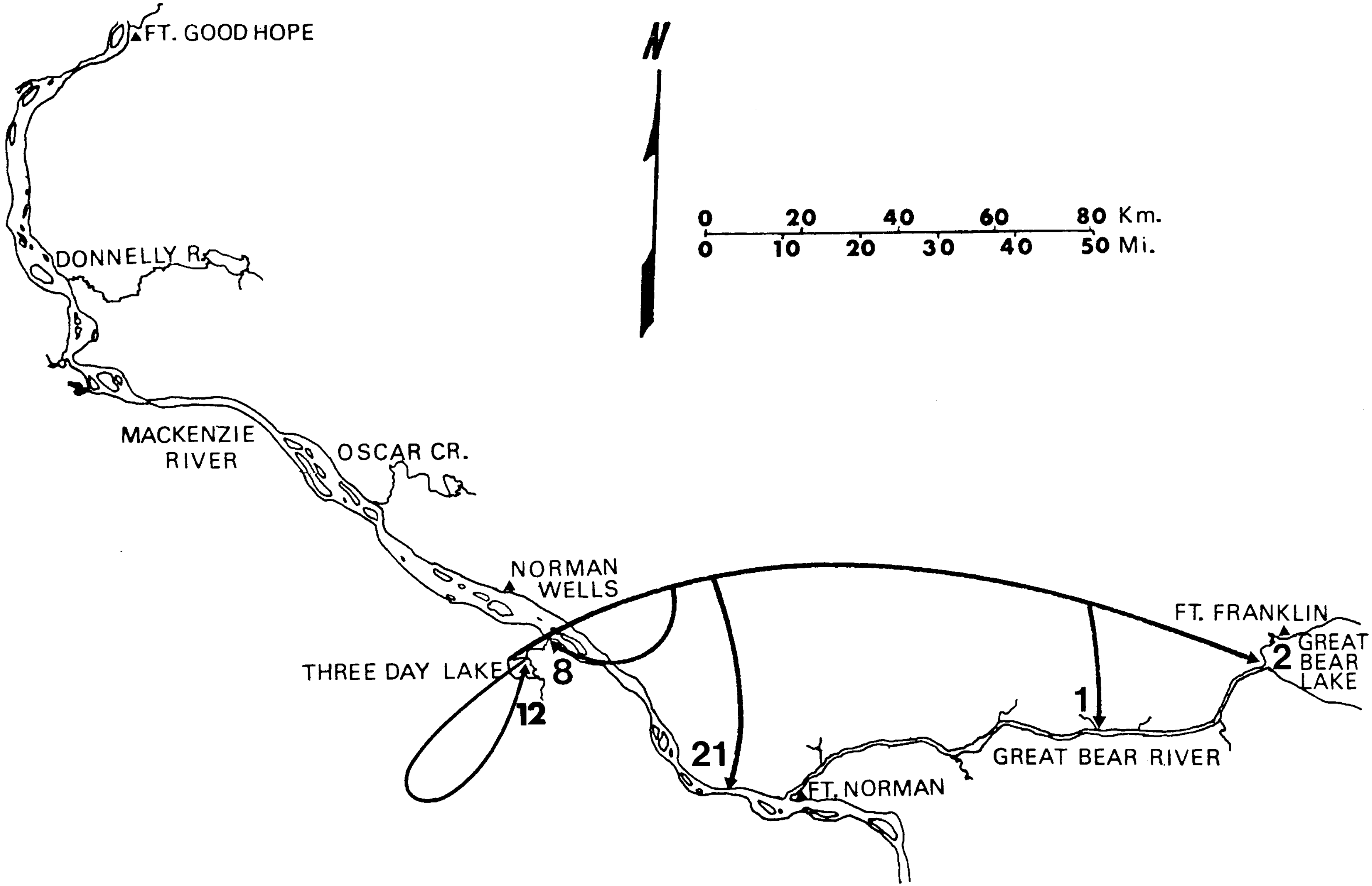

Fig. 29. The site and number of recaptures in 1974 of Arctic grayling released in Three Day Lake in May-June 1973.

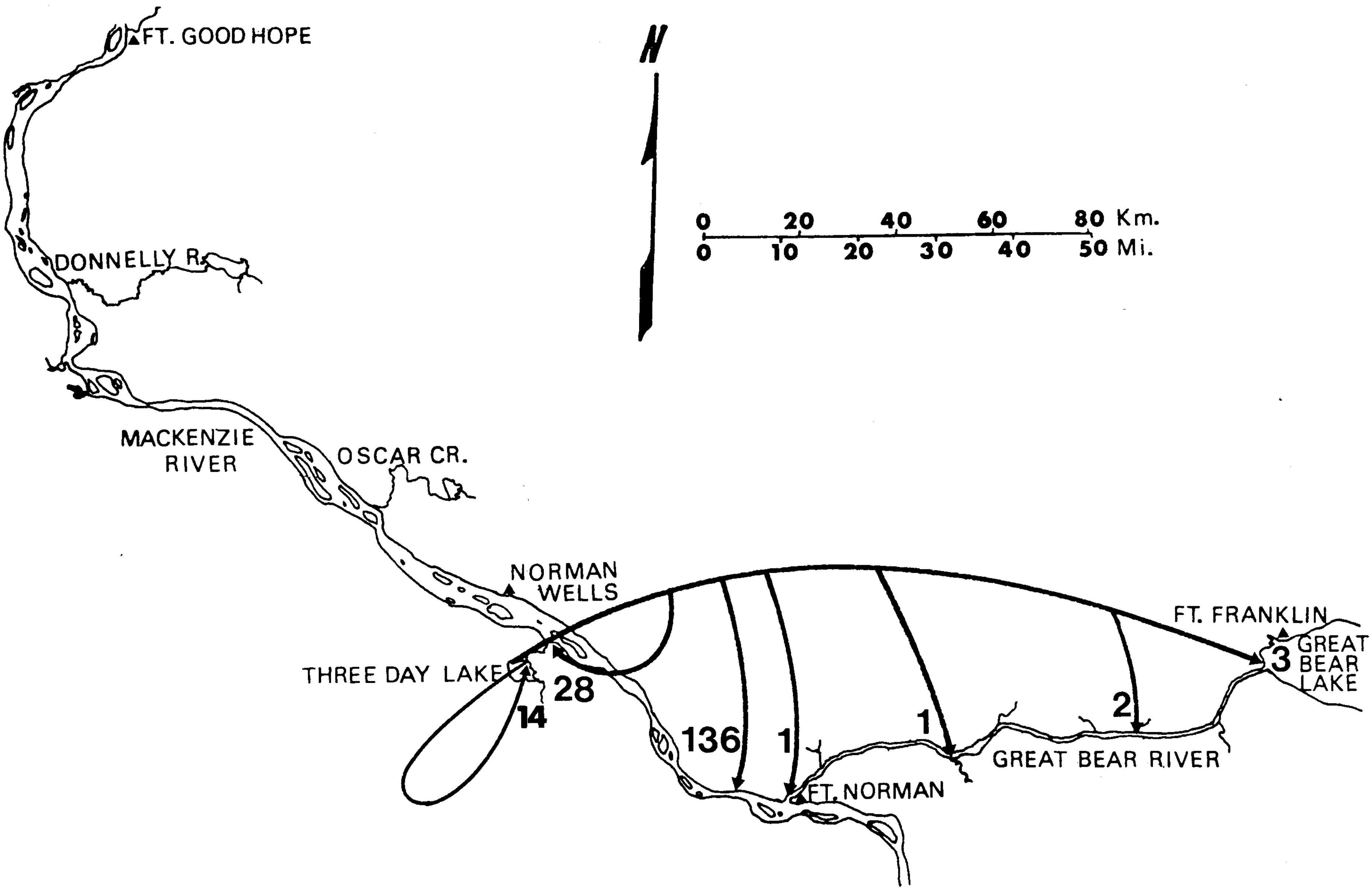

Fig. 30. The site and number of recaptures in 1974 of Arctic grayling released in Three Day Lake in May-June 1974.

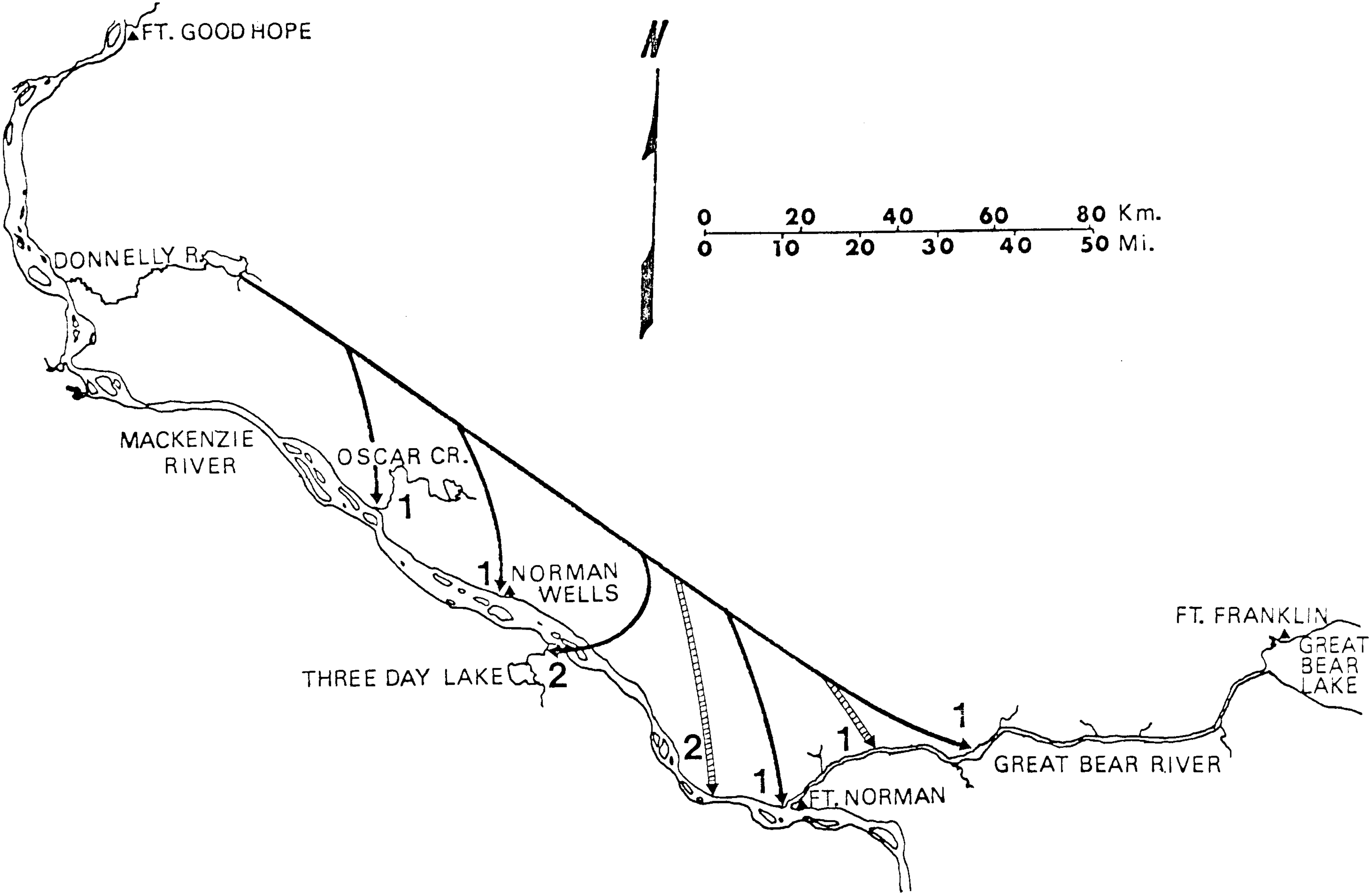

Fig. 31. The site and number of recaptures in 1972 (hatched arrows) and 1973 (solid arrows) of Arctic grayling released in Donnelly Lake in June-July 1972.

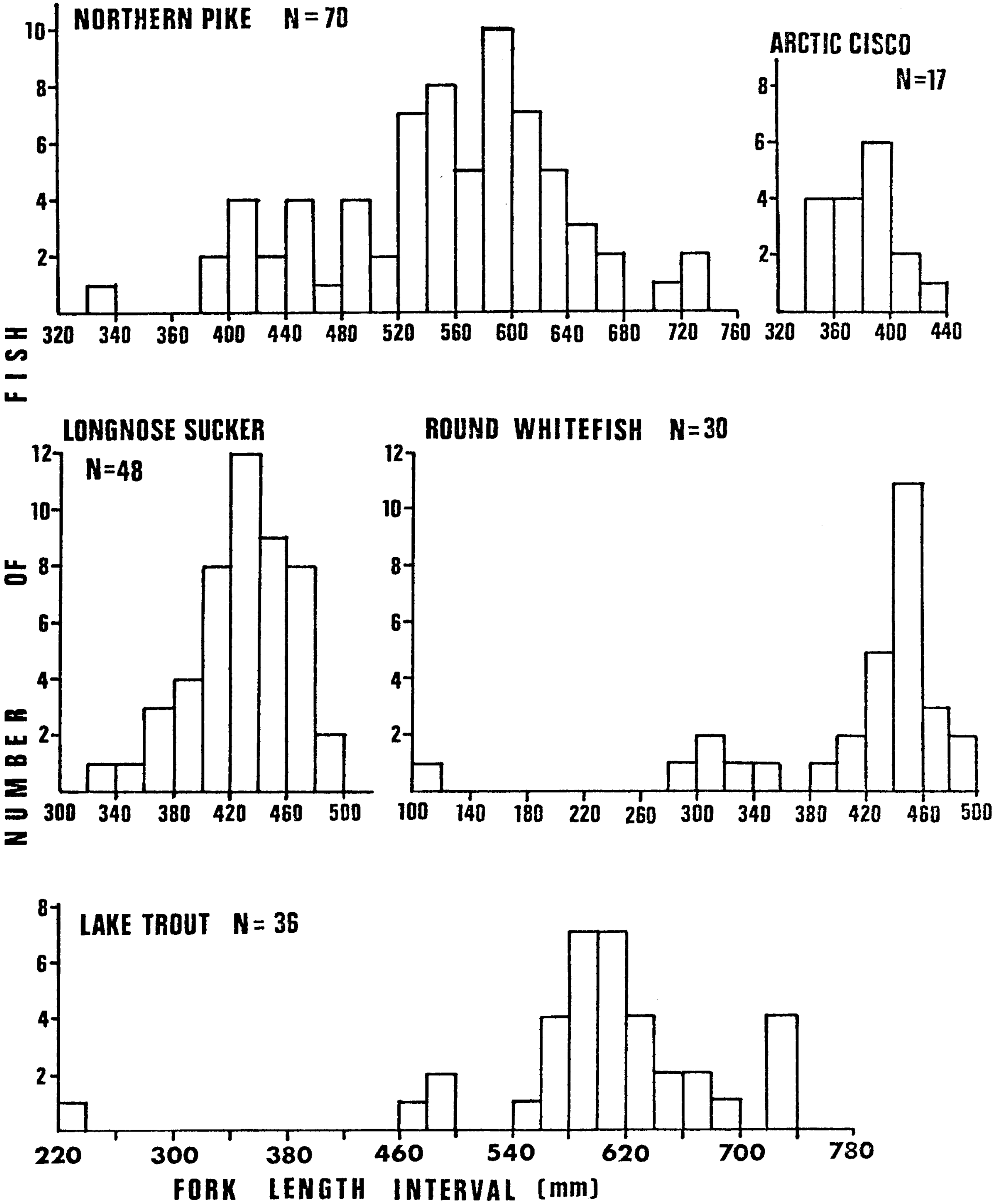

Fig. 32. Length-frequency distribution of lake trout, Arctic cisco, round whitefish, northern pike and longnose sucker caught in gill nets in Great Bear River, 1974.

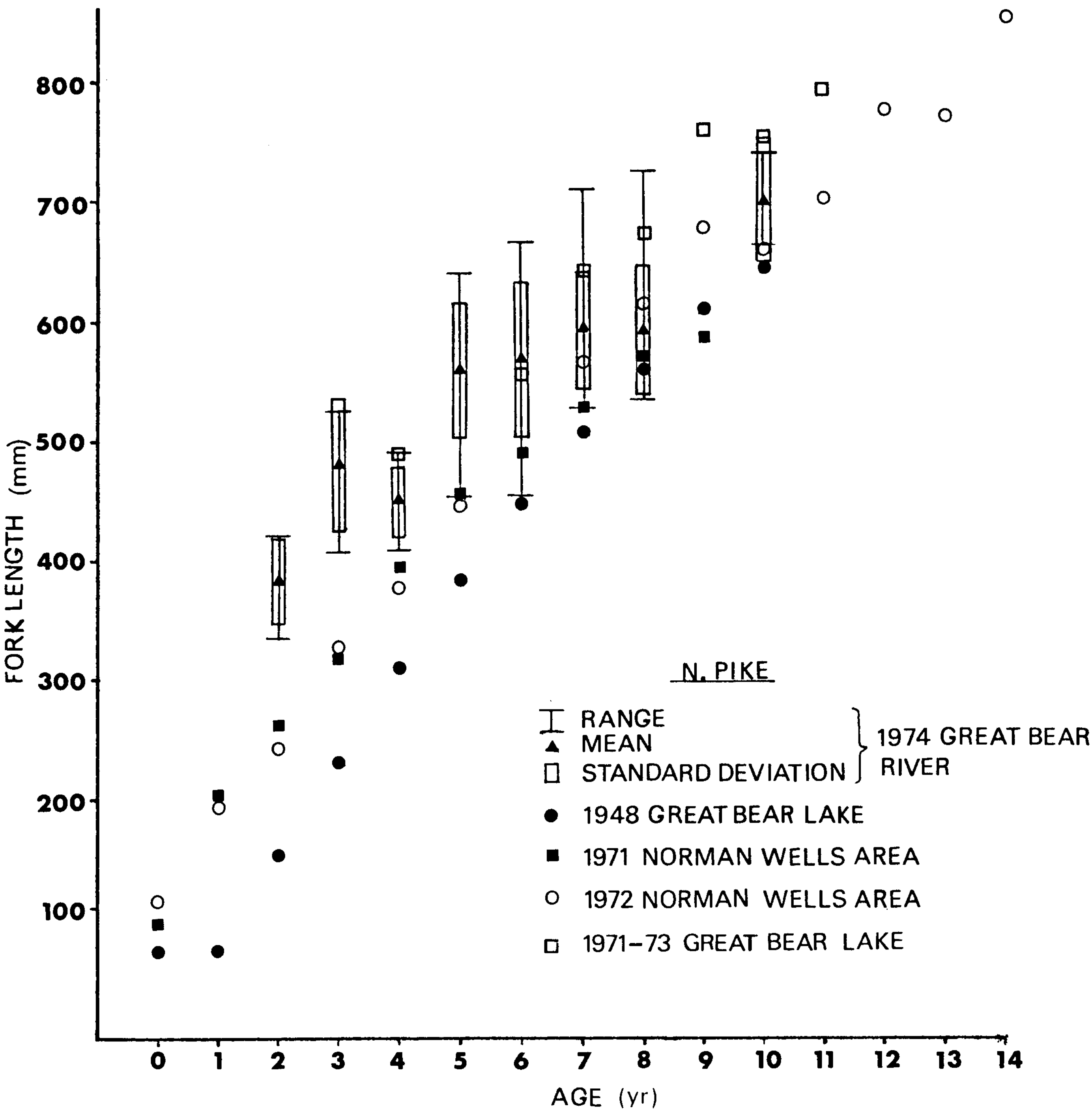

Fig. 33. Comparison of age-length relationship of northern pike from the Great Bear River with the population in Great Bear Lake (Miller and Kennedy 1948b; Falk and Dahlke 1974), and the Mackenzie River in the Norman Wells area (Hatfield et al. 1972a; Stein et al. 1973b).

APPENDIX 1. Alphabetical list of common names and associated generic names for Mackenzie Valley fish species.

Arctic char - *Salvelinus alpinus* (Linnaeus)
Arctic cisco - *Coregonus autumnalis* (Pallas)
Arctic grayling - *Thymallus arcticus* (Pallas)
Arctic lamprey - *Lampetra japonica* (Martens)
Broad whitefish - *Coregonus nasus* (Pallas)
Burbot - *Lota lota* (Linnaeus)
Chum salmon - *Oncorhynchus keta* (Walbaum)
Deepwater sculpin - *Myoxocephalus quadricornis* (Linnaeus)
Dolly Varden - *Salvelinus malma* (Walbaum)
Flathead chub - *Platygobio gracilis* (Richardson)
Goldeye - *Hiodon alosoides* (Rafinesque)
Humpback whitefish - *Coregonus clupeaformis* (Mitchill)
Inconnu - *Stenodus leucichthys nelma* (Pallas)
Lake chub - *Couesius plumbeus* (Agassiz)
Lake cisco - *Coregonus artedii* (LeSueur)
Lake trout - *Salvelinus namaycush* (Walbaum)
Least cisco - *Coregonus sardinella* (Valenciennes)
Longnose dace - *Rhinichthys cataractae* (Valenciennes)
Longnose sucker - *Catostomus catostomus* (Forster)
Mountain whitefish - *Prosopium williamsoni* (Girard)
Ninespine stickleback - *Pungitius pungitius* (Linnaeus)
Northern pike - *Esox lucius* (Linnaeus)
Round whitefish - *Prosopium cylindraceum* (Pallas)
Slimy sculpin - *Cottus cognatus* (Richardson)
Spottail shiner - *Notropis hudsonius* (Clinton)
Trout-perch - *Percopsis omiscomaycus* (Walbaum)
White sucker - *Catostomus commersoni* (Lacépède)
Yellow walleye - *Stizostedion vitreum vitreum* (Mitchill)